OPTICS FRONTIER

CIOP 2019

August 6-9, 2019
Xi'an, China

The 11th International Conference on Information Optics and Photonics

CONFERENCE

PROGRAM/ABSTRACTS

CHINESE LASER PRESS 中国激光杂志社 2009—2019

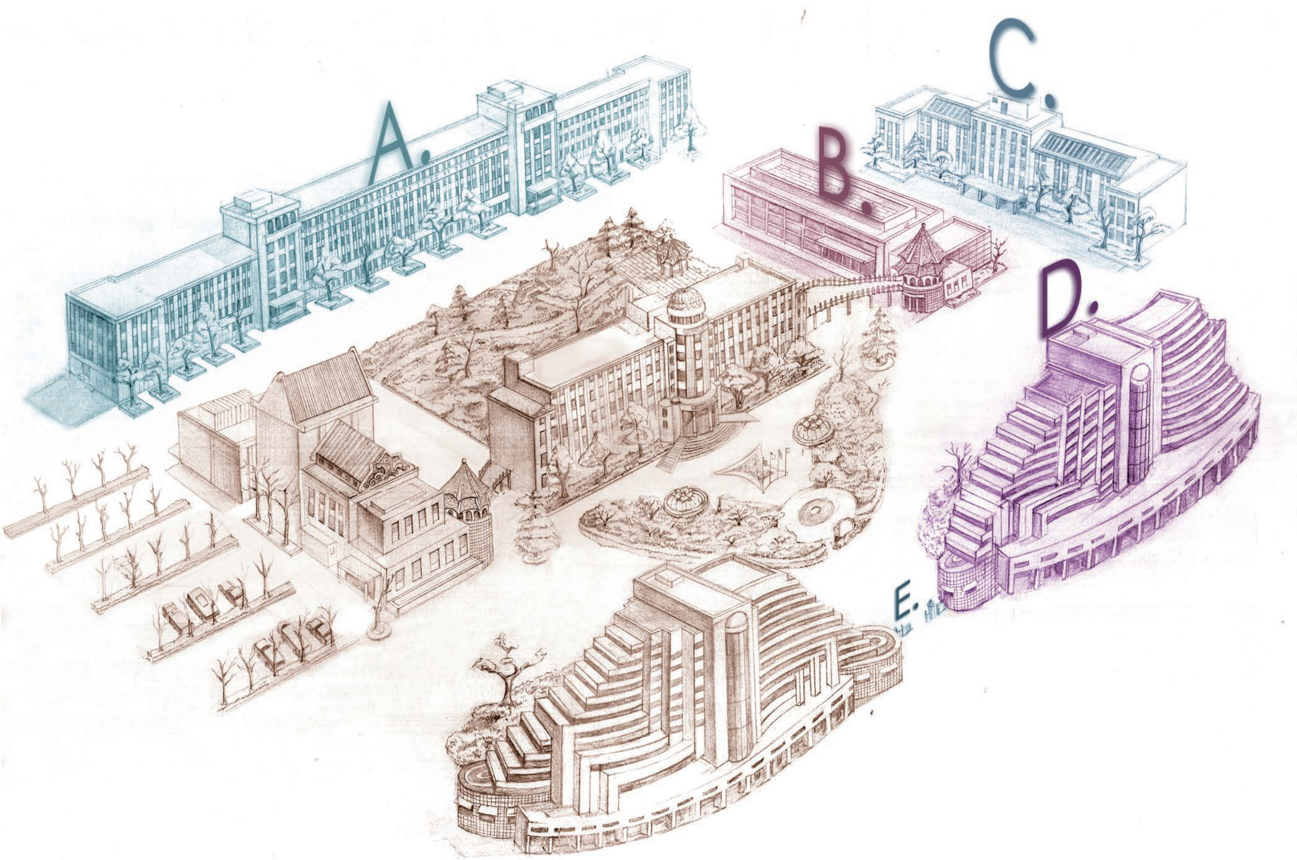
西北工業大學 NORTHWESTERN POLYTECHNICAL UNIVERSITY

Conference Schedule

	August 6	August 7	August 8	August 9	Location
Registration	8:30-19:30	7:30-19:30	8:00-19:30	8:00-15:00	1F
Welcome Reception	18:00-20:00				Xi'an 57, Grand Mercure & AZUR, Sofitel
Opening & Plenary Session	8:30-12:15				3F, Grand Ballroom
Technical Sessions		13:30-17:30	8:30-12:00 13:30-15:30	8:30-12:00 13:30-17:30	1F & 2F & 3F Convention Centre
Best Student Awards Competition		13:30-17:30			1F, Pissaro
Poster Session			15:30-17:30		1F
Banquet and Award Ceremony			18:00-20:00		3F, Grand Ballroom
飞秒激光微纳制造培训班	10:00-17:15				2F, Avignon
光电产业高峰论坛	14:00-17:00				2F, Paris
Optical Access Networks for 5G	14:20-17:00				2F, Nice
Optics Frontier Conference: Advanced Photonics		13:30-17:00	8:30-12:00		3F, Grand Ballroom I
Meet CLP's Editors			15:30-16:30		1F
Badminton Game	18:00-21:00	18:00-21:00			
Table Tennis Game	18:00-21:00	18:00-21:00			

Map

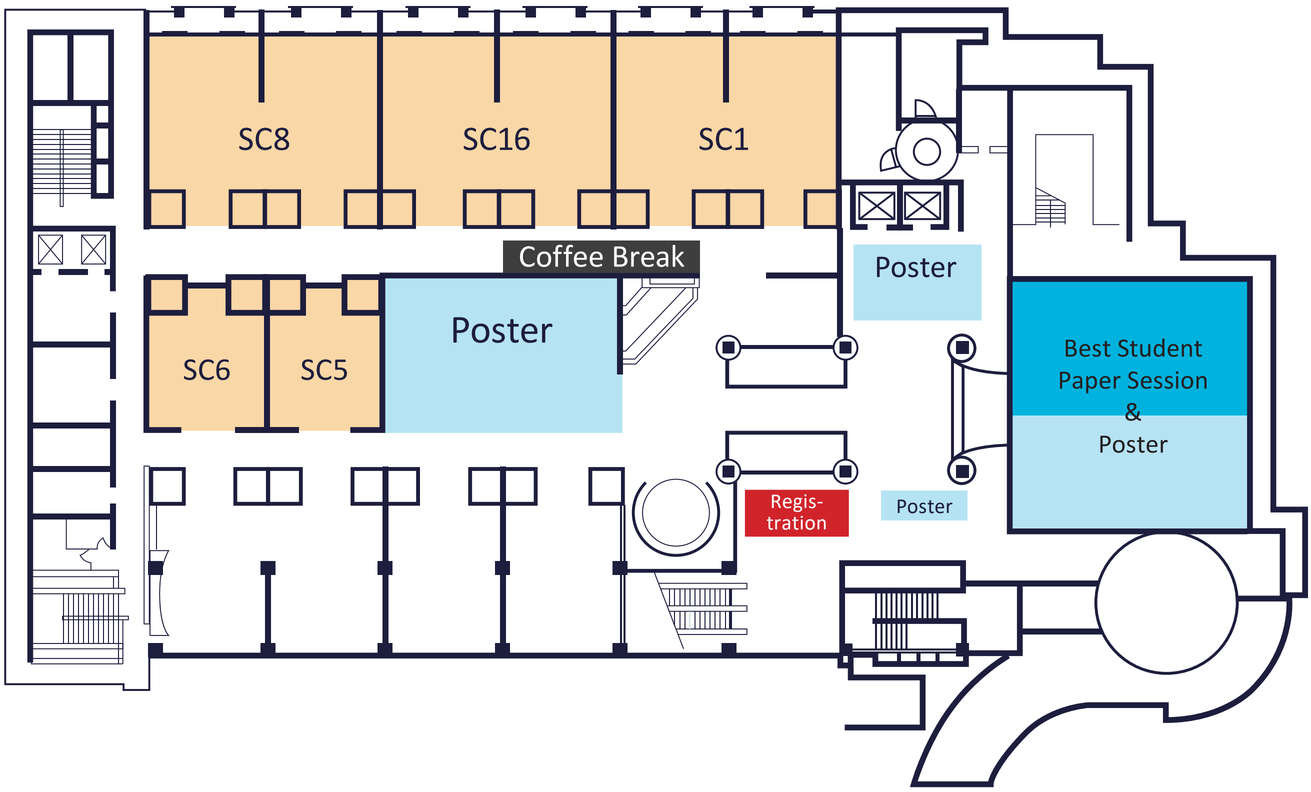
Add: 319 Dong Xin Street, XI'AN, 710004, Shaanxi, CHINA



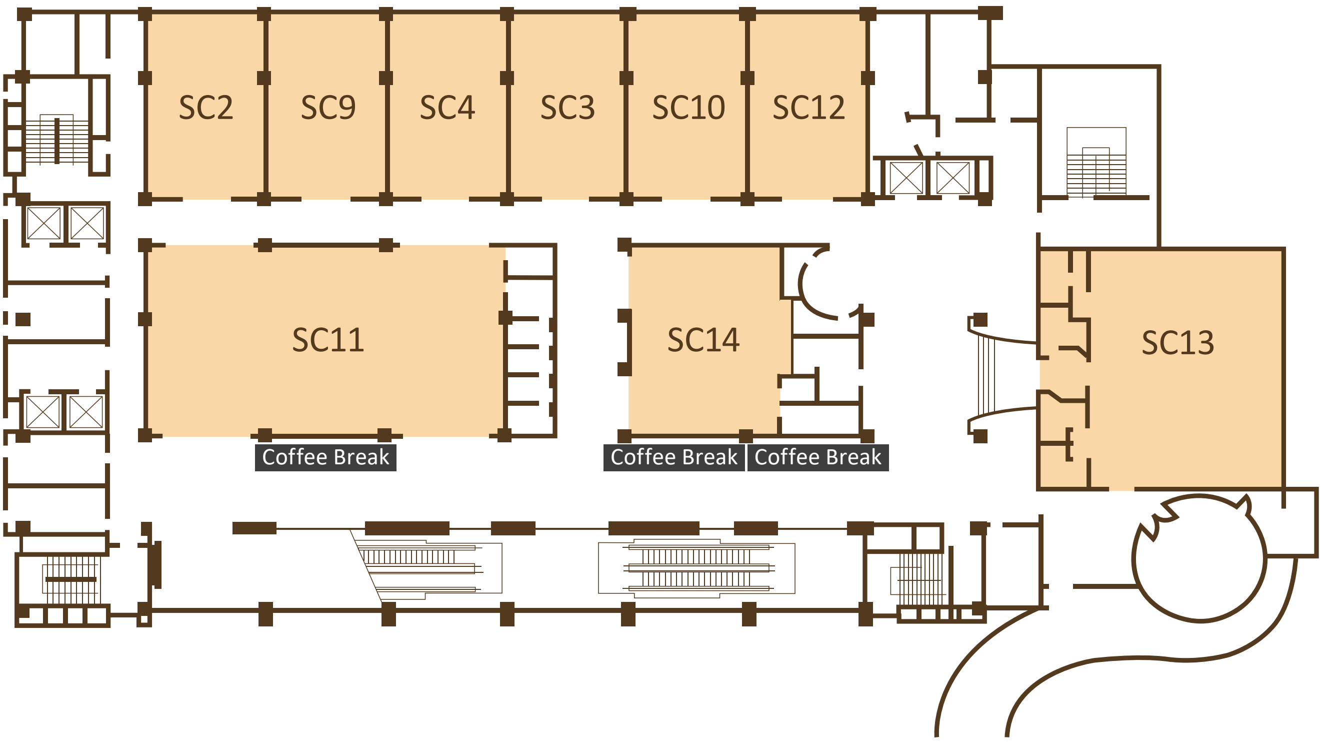
- A. Grand Mercure (Xi'an 57 Restaurant)
- B. Convention Centre
- C. Mercure (Arc de Triomphe)
- D. Sofitel (Azur Restaurant)
- E. Gate

Map

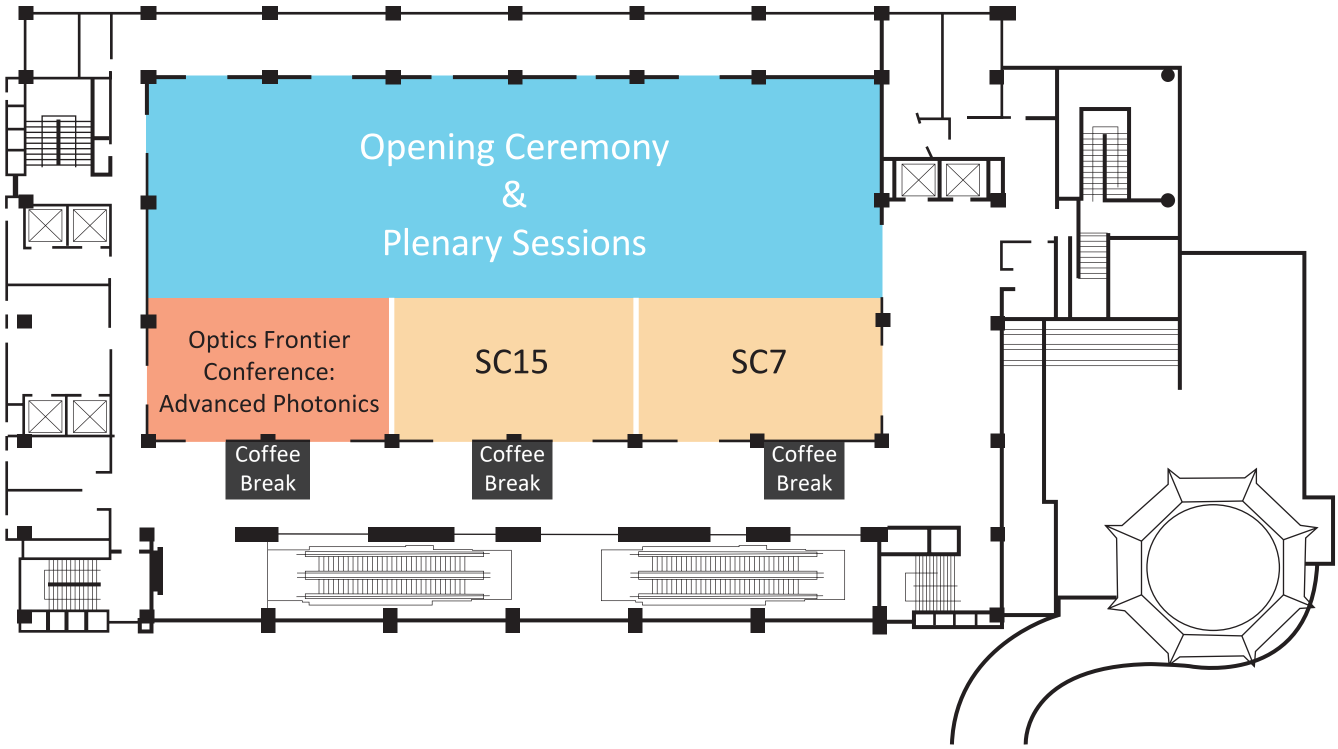
1F, Convention Centre



SC1 Light-Matter Interactions	Rodin
SC5 Silicon Photonics	Cezanne
SC6 Microwave Photonics	Degas
SC8 Optical Materials	Picasso
SC16 Atomic Physics, Quantum Photonics, and Quantum Information	Gaoguin
Best Student Paper Competition	Pissarro
Poster Session	15:30-17:30, Aug 8
Registration	
Coffee Break	



SC2 Plasmonics and Metamaterials	Toulouse
SC3 Ultrafast and Nonlinear Phenomena	Avignon
SC4 Solid State, Fiber, and Other Laser Sources	Dijon
SC9 Optical Measurement and Metrology	Cannes
SC10 Infrared and Terahertz Technologies	Marseilles
SC11 Optical Imaging, Display, and Storage	Paris
SC12 Optical Communications and Networks	Lyon
SC13 Optical Fiber and Waveguide Technologies	Bordeaux
SC14 Biophotonics and Optofluidics	Nice
Coffee Break	



SC7 Micro and Nanophotonics	Grand Ballroom III
SC15 Optical Sensors and Systems	Grand Ballroom II
Optics Frontier Conference: Advanced Photonics	Grand Ballroom I
Opening Ceremony, Plenary Sessions, Banquet and Award Ceremony	Grand Ballroom
Coffee Break	

Contents

Committees

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Nanjing University, China

Dieter Bimberg
CIOMP, CAS, China
TU Berlin, Germany

Technical Program Chairs

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Northwestern Polytechnical University, China

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Tsinghua University, China

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Ming Tang, *Huazhong University of Science and Technology, China*
Shilong Pan, *Nanjing University of Aeronautics and Astronautics, China*

Committees

Hosts

CHINESE LASER PRESS 2009–2019

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瞬态光学与光子技术国家重点实验室
State Key Laboratory of Transient Optics and Photonics

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Acknowledgement

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VisionFly 视尔雅

Huaray ULTRAFAST FIBER LASER

RealLight

MATRIX MATRIX U/E TECHNOLOGIES LTD 矩阵科技有限公司

General Information

Conference Venue: Convention Centre, Sofitel Xi'an on Renmin Square Hotel
Address: 319 Dong Xin Street, XI'AN, 710004, Shaanxi, CHINA

Speaker Preparation

Oral, invited and tutorial speakers should arrive the session room 30 min prior to your talk to upload and check you slides. All presentation should be in English.

Presentation types are noted as following in agenda:

Ⓟ for plenary talk (45 min)

Ⓣ for tutorial talk (45 min)

Ⓘ for invited talk (30 min)

Ⓞ for oral talk (15 min)

Poster Preparation

Authors are required to stand by their poster during the poster session for discussion. Please make sure to print your mobile tel. and email in the poster, because the conference staff will contact the winner of Best Poster Awards, which will be selected on-site the poster session.

Poster session: ***Thursday, August 8, 15:30-17:30***
Poster board size: ***0.95 m (length) * 2.47 m (height)***, recommended poster size: ***0.8m * 1.2 m***
Set-up time: ***Thursday, August 8, 8:00-15:30***
Poster presenters are responsible to remove their poster, the conference staff will not collect the posters left at the end of the poster session.

Please note that any no-show paper (all presentation types) will NOT be published or indexed.

Social Events

Welcome Reception
The welcome reception of CIOP 2019 is open for all registered attendees. It will be held on **Tuesday, August 6**. A ticket is provided within the badge.
Location: Xi'an 57, Grand Mercure & AZUR, Sofitel
Time: 18:00-20:00

Banquet and Award Ceremony
The banquet and award ceremony of CIOP 2019 will be held on **Thursday, August 8**. A ticket is provided within the badge of the **Regular** registration type.
Location: 3F, Grand Ballroom, Convention Centre
Time: 18:00-20:00

The following awards will be presented at the banquet:

Best Student Paper Awards *3 winners*

Best Poster Awards *12 winners*

2018 Editor-in-Chief Choice Award of Photonics Research *1 winner*

2018 Editor-in-Chief Choice Award of Chinese Optics Letters *1 winner*

Badminton Game *3 winners, sponsored by* YSL 安扬激光

Table Tennis Game *3 winners, sponsored by* CHINESE LASER PRESS

Tips

- Volunteers and staffs are in blue T-shirts. You can go to registration desk or the CLP service center if you need any help.
- Wifi: Sofitel Convention Contre_Xian (No password, free)
- The meal tickets are printed with badge, please go to the restaurant according to the time and location written in tickets.
- There are three restaurants for distribution: **Xi'an 57, 4F, Grand Mercure**, **AZUR, 1F, Sofitel, and Arc de Triomphe, 4F, Mercure**

飞秒激光微纳制造培训班 (in Chinese)

飞秒激光加工已经成为极端条件下微纳制造的一种新方法，也是目前国际上激光应用和极端制造领域的一个前沿热点方向。本次培训授课方向包括：飞秒激光诱导现象与机理、微纳集成器件制备新方法、复杂微细结构的飞秒激光微加工。

培训时间 8 月 6 日，10:00-17:20

培训地点 会议中心 2 层，亚威农厅

培训费用 CIOP 参会人员 1000 元 / 人，非参会人员 1200 元 / 人。
须至会议报到台领取听课证，凭证入场

日 程

<table>
<tr><th>时间</th><th>课程</th><th>授课专家</th></tr>
<tr><td>10:00-10:45</td><td>飞秒激光诱导现象与机理</td><td rowspan="3">邱建荣 教授
浙江大学</td></tr>
<tr><td>10:45-11:00</td><td>休息</td></tr>
<tr><td>11:00-11:45</td><td>飞秒激光诱导现象与机理</td></tr>
<tr><td>11:45-13:30</td><td colspan="2">午餐</td></tr>
<tr><td>13:30-14:15</td><td>微纳集成器件制备新方法</td><td rowspan="3">张永来 教授
吉林大学</td></tr>
<tr><td>14:15-14:30</td><td>休息</td></tr>
<tr><td>14:30-15:15</td><td>微纳集成器件制备新方法</td></tr>
<tr><td>15:15-15:30</td><td>休息</td><td></td></tr>
<tr><td>15:30-16:15</td><td>复杂微细结构的飞秒激光微加工</td><td rowspan="3">陈 烽 教授
西安交通大学</td></tr>
<tr><td>16:15-16:30</td><td>休息</td></tr>
<tr><td>16:30-17:15</td><td>复杂微细结构的飞秒激光微加工</td></tr>
</table>

“光电产业高峰论坛——光电改变世界 (in Chinese)

随着光电领域科学技术的不断发展，光电产品正在向更多的应用场景延伸，从工业到生活，改变着我们周围的世界。此次论坛，邀请了拥有成果转化经验的高等研究机构的教授、行业上市公司或骨干企业的产品负责人，以及在光电领域有战略布局的投资人，同聚一堂、共话发展。

培训时间 8 月 6 日，14:00-17:00

培训地点 会议中心 2 层，巴黎厅

发起人 & 主持人 黄翊东教授，清华大学

日 程

时间	报告
14:00-14:10	**开场致辞** 黄翊东, 清华大学
14:10-14:30	**光电芯片引领硬科技革命** 米磊, 陕西光电子集成电路先导技术研究院
14:30-14:50	**光电子芯片产业化和国产化的机遇与挑战** 黄卫平, 海信宽带多媒体技术有限公司
14:50-15:10	**国产高功率连续和脉冲半导体激光器** 胡海, 深圳瑞波光电子有限公司
15:10-15:30	**10G-PON 及 Next-gen PON 网络中核心光芯片的需求及国产化机遇** 李文, 华慧科锐
15:30-16:00	**茶歇**
16:00-16:20	**制造型高科技企业如何在激烈的竞争环境中生存?** 王兴龙, 光库科技
16:20-16:40	**汇聚资源, 构建电子信息领域创新的桥梁** 王瀚晟, 清华大学天津电子信息研究院
16:40-17:00	**抓自主发展机遇, 推光电产业突围** 陈洪武, 国科嘉和

Workshop on Optical Access Networks for 5G

Time 14:20 – 17:30, Tuesday, August 6

Location 2F, Nice, Convention Centre

Description 5G wireless is seen by many to be a huge opportunity to develop new transport technologies to handle the inevitably large amounts of data from the wireless equipment. There are many possible solutions, but a key characteristic will have to be lowered cost. Broadband access, and particularly passive optical networks (PONs), offer very high bandwidths at very competitive cost levels, and they are made to be operationally simple. As a result, many are looking at how optical access can work to serve 5G. This workshop gathers together several of the world's experts on these matters to discuss the various aspects of the problem and some of the solutions that are currently under development.

Organizer Dr. Frank Effenberger, Futurewei Technologies, USA

Agenda

14:20-14:30	*Opening* **Frank Effenberger**, Futurewei Technologies, USA
14:30-15:00	*Overview of G.Sup66: 5G wireless fronthaul in a PON context* **Jun Shan Wey**, ZTETX, USA
15:00-15:30	*WDM-PON for 5G fronthaul* **Dezhi Zhang**, STTRI, China
15:30-16：00	**Coffee Break**
16:00-16:20	*Cooperative DBA for low latency PON in 5G era* **Hirotaka Nakamura**, NTT Network Innovation Laboratories, Japan
16:20-16:40	*DSP analog methods for fronthaul* **Lei Zhou**, Huawei, China
16:40-17:00	**Discussion**

Time 14:00-17:30 August 7, 8:30-12:00 August 8

Location 3F, Grand Ballroom I, Convention Centre

Optics Frontier Conference Advanced Photonics is organized by the highly selective journal Advanced Photonics (AP), which is co-published by Chinese Laser Press (CLP) and SPIE. The conference is to create an international platform for leading researchers worldwide to discuss their latest research results in certain fields of optics and photonics. The conference aims at providing a networking chance for scientists and students in this community by fostering and facilitating communications and collaborations.

Co-chair Xiao-Cong (Larry) Yuan, Shenzhen University, China
Anatoly Zayats, King's College London, UK

Agenda

August 7	
Section Chairs: Peng Xi, Peking University, China; Michael G. Somekh, Shenzhen University, China	
14:00-14:45	*Data-driven computational optical imaging* **Guohai Situ**, Shanghai Institute of Optics and Fine Mechanics, CAS, China
14:45-15:30	*Ultra-high-Q microcavity optics and photonics* **Yun-feng Xiao**, Peking University, China
15:30-16:00	**Coffee Break**
16:00-16:45	*High spatiotemporal resolution fluorescence imaging of biological samples in vivo* **Liangyi Chen**, Peking University, China
16:45-17:30	*Toward active dielectric metasurface devices* **Arseniy Kuznetsov/Shiqiang Li**, Institute of Materials Research and Engineering, ASTAR, Singapore

August 8	
Section Chairs: Ting Mei, Northwestern Polytechnical University, China; Siyuan Yu, Bristol University, UK	
08:30-09:15	*Geometric phase and nonlinear photonic metasurfaces* **Guixin Li**, Southern University of Science and Technology, China
09:15-10:00	*PerovLight: perovskite materials for emergent nanophotonics and polaritonics* **Qihua Xiong**, Nanyang Technological University, NTU, Singapore
10:00-10:30	**Coffee Break**
10:30-11:15	*Nanophotonic designs for energy conversion and storage* **Jia Zhu**, Nanjing University, China
11:15-12:00	*Eigenmode dngineering of nanolasers* **Renmin Ma**, Peking University, China

Meet CLP's Editors

If you will attend CIOP 2019, be sure to stop by poster section area to meet CLP Journal Editors, including the Editors-in-Chief of Advanced Photonics, Photonics Research, Acta Optica Sinica and Laser & Optoelectronics Progress for conversation. Local snacks, ice cream, and beverages will be served.

What: *Meet the Editors from CLP's Journals*

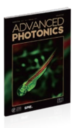
When: *15:30-16:30, August 8, 2019 (Tuesday)*

Where: *Poster area at Convention Centre, 1F*

All your questions, concerns and ideas for the journals are welcome, such as:

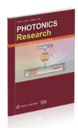
- How do you prepare manuscript and cover letter?
- What kind of researches are attractive to Editors-in-Chief?
- How do editors choose reviewers?
- What criteria do editors and reviewers use to select papers?
- How do journals promote published articles worldwide?

Don't miss the opportunity to get an insight into the process of paper get published and clear up any submissions queries you may have. All attendees are welcome!



Advanced Photonics

Xiaocong(Larry) Yuan
Shenzhen University

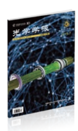


Photonics Research

Lan Yang
Washington University in St. Louis

Laser & Optoelectronics Progress

Jianrong Qiu
Zhejiang University



Acta Optica Sinica

Jianlin Zhao
Northwestern Polytechnical University

Agendas of Technical Sessions

Opening Ceremony & Plenary Talks

Location: 3F, Grand Ballroom, Convention Centre

August 7		
Presider: Zhiping (James) Zhou, Peking University, China		
08:30-08:45	**Opening Ceremony**	
Presider: Xi-Cheng Zhang, University of Rochester, USA		
08:45-09:30	*Spin-orbit coupling in nanophotonics* **Anatoly V Zayats**, King's College London, UK	P ***p53***
09:30-10:15	*Higher speed PON: evolution, technology, and applications* **Frank Effenberger**, Futurewei Technologies, USA	P ***p54***
10:15-10:45	Coffee Break	
Presider: Yidong Huang, Tsinghua University, China		
10:45-11:30	*Fundamentals of plasmonic nanocavity and circuits* **Hongxing Xu**, Wuhan University, China	P ***p55***
11:30-12:15	*VCSEL photonics for communications and 3D sensing* **Fumio Koyama**, Tokyo Institute of Technology, Japan	P ***p56***

Agendas

SC1 Light-Matter Interactions

Jianrong Qiu, Zhejiang University, China (Chair)
Feng Chen, Xi'an Jiaotong University, China (Co-chair)
Hongbo Sun, Tsinghua University, China (Co-chair)
Qiang Wu, Nankai University, China (Co-chair)
Yves Bellouard, École Polytechnique Fédérale de Lausanne, EPFL, Switzerland
Saulius Juodkazis, Swinburne University of Technology, Australia
Peter Kazansky, University of Southampton, UK
Matthieu Lancry, Paris-Sud University, France
Yongfeng Lu, University of Nebraska, USA
Xiaoming Yu, University of Central Florida, USA

Location: 1F, Rodin, Convention Centre

August 7			
Presider: Jianrong Qiu, Zhejiang University, China			
13:30-14:15	*Laser 3D printing and structuring of materials from nano-to-macro scales* **Saulius Juodkazis**, Swinburne University of Technology and Melbourne Center for Nanofabrication, Australia	T	***p57***
14:15-14:45	*Multiphoton lithography for biomedical applications* **Aleksandr Ovsianikov**, Technische Universität Wien, Austria	I	***p58***
14:45-15:15	*Femtosecond laser hyperdoping crystal: principle and applications* **Qiang Wu**, Nankai University, China	I	***p58***
15:15-15:30	CIOP2019-2019-000160 *Polymer IR artificial compound eyes micro-optics by femtosecond laser assisted micro manufacturing* **Feng Liu**, Xi'an Jiaotong University, China	O	***p66***
15:30-16:00	Coffee Break		
Presider: Saulius Juodkazis, Swinburne University of Technology and Melbourne Center for Nanofabrication, Australia			
16:00-16:30	*3D μ-printing: from structural colors to brilliant white* **Georg von Freymann**, Technical University of Kaiserslautern, Germany	I	***p59***
16:30-17:00	*Self-assembled photonic structures: induced by ultrafast laser in transparent solids and applications* **Dezhi Tan**, Zhejiang University, China	I	***p59***
17:00-17:30	*Enhancement of photocurrent and THz emission by femtosecond laser surface nanostructuring of semiconductors* **Quanzhong Zhao**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p60***
17:30-17:45	CIOP2019-2019-000187 *Bioinspired anisotropic superhydrophobic/underwater superoleophobic surface fabricated by femtosecond laser* **Fang Yao**, Xi'an Jiaotong University, China	O	***p66***

August 8			
Presider: Georg von Freymann, Technical University of Kaiserslautern, Germany			
08:30-09:00	*The nature of non-equilibrium ultrafast demagnetization in ferromagnetic nickel* **Zhensheng Tao**, Fudan University, China	Ⓘ	***p61***
09:00-09:30	*Spatially shaped ultrafast laser micro/nano-fabrication* **Xiaowei Li**, Beijing Institute of Technology, China	Ⓘ	***p61***
09:30-10:00	*Structured beams generation and its application* **Yuanjie Yang**, University of Electronic Science and Technology of China, China	Ⓘ	***p62***
10:00-10:15	CIOP2019-2019-000370 *Compressed ultrafast spectral-temporal (CUST) photography: enabling 3.85 trillion frame rate ultrafast movies with single snapshot* **Yu Lu**, Xi'an Jiaotong University, China	Ⓞ	***p66***
10:15-10:30	CIOP2019-2019-000155 *Experiment and simulation of crosstalk effects for laser irradiated IT-CCD* **Xuanfeng Zhou**, Luoyang Electronic Equipment Test Center of China, China	Ⓞ	***p66***
10:30-11:00	Coffee Break		
Presider: Xiaoming Yu, University of Central Florida, USA			
11:00-11:30	*Nepenthes inspired omniphobic slippery liquid infused porous surface (SLIPS) by femtosecond laser direct writing* **Feng Chen**, Xi'an Jiaotong University, China	Ⓘ	***p63***
11:30-12:00	*Ultrafast dynamics of periodic nanoripples induced by femtosecond lasers* **Tianqing Jia**, East China Normal University, China	Ⓘ	***p63***
12:00-13:30	Lunch Break		
Presider: Feng Chen, Xi'an Jiaotong University, China			
13:30-14:00	*Ultrafast laser material processing: From a technological niche to an enabling manufacturing tool* **Xiaoming Yu**, University of Central Florida, USA	Ⓘ	***p64***
14:00-14:30	*Single shot compressed ultrafast photography* **Shian Zhang**, East China Normal University, China	Ⓘ	***p65***
14:30-15:00	*High efficiency 3D Femtosecond laser microfabrication based on spatial light modulation* **Dong Wu**, University of Science and Technology of China, China	Ⓘ	***p65***
15:00-15:15	CIOP2019-2019-000300 *Picosecond laser-induced tunable ripple structures evolution on amorphous* $Ge_2Sb_2Te_5$ **Zihao Han**, Beijing University of Technology, China	Ⓞ	***p66***
15:15-15:30	CIOP2019-2019-000017 *Study of photonics* **Xiaofan Chen**, Harbin Institute of Technology, China	Ⓞ	***p66***
15:30-17:30	Poster Session & Coffee Break		

SC2 Plasmonics and Metamaterials

Hui Liu, Nanjing University, China (Chair)
Zheyu Fang, Peking University, China (Co-chair)
Fang Liu, Tsinghua University, China (Co-chair)
Lei Zhou, Fudan University, China (Co-chair)
Che Ting Chan, The Hong Kong University of Science and Technology, Hong Kong, China
Yuri Kivshar, Australian National University, Australia
Jensen Li, The Hong Kong University of Science and Technology, Hong Kong, China
Zhiyuan Li, South China University of Technology, China
Cheng-Wei Qiu, National University of Singapore, Singapore
Min Qiu, Westlake University, China

Location: 2F, Toulouse, Convention Centre

August 7			
Presider: Tiejun Cui, Southeast University, China			
13:30-14:15	*A new generation of photonic crystals and metamaterials* **Che Ting Chan**, The Hong Kong University of Science and Technology, Hong Kong, China	T	***p67***
14:15-14:45	*Nanophotonic control of thermal emission* **Min Qiu**, Westlake University, China	I	***p67***
14:45-15:15	*Graphene plasmon mediated super-Planckian near-field thermal radiation* **Yungui Ma**, Zhejiang University, China	I	***p68***
15:15-15:30	CIOP2019-2019-000086 *Nanofabrication via synergistic effect of plasmonic heating and optical forces* **Tao Ding**, Wuhan University, China	O	***p78***
15:30-16:00	Coffee Break		
Presider: Lei Zhou, Fudan University, China			
16:00-16:30	*The role of quantum and optical interaction in the giant spectral splitting in a strongly-coupled plasmon-molecules system* **Zhiyuan Li**, South China University of Technology, China	I	***p68***
16:30-17:00	*Dynamically-tunable plasmonic devices based on phase transition of vanadium dioxide* **Ruwen Peng**, Nanjing University, China	I	***p69***
17:00-17:15	CIOP2019-2019-000142 *Plasmonic tip excited by radial vector beam for surface enhanced raman spectroscopy* **Min Liu**, Northwestern Polytechnical University, China	O	***p78***
17:15-17:30	CIOP2019-2019-000087 *A low-loss graphene plasmonic resonance device working at a few hundred GHz* **Yan Yin**, Institute of Physics, CAS & University of Chinese Academy of Sciences, China	O	***p78***

August 8			
Presider: Che Ting Chan, The Hong Kong University of Science and Technology, Hong Kong, China			
08:30-09:15	*Information Metasurfaces* **Tiejun Cui**, Southeast University, China	T	***p70***
09:15-09:45	*Recent experimental progress in invisibility cloaks* **Hongsheng Chen**, Zhejiang University, China	I	***p70***
09:45-10:00	CIOP2019-2019-000517 *Transformation optics based on metasurfaces* **Chong Sheng**, Nanjing University, China	O	***p78***
10:00-10:15	CIOP2019-2019-000269 *Analysis of the coupling between surface plasmon polariton mode and dipole mode at terahertz metasurface absorber* **Zijian Cui**, Xi'an University of Technology; Harbin University of Science and Technology, China	O	***p78***
10:15-10:30	CIOP2019-2019-000169 *Plasmonic chiral metasurface induced chiral purcell effect* **Yu Peng**, University of Electronic Science and Technology of China, China	O	***p79***
10:30-11:00	Coffee Break		
Presider: Hui Liu, Nanjing University, China			
11:00-11:30	*Metasurfaces for controlling terahertz waves* **Lei Zhou**, Fudan University, China	I	***p71***
11:30-12:00	*Some recent experiments on transformation optics* **Huanyang Chen**, Xiamen University, China	I	***p71***
12:00-13:30	Lunch Break		
Presider: Zhiyuan Li, South China University of Technology, China			
13:30-14:00	*Towards ideal transformation optical devices* **Yu Luo**, Nanyang Technological University, Singapore	I	***p72***
14:00-14:30	*On-chip free electron light sources* **Fang Liu**, Tsinghua University, China	I	***p72***
14:30-15:00	*High power continuous wave operation of 1.3-μm quantum-dot PCSEL* **Sicong Tian**, Changchun Institute of Optics, Fine Mechanics and Physics, CAS, China	I	***p73***
15:00-15:15	CIOP2019-2019-000190 *Nonlinear microscopy of nanostructures with cylindrical vector beams* **Xiaorun Zang**, Tampere University, Finland	O	***p79***
15:15-15:30	CIOP2019-2019-000165 *Optical traction based on photonic crystal structures* **Hang Li**, Harbin Institute of Technology, China	O	***p79***
15:30-17:30	Poster Session & Coffee Break		

August 9

Presider: Fang Liu, Tsinghua University, China			
08:30-09:00	*Plasmonics for sensors and filters* **Junpeng Guo**, University of Alabama in Huntsville, USA	I	***p73***
09:00-09:30	*Light manipulation by dispersion tuning from elliptic to hyperbolic structures* **Hong Chen**, Tongji University, China	I	***p74***
09:30-10:00	*Pseudo-local metamaterials with extraordinary parameters and applications* **Yun Lai**, Nanjing University, China	I	***p75***
10:00-10:15	CIOP2019-2019-000029 *Topological phase in optical waveguide arrays with anti-PT symmetry* **Shaolin Ke**, Wuhan Institute of Technology, China	O	***p79***
10:15-10:30	CIOP2019-2019-000037 *Topological edge state in the X-ray regime* **Zhi-Wei Guo**, Tongji University, China	O	***p79***
10:30-11:00	Coffee Break		
Presider: Hong Chen, Tongji University, China			
11:00-11:30	*Topological photonics in synthetic spaces* **Hui Liu**, Nanjing University, China	I	***p75***
11:30-12:00	*Guiding and routing the light in valley topological nanophotonics* **Jianwen Dong**, Sun Yat-Sen University, China	I	***p76***
12:00-13:30	Lunch Break		
Presider: Yun Lai, Nanjing University, China			
13:30-14:00	*Angular momentum-dependent topological transport* **Meng Xiao**, Wuhan University, China	I	***p76***
14:00-14:30	*Pseudospin and topological phenomena in photonic graphene* **Daohong Song**, Nankai University, China	I	***p77***
14:30-14:45	CIOP2019-2019-000326 *Narrow linewidth plasmonic optical filter* **Rong He**, Fudan University, China	O	***p79***
14:45-15:00	CIOP2019-2019-000239 *Plasmonic voltage tunable filter based on H-type resonators* **Zhihao Guo**, Lanzhou University, China	O	***p79***
15:30-16:00	Coffee Break		

SC3 Ultrafast and Nonlinear Phenomena

Zenghu Chang, University of Central Florida, USA (Chair)
Xianfeng Chen, Shanghai Jiao Tong University, China (Chair)
Claudio Conti, University Sapienza in Rome, Italy (Co-chair)
Yunquan Liu, Peking University, China (Co-chair)
Zhiwen Liu, The Pennsylvania State University, USA (Co-chair)
Pengfei Lan, Huazhong University of Science and Technology, China
Xueguang Ren, Xi'an Jiaotong University, China
Yan Sheng, Australian National University, Australia
Chuanshan Tian, Fudan University, China
Wenjie Wan, Shanghai Jiao Tong University, China
Kun Zhao, Institute of Physics, CAS, China

Location: 2F, Avignon, Convention Centre

August 7			
Presider: Zenghu Chang, University of Central Florida, USA			
13:30-14:15	*Complexity, topology, and machine learning in nonlinear optics* **Claudio Conti**, University Sapienza of Rome, Italy	T	***p80***
14:15-14:45	*Optical force and nonlinear phenomena in biological suspensions* **Zhigang Chen**, Nankai University, China	I	***p80***
14:45-15:15	*Multiphoton energy absorption and deposition in strong-field ionization of molecules* **Jian Wu**, East China Normal University, China	I	***p81***
15:15-15:30	CIOP2019-2019-000328 *Topological photonics in a synthetic 2D space including both frequency and OAM axes of light* **Luqi Yuan**, Shanghai Jiao Tong University, China	O	***p92***
15:30-16:00	Coffee Break		
Presider: Claudio Conti, University Sapienza of Rome, Italy			
16:00-16:30	*The Stern-Gerlach effect in nonlinear optics* **Ady Arie**, Tel Aviv University, Israel	I	***p81***
16:30-17:00	*Characterization of laser-pulse parameters by strong field ionization* **Liangyou Peng**, Peking University, China	I	***p82***
17:00-17:15	CIOP2019-2019-000058 *Spatial control of topological edge state in polariton topological insulators* **Yiqi Zhang**, Xi'an Jiaotong University, China	O	***p92***
17:15-17:30	CIOP2019-2019-000327 *Cascaded sum-frequency generation and electro-optic polarization coupling in the PPLNOI ridge waveguide* **Dan Wang**, Shanghai Jiao Tong University, China	O	***p92***

August 8			
Presider: Xianfeng Chen, Shanghai Jiao Tong University, China			
09:00-09:30	*Gigawatt soft-x-ray attosecond super-continuum* **Eiji J. Takahashi**, RIKEN, Japan	I	***p83***
09:30-10:00	*MIR femtosecond laser* **Yuxin Leng**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p83***
10:00-10:15	CIOP2019-2019-000521 *Controllable generation of second-harmonic vortex beams through nonlinear supercell grating* **Huijun Wang**, Nanjing University, China	O	***p92***
10:15-10:30	CIOP2019-2019-000210 *Enhanced optical nonlinearities and optical limiting properties of SnO_2 materials by vector light field* **Lei Yan**, Taiyuan University of Technology, China	O	***p92***
10:30-11:00	Coffee Break		
Presider: Yunquan Liu, Peking University, China			
11:00-11:30	*Nonlinear optical properties and ultrafast carrier dynamics in $PtSe_2$ and PtS* **Jun Wang**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p84***
11:30-12:00	*Light, sound and microwave induced modulation in a microcavity Brillouin laser* **Wenjie Wan**, Shanghai Jiao Tong University, China	I	***p84***
12:00-13:30	Lunch Break		
Presider: Wenjie Wan, Shanghai Jiao Tong University, China			
13:30-14:00	*An anatomy of strong-field ionization-induced air lasing* **Ya Cheng**, East China Normal University, China	I	***p85***
14:00-14:30	*Ultrafast tunable photonic microstructure materials* **Xiaoyong Hu**, Peking University, China	I	***p85***
14:30-15:00	*Determination of the carrier-envelop phase of PW laser pulses* **Jianxing Li**, Xi'an Jiaotong University, China	I	***p86***
15:00-15:15	CIOP2019-2019-000195 *Noise-like pulses with H-shape from a 2 μm mode-locked fiber Oscillator* **Jingru Wang**, Jiangsu Normal University, China	O	***p93***
15:30-17:30	Poster Session & Coffee Break, 1F		

August 9			
Presider: Xueguang Ren, Xi'an Jiaotong University, China			
08:30-09:00	*Nucleation and dissociation of methane clathrate embryo at the gas/water interface* **Chuanshan Tian**, Fudan University, China	I	***p86***
09:00-09:30	*3D ferroelectric domain engineering with ultrafast light* **Yan Sheng**, Australian National University, Australia	I	***p87***
09:30-10:00	*High-flux attosecond pulse generation* **Xinkui He**, Institute of Physics, CAS, China	I	***p88***
10:00-10:15	CIOP2019-2019-000340 *Slow and fast light enhanced light drag in a moving microcavity* **Wenjie Wan**, Shanghai Jiao Tong University, China	O	***p93***
10:15-10:30	CIOP2019-2019-000367 *Nonlinear frequency conversion in $BaMgF_4$, a vacuum ultraviolet ferroelectric crystal* **Shuo Yan**, School of Physics and Astronomy, Shanghai Jiao Tong University, China	O	***p93***
10:30-11:00	Coffee Break		
Presider: Chuanshan Tian, Fudan University, China			
11:00-11:30	*Ultrafast energy transfer in hydrated biomolecule complex via intermolecular Coulombic decay* **Xueguang Ren**, Xi'an Jiaotong University, China	I	***p88***
11:30-12:00	*Strong-field double ionization of atoms: timing recollision and the role of recollision excitation cross section* **Huipeng Kang**, Friedrich Schiller University Jena, Germany	I	***p89***
12:00-13:30	Lunch Break		
Presider: Yan Sheng, Australian National University, Australia			
13:30-14:00	*CEP uncertainty extracted by phase deviation analysis* **Kun Zhao**, Institute of Physics, CAS, China	I	***p89***
14:00-14:30	*Attosecond photoelectron holography in strong field tunneling ionization* **Yueming Zhou**, Huazhong University of Science and Technology, China	I	***p90***
14:30-15:00	*On-chip zero-index metamaterials for nonlinear optics* **Yang Li**, Tsinghua University, China	I	***p91***
15:00-15:15	CIOP2019-2019-000561 *Surface and bulk contribution to sum-frequency vibrational spectroscopy of surface of single crystal ice* **Xiaofan Xu**, Fudan University, China	O	***p93***
15:15-15:30	CIOP2019-2019-000266 *Dissipative soliton resonance in an erbium-doped mode-locked fiber laser with a nonlinear amplifying loop mirror* **Long Han**, Changchun University of Science and Technology, China	O	***p93***
15:30-16:00	Coffee Break		

SC4 Solid State, Fiber, and Other Laser Sources

Zhichuan Niu, Institute of Semiconductors, CAS, China (Chair)
Jun Liu, Shanghai Institute of Optics and Fine Mechanics, CAS, China (Chair)
Haifeng Jiang, National Time Service Center, CAS, China (Co-chair)
Ming Li, Institute of Semiconductors, CAS, China (Co-chair)
Huiyun Liu, University College London, UK (Co-chair)
Jiangfeng Zhu, Xidian University, China (Co-chair)
Zizheng Cao, Eindhoven University of Technology, Netherlands
Zhaoyang Li, Osaka University, Japan
Dong Mao, Northwestern Polytechnical University, China

Location: 2F, Dijon, Convention Centre

August 7			
Presider: Zhichuan Niu, Institute of Semiconductors, CAS, China			
13:30-14:15	*Opportunities open by high-power modelocked thin-disk lasers* **Clara Saraceno**, Ruhr-University Bochum, Germany	T	***p94***
14:15-14:45	*Few cycle pulse generation through pulse dynamics manipulation in a fiber laser* **Minglie Hu**, Tianjin University, China	I	***p94***
14:45-15:15	*Research progress of high-power ultrafast Yb solid-state lasers* **Jiangfeng Zhu**, Xidian University, China	I	***p95***
15:15-15:30	CIOP2019-2019-000117 Microfiber-enabled dissipative soliton laser at 2 um **Yuhang Li**, Tsinghua University, China	O	***p107***
15:30-16:00	Coffee Break		
Presider: Clara Saraceno, Ruhr-University Bochum, Germany			
16:00-16:30	*Repeatable high energy laser development at Osaka University* **Junji Kawanaka**, Osaka University, Japan	I	***p95***
16:30-17:00	*High performance multicolor femtosecond laser pulses and their applications* **Jun Liu**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p96***
17:00-17:30	*Extending SESAM technology into the mid-infrared* **Fengqiu Wang**, Nanjing Univeristy, China	I	***p97***
17:30-17:45	CIOP2019-2019-000196 *Thermal simulation and structure design of thermally tuned multi-channel interference (MCI) laser* **Miao Zhang**, Huazhong University of Science and Technology, China	O	***p107***

August 8			
Presider: Jun Liu, Shanghai Institute of Optics and Fine Mechanics, CAS, China			
08:30-09:00	*MXenes and MAX phases for ultrafast fiber lasers* **Ju Han Lee**, University of Seoul, South Korea	I	***p97***
09:00-09:30	*Dynamics of ultrafast fiber soliton lasers* **Xueming Liu**, Zhejiang University, China	I	***p98***
09:30-10:00	*High repetition rate ultrafast VUV sources* **Zhigang Zhao**, Shandong University, China	I	***p98***
10:00-10:15	CIOP2019-2019-000091 *Generation of complex structured beams with selective modes* **Shiyao Fu**, Beijing Institute of Technology, China	O	***p107***
10:15-10:30	CIOP2019-2019-000156 *Lateral mode tailoring in broad area diode lasers based on laterally coupled passive waveguide* **Jingjing Yang**, Changchun University of Science and Technology, China	O	***p107***
10:30-11:00	Coffee Break		
Presider: Ju Han Lee, University of Seoul, South Korea			
11:00-11:30	*High-power 2.8 μm erbium fiber lasers and their applications* **Shigeki Tokita**, Osaka University, Japan	I	***p99***
11:30-12:00	*Radially polarized and mode-locked fiber laser* **Jianlang Li**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p99***
12:00-12:15	CIOP2019-2019-000575 *Generations of cylindrical vector beam in the Rotary Nd:YAG disk laser* **Sanbin Chen**, North China Research Institute of Electro-optics & Xidian University, China	O	***p107***
12:15-13:30	Lunch Break		
Presider: Shigeki Tokita, Osaka University, Japan			
13:30-14:00	*Coherent pulse combination by phase controlled polarization switching and delay lines* **Zhigang Zhang**, Peking University, China	I	***p100***
14:00-14:30	*High power low noise single frequency fiber laser at 2 μm for gravitational wave detection* **Pu Wang**, Beijing University of Technology, China	I	***p100***
14:30-15:00	*Spatiotemporal manipulation of pulse helps solving the pulse-contrast challenge in ultrafast intense lasers* **Jingui Ma**, Shanghai Jiao Tong University, China	I	***p101***
15:00-15:15	CIOP2019-2019-000212 *Noise-like pulses with low repetition rate in an all-polarization-maintaining mode-locked figure-of-9 Er-doped fiber laser* **Yan Pei**, Beijing University of Posts and Telecommunications, China	O	***p107***
15:15-15:30	CIOP2019-2019-000157 *Low threshold current, narrow linewidth surface emitting distributed feedback lasers* **Yina Hai**, Changchun University of Science and Technology, China	O	***p108***
15:30-15:45	CIOP2019-2019-000515 *High-efficiency and high-purity Laguerre-Gaussian laser based on intracavity spin-orbital angular momentum conversion* **Dunzhao Wei**, Nanjing University & Sun Yat-sen University, China	O	***p108***
15:30-17:30	Poster Session & Coffee Break		

August 9			
Presider: Weihua Guo, Huazhong University of Science and Technology, China			
08:30-09:00	*Possible method for a single-cycle 100 petawatt laser with wide-angle non-collinear optical parametric chirped pulse amplification* **Zhaoyang Li**, Osaka University, Japan	I	***p101***
09:00-09:30	*Vortex laser and applications in free-space communications* **Guoqiang Xie**, Shanghai Jiao Tong University, China	I	***p102***
09:30-10:00	*High performance GaSb-based FP lasers and SDL* **Yu Zhang**, Institute of Semiconductors, CAS, China	I	***p102***
10:00-10:30	*Sub-100-fs bulk solid-state lasers near 2-micron* **Valentin Petrov**, Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Germany	I	***p103***
10:30-11:00	Coffee Break		
Presider: Yan Feng, Shanghai Institute of Optics and Fine Mechanics, CAS, China			
11:00-11:30	*The generation and detection of intense ultrafast vortex pulses* **Shixiang Xu**, Shenzhen University, China	I	***p103***
11:30-12:00	*Semiconductor lasers with novel concepts developed for optical communications* **Weihua Guo**, Huazhong University of Science and Technology, China	I	***p104***
12:00-12:15	CIOP2019-2019-000374 *MHz-level energetic ultrafast laser source tunable between 940-1250 nm for multi-photon microscopy* **Yang Yu**, Xidian University & Institute of Physics, CAS, China	O	***p108***
12:00-13:30	Lunch Break		
Presider: Guoqiang Xie, Shanghai Jiao Tong University, China			
13:30-14:00	*Manipulation the optical field of random distributed feedback fiber laser* **Pu Zhou**, National University of Defense Technology, China	I	***p104***
14:00-14:30	*Wavelength-agile fiber amplifiers for quantum technology* **Yan Feng**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p105***
14:30-15:00	*Very long wave infrared (≥14 μm) quantum cascade lasers based on novel design* **Junqi Liu**, Institute of Semiconductors, CAS, China	I	***p105***
15:00-15:15	CIOP2019-2019-000147 *Polarization-stabilized tunable VCSEL with a internal-cavity sub-wavelength grating* **Xiaolong Wang**, Changchun University of Science and Technology, China	O	***p108***
15:15-15:30	CIOP2019-2019-000679 *Stannic sulfide (SnS_2) nanosheets as saturable absorber for high-order soliton molecules generation in Er-doped fiber resonator* **Xiaohui Li**, Shaanxi Normal University, China	O	***p108***
15:30-16:00	Coffee Break		

SC5 Silicon Photonics

Zhiping (James) Zhou, Peking University, China (Chair)
Daoxin Dai, Zhejiang University, China (Co-Chair)
Odile Liboiron-Ladouceur, McGill University, Canada (Co-Chair)
Jing Liu, Tianjin University, China (Co-Chair)
Jurgen Michel, Massachusetts Institute of Technology, USA (Co-Chair)
Vilson Rosa de Almeida, Instituto Tecnológico de Aeronáutica (ITA) & Universidade Brasil, Brazil
Xuetao Gan, Northwestern Polytechnical University, China
Yuqing Jiao, Eindhoven University of Technology, Netherlands
Di Liang, Hewlett Packard Labs, USA
Wei Shi, Université Laval, Canada

Location: 1F, Cezanne, Convention Centre

August 7			
Presider: Zhiping (James) Zhou, Peking University, China			
13:30-14:15	*Silicon photonic devices for optical signal processing in wavelength, polarization and mode* **Yikai Su**, Shanghai Jiao Tong University, China	T	***p109***
14:15-14:45	*All-silicon lasers with a wide gain range* **Xiang Wu**, Fudan University, China	I	***p109***
14:45-15:15	*A miniature interrogator for multiplexed FBG strain sensors* **Wenjia Zhang**, Shanghai Jiao Tong University, China	I	***p110***
15:15-15:30	CIOP2019-2019-000036 *64 Gb/s PAM-4 modulation using a single-drive silicon Mach-Zehnder modulator with 2 V drive voltage* **Gangqiang Zhou**, Shanghai Jiaotong University, China	O	***p120***
15:30-16:00	Coffee Break		
Presider: Xiang Wu, Fudan University, China			
16:00-16:30	*Er silicate amplifier and laser for silicon photonics* **Xingjun Wang**, Peking University, China	I	***p110***
16:30-17:00	*Recent advances in dispersion engineering of integrated optical waveguides* **Lin Zhang**, Tianjin University, China	I	***p111***
17:00-17:15	CIOP2019-2019-000173 *Reconfigurable optical directed logic device based on cascaded micro ring resonators* **Yonghui Tian**, Lanzhou University, China	O	***p120***
17:15-17:30	CIOP2019-2019-000397 *Closed-loop thermal-electronic-photonic co-simulation for a novel Mach-Zehnder modulator bias control scheme* **Yuhang Wang**, Huazhong University of Science and Technology, China	O	***p120***

August 8			
Presider: Kaikai Xu, University of Electronic Science and Technology of China, China			
09:00-09:45	*Multimode silicon photonics* **Daoxin Dai**, Zhejiang University, China	T	***p112***
09:45-10:15	*III-V Nano-lasers directly grown on silicon* **Kei May Lau**, The Hong Kong University of Science and Technology, Hong Kong, China	I	***p112***
10:15-10:30	CIOP2019-2019-000353 *Theoretical study of microring resonator based refractive index sensor* **Rahul Kumar Gangwar**, Peking University, China	O	***p120***
10:30-11:00	Coffee Break		
Presider: Frédéric Grillot, Telecom ParisTech, France			
11:00-11:30	*Advances in twisting light on silicon platform* **Jian Wang**, Huazhong University of Science and Technology, China	I	***p113***
11:30-12:00	*Chip-based silicon light-emitting device* **Kaikai Xu**, University of Electronic Science and Technology of China, China	I	***p114***
12:00-13:30	Lunch Break		
Presider: Daoxin Dai, Zhejiang University, China			
13:30-14:00	*High coherence semiconductor lasers for next generation silicon photonics* **Frédéric Grillot**, Telecom ParisTech, France	I	***p114***
14:00-14:30	*Photon lifetime dependent reduction of VCSEL energy consumption* **Gunter Larisch**, Changchun Institute of Optics, Fine Mechanics and Physics, CAS, China	I	***p115***
14:30-15:00	*Realizing Lorentzian, Fano and EIT resonance lineshapes in a microring resonator* **Xuetao Gan**, Northwestern Polytechnical University, China	I	***p116***
15:00-15:15	CIOP2019-2019-000551 *High extinction ratio subwavelength grating ring resonator* **Lijun Huang**, Huaihua University, China	O	***p120***
15:15-15:30	CIOP2019-2019-000524 *Near-infrared optical amplifier and lasers based on Erbium silicate nanostructures* **Xiujuan Zhuang**, Hunan University, China	O	***p120***
15:30-17:30	Poster Session & Coffee Break, 8F		
August 9			
Presider: Xuetao Gan, Northwestern Polytechnical University, China			
09:00-09:30	*Manipulating mesoscopic mechanical vibrations with an optomechanical toolbox* **Gustavo Wiederhecker**, University of Campinas, Brazil	I	***p116***
09:30-10:00	*Full-stokes polarimeters in silicon photonics* **Wei Shi**, Université Laval, Canada	I	***p117***
10:00-10:30	*Fabrication technology and foundry models of silicon photonics* **Junbo Feng**, Chongqing United Micro-Electronics Center, China	I	***p117***
10:30-11:00	Coffee Break		
Presider: Junbo Feng, Chongqing United Micro-Electronics Center, China			
11:00-11:30	*Design of high-speed drivers for 400GbE datacenter interconnects* **Nan Qi**, Institute of Semiconductors, CAS, China	I	***p118***
11:30-12:00	*Universal silicon based multimode photonic devices based on transformation optics* **Dingshan Gao**, Huazhong University of Science and Technology, China	I	***p119***

SC6 Microwave Photonics

Shilong Pan, Nanjing University of Aeronautics and Astronautics, China (Chair)
Antonella Bogoni, National Laboratory of Photonic Networks of CNIT, Italy (Co-chair)
Ming Li, Institute of Semiconductors, CAS, China (Co-chair)
Xiaoke Yi, The University of Sydney, Australia (Co-chair)
Fabien Bretenaker, French National Centre for Scientific Research, France
Lawrence Chen, Mcgill University, Canada
Yitang Dai, Beijing University of Posts and Telecommunications, China
Jungwon Kim, Korea Advanced Institute of Science and Technology, South Korea

Location: 1F, Degas, Convention Centre

August 7			
Presider: Fabien Bretenaker, Laboratoire Aimé Cotton, France			
13:30-14:15	*Microwave photonics* **Thas Nirmalathas**, University of Melbourne, Australia	T	***p121***
14:15-14:45	*Recent advances in optoelectronic oscillators* **Ming Li**, Institute of Semiconductors, CAS, China	I	***p122***
14:45-15:15	*The six-port in microwave photonics* **Zhenzhou Tang**, Nanjing University of Aeronautics and Astronautics, China & Ghent University, Belgium	I	***p122***
15:15-15:30	CIOP2019-2019-000136 *Hybrid integration of high-speed MUTC-PD on SOI* **Enfei Chao**, Tsinghua University, China	O	***p129***
15:30-16:00	Coffee Break		
Presider: Shilong Pan, Nanjing University of Aeronautics and Astronautics, China			
16:00-16:30	*Frequency-time coherence and dispersion engineering for microwave photonic applications* **Thomas Schneider**, Technical University-Braunschweig, Germany	I	***p123***
16:30-17:00	*Microwave photonic radar* **Wangzhe Li**, Institute of Electronics, CAS, China	I	***p123***
17:00-17:15	CIOP2019-2019-000361 *Stable OFC generator based on cascaded phase modulators* **Xiangchuan Wang**, Nanjing University of Aeronautics and Astronautics, China	O	***p129***
17:15-17:30	CIOP2019-2019-000532 *Low-noise Dual-frequency VECSELs realized with correlated pumping* **Hui Liu**, Laboratoire Aimé Cotton, CNRS, Université Paris–Sud, ENS Paris–Saclay, Université Paris–Saclay, Orsay, France	O	***p129***

August 8			
Presider: Ming Li, Institute of Semiconductors, CAS, China			
09:00-09:30	*Integrated microwave photonics: from photons to radio waves on a chip* **Guillermo Carpintero**, Universidad Carlos III de Madrid, Spain	I	***p124***
09:30-10:00	*Non-Hermitian microwave photonic systems* **Jiejun Zhang**, Jinan University, China	I	***p125***
10:00-10:30	*High performance microwave photonic coherent receiver* **Yunxin Wang**, Beijing University of Technology, China	I	***p125***
10:30-11:00	Coffee Break		
Presider: Thas Nirmalathas, University of Melbourne, Australia			
11:00-11:30	*High speed PON and RoF based optical access technologies for 5G and beyond* **Hwan Seok Chung**, Electronics and Telecommunications Research Institute (ETRI), South Korea	I	***p126***
11:30-12:00	*Microwave signal processing with optoelectronic oscillator* **Xiuyou Han**, Dalian University of Technology, China	I	***p127***
12:00-13:30	Lunch Break		
Presider: Yunxin Wang, Beijing University of Technology, China			
13:30-14:00	*RF signal generation, hoping and switching based on negative wavelength detuning in SMFP-LDs* **Bikash Nakarmi**, Nanjing University of Aeronautics and Astronautics, China	I	***p127***
14:00-14:30	*Microwave photonic system with bandwidth scaling* **Feifei Yin**, Beijing University of Posts and Telecommunications, China	I	***p128***
14:30-14:45	CIOP2019-2019-000123 *Parity-time-symmetry based optoelectronic oscillator* **Haitao Tang**, Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China	O	***p129***
14:45-15:00	CIOP2019-2019-000335 *Optical sensor network interrogation based on nonunifomly spaced microwave photonic delay-line filter* **Dongrui Xiao**, Southern University of Science and Technology, China	O	***p129***
15:30-17:30	Poster Session & Coffee Break, 1F		

SC7 Micro and Nanophotonics

Ting Mei, Northwestern Polytechnical University, China (Chair)
Cunzheng Ning, Tsinghua University, China & Arizona State University, USA (Chair)
Limin Tong, Zhejiang University, China (Chair)
Jimin Bao, University of Houston, USA
Dawei Di, Zhejiang University, China
Elhadj Dogheche, Université Polytechnique des Hauts-de-France, France
Amr Helmy, University of Toronto, Canada
Byoungho Lee, Seoul National University, South Korea
Dangyuan Lei, City University of Hong Kong, Hong Kong, China
Renmin Ma, Peking University, China
Qihua Xiong, Nanyang Technological University, Singapore
Weidong Zhou, University of Texas at Arlington, USA

Location: 3F, Grandball Room III, Convention Centre

August 7			
Presider: Ting Mei, Northwestern Polytechnical University, China			
13:30-14:15	*Whispering-gallery-mode microresonators: fundamentals and applications* **Lan Yang**, Washington University in St. Louis, USA	T	***p130***
14:15-14:45	*Quantum signatures in plasmonics systems* **Dangyuan Lei**, City University of Hong Kong, Hong Kong, China	I	***p131***
14:45-15:15	*Enhanced performance of plasmonic nanolasers on graphene-insulator-metal platform* **Tien-chang Lu**, National Chiao Tung University, Taiwan, China	I	***p131***
15:15-15:30	CIOP2019-2019-000042 *Fiber-based tunable microcavity with high coupling efficiency* **Wei Fang**, Zhejiang University, China	O	***p143***
15:30-16:00	Coffee Break		
Presider: Hin-Lap Yip, South China University of Technology, China			
16:00-16:30	*Extended Drude model for intraband transition induced optical nonlinearity: the physical origin* **Ting Mei**, Northwestern Polytechnical University, China	I	***p132***
16:30-17:00	*Closely packed quantum well stacks individually resolved near to physical resolution limit* **Frank Bertram**, University Magdeburg, Germany	I	***p133***
17:00-17:30	*Laser printing crypto-display nano-imprints and metasurfaces* **Xiangping Li**, Jinan University, China	I	***p133***
17:30-17:45	CIOP2019-2019-000088 *Optical tuning of surface plasmons and their enhanced photoluminescence* **Tao Ding**, Wuhan University, China	O	***p143***

August 8

Presider: Limin Tong, Zhejiang Univerity, China			
08:45-09:30	*Subwavelength grating metamaterial for integrated photonics* **Ray Chen**, University of Texas at Austin, USA	T	***p134***
09:30-10:00	*Strong optical nonlinearity in Si-based nanoplasmonic guides* **Abdulhakem Elezzabi**, University of Alberta, Canada	I	***p135***
10:00-10:30	*III-V optoelectronic devices directly on Si substrate* **Jiang Wu**, University of Electronic Science and Technology of China, China	I	***p136***
10:30-11:00	Coffee Break		
Presider: Linjie Zhou, Shanghai Jiao Tong University, China			
11:00-11:30	*Quantum state control in single quantum dots and the coupling with photonic crystal cavities* **Xiulai Xu**, Institute of Physics, CAS, China	I	***p136***
11:30-12:00	*Femtosecond polarization pulse shaping by dielectric metasurfaces* **Lu Chen**, National Institute of Standards and Technology, USA	I	***p137***
12:00-13:30	Lunch Break		
Presider: Ray Chen, University of Texas at Austin, USA			
13:30-14:00	*Influence of dopants induced electric fields on the band-edge absorption of GaN* **Shijie Xu**, The University of Hong Kong, Hong Kong, China	I	***p138***
14:00-14:30	*High-throughput optical modeling guided design of polymer solar cells* **Hin-Lap Yip**, South China University of Technology, China	I	***p138***
14:30-15:00	*Non-volatile integrated photonic devices based on Si-GST hybrid waveguides* **Linjie Zhou**, Shanghai Jiao Tong University, China	I	***p139***
15:00-15:30	*$CsPbBr_3$ nanocrystals—the origin of the strong green emission from the edge of two-dimensional pervoskite $CsPb_2Br_5$* **Chong Wang**, Yunnan University, China	I	***p140***
15:30-17:30	Poster Session & Coffee Break, 8F		

August 9

Presider: Dangyuan Lei, City University of Hong Kong, Hong Kong, China			
09:00-09:30	*Nanowire plasmons: waveguiding and coupling with quantum emitters* **Hong Wei**, Institute of Physics, CAS, China	I	***p140***
09:30-10:00	*Semiconductor nanowire lasers: possible routes towards practical applications* **Xin Guo**, Zhejiang University, China	I	***p141***
10:00-10:30	*Nanocavities for strong light-matter interaction* **Shunping Zhang**, Wuhan University, China	I	***p141***
10:30-11:00	Coffee Break		
Presider: Shunping Zhang, Wuhan University, China			
11:00-11:30	*Computational simulations of optical properties in novel two-dimensional materials using many-body perturbation theory* **Liujiang Zhou**, University of Electronic Science and Technology of China, China	I	***p142***
11:30-11:45	CIOP2019-2019-000508 *Selective trimming of optical resonances in three-dimensional tubular optical microcavities* **Jiawei Wang**, IFW Dresden, Germany	O	***p143***
11:45-12:00	CIOP2019-2019-000182 *Symmetry breaking due to misaligned structural and material axes for the stimulated brillouin scattering in a sub-wavelength anisotropic waveguide* **Xiaoxing Su**, Beijing Jiaotong University, China	O	***p143***

SC8 Optical Materials

Jun Wang, Shanghai Institute of Optics and Fine Mechanics, CAS, China (Chair)
Shifeng Zhou, South China University of Technology, China (Chair)
Juejun Hu, Massachusetts Institute of Technology, USA (Co-chair)
Jean-Michel Nunzi, Queen's University, Canada (Co-chair)
André-Jean Attias, Université Pierre et Marie Curie, France
Yong Gyu Choi, Korea Aerospace University, South Korea
Hirokazu Masai, National Institute of Advanced Industrial Science and Technology, Japan
Liangbi Su, Shanghai Institute of Ceramics, CAS, China

Location: 1F, Picasso, Convention Centre

August 7			
Presider: Jun Wang, Shanghai Institute of Optics and Fine Mechanics, CAS, China			
13:30-14:15	*Fluorooxoborates: novel candidates for DUV nonlinear optical materials* **Shilie Pan**, Xinjiang Technical Institute of Physics & Chemistry, CAS, China	T	***p144***
14:15-14:45	*Quantum dots for optoelectronic and photonic applications* **Kwang-Sup Lee**, Hannam Univerity, South Korea	I	***p144***
14:45-15:15	*Tailoring refractive index dispersion of chalcogenide glasses for use in thermal imaging applications* **Yong Gyu Choi**, Korea Aerospace University, South Korea	I	***p145***
15:15-15:30	CIOP2019-2019-000244 *Temperature insensitive FBG sensors based on multicomponent glass fiber* **Ziyu Lin**, School of Materials Science and Engineering, South China University of Technology, China	O	***p154***
15:30-16:00	Coffee Break		
Presider: Yong Gyu Choi, Korea Aerospace University, South Korea			
16:00-16:30	*Materials and devices for bendable and stretchable integrated photonics* **Lan Li**, Westlake University, China	I	***p146***
16:30-17:00	*Two-dimensional and other nanoparticles as low-concentration dopants for stimulated Brillouin scattering suppression* **Ivan Kislyakov**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p146***
17:00-17:15	CIOP2019-2019-000131 *Controllability of refractive index of optical thin films and its application in antireflective coatings of multi-junction GaAs solar cells* **Mengqi Shi**, Shanghai Institute of Space Power-sources, China	O	***p154***
17:15-17:30	CIOP2019-2019-000149 *Self-powered photodetector based on vertical MoO_3/MoS_2 heterostructure with gate tunable photo-response* **Xinli Ma**, School of Precision Instruments and Optoelectronics Engineering of Tianjin University, China	O	***p154***

August 8

Presider: Shifeng Zhou, South China University of Technology, China			
09:00-09:45	*Bio-mimetic nanophotonics* **Jean-Michel Nunzi**, Queen's University, Canada	T	***p147***
09:45-10:15	*Tuning the graphene photonic properties by surface-confined supramolecular self-assembly* **André-Jean Attias**, Sorbonne Université, France	I	***p148***
10:15-10:30	CIOP2019-2019-000027 *Electronic, optical properties and effective masses of $Al_xGa_{1-x}As$ and $In_yGa_{1-y}As$ based on the first principle* **Congcong Wang**, Beijing University of Technology, China	O	***p154***
10:30-11:00	Coffee Break		
Presider: Jean-Michel Nunzi, Queen's University, Canada			
11:00-11:30	*Phosphor in glasses for white LED color conversion* **Woon Jin Chung**, Kongju National University, South Korea	I	***p148***
11:30-12:00	*Progress on self-frequency-doubled $Yb:Ca_4YO(BO_3)_3$ laser crystal* **Haohai Yu**, Shandong University, China	I	***p149***
12:00-13:30	Lunch Break		
Presider: André-Jean Attias, Sorbonne Université, France			
13:30-14:00	*Relationship between structure and optical properties of oxide glasses* **Hirokazu Masai**, National Institute of Advanced Industrial Science and Technology, Japan	I	***p150***
14:00-14:30	*Low-noise plastic optical fiber for radio-over-fiber network* **Azusa Inoue**, Keio University, Japan	I	***p150***
14:30-15:00	*TBA* **Liangbi Su**, Shanghai Institute of Ceramics, CAS, China	I	***p151***
15:00-15:15	CIOP2019-2019-000541 *Core-shell nanoparticles as surface-enhanced raman scattering substrates for sensitive detection of thiram* **Yunjie Lv**, Shenzhen University, China	O	***p154***
15:30-17:30	Poster Session & Coffee Break, 1F		

August 9

Presider: Liangbi Su, Shanghai Institute of Ceramics, CAS, China			
09:00-09:30	*Development of novel inorganic scintillators and analysis of the excited states dynamics responsible for scintillation* **Masanori Koshimizu**, Tohoku University, Japan	I	***p151***
09:30-10:00	*Polycrystalline transparent ceramics for demanding optical applications* **Jian Zhang**, Shanghai Institute of Ceramics, CAS, China	I	***p152***
10:00-10:30	*Observation of near-field chirality generation on an achiral plasmonic structure* **Tomoya Oshikiri**, Research Institute for Electronic Science, Hokkaido University, Japan	I	***p152***
10:30-11:00	Coffee Break		
Presider: Hirokazu Masai, National Institute of Advanced Industrial Science and Technology, Japan			
11:00-11:30	*Single-mode laser in sub-micron semiconductor optical microcavities* **Hongxing Dong**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p153***
11:30-11:45	CIOP2019-2019-000406 *Size-dependent broadband nonlinear optical enhancement and origin in BP nanosheets and quantum dots* **Baohua Zhu**, Henan University, China	O	***p155***
11:45-12:00	CIOP2019-2019-000199 *Effects on the surface and luminescence properties of GaAs by octadecanethiol solution passivation* **Yumeng Xu**, Changchun University of Science and Technology, China	O	***p155***

SC9 Optical Measurement and Metrology

Denis Dontsov, SIOS Meßtechnik GmbH, Germany (Chair)
Yanqiu Li, Beijing Institute of Technology, China (Chair)
Sen Han, University of Shanghai for Science and Technology, China (Co-chair)
Cheng Liu, Shanghai Institute of Optics and Fine Mechanics, CAS, China (Co-chair)
Josef Lazar, Institute of Scientific Instruments of the Czech Academy of Sciences, Czech Republic
Peter Lehmann, University of Kassel, Germany
Linbo Liu, Nanyang Technological University, Singapore
Shiyuan Liu, Huazhong University of Science and Technology, China
Eberhard Manske, Technische Universität Ilmenau, Germany

Location: 2F, Cannes, Convention Centre

August 7			
Presider: Sen Han, University of Shanghai for Science and Technology, China			
13:30-14:15	*Laser interferometry for high precision and ultra-stable applications* **Denis Dontsov**, SIOS Messtechnik GmbH Ilmenau, Germany	T	***p156***
14:15-14:45	*A method determining the resolution and stability on nanometer scale of optical instrument* **Wenhao Huang**, University of Science and Technology of China, China	I	***p156***
14:45-15:15	*The development of ultra-precision displacement measuring laser interferometer at Harbin Institute of Technology* **Pengcheng Hu**, Harbin Institute of Technology, China	I	***p157***
15:15-15:30	CIOP2019-2019-000364 *LED arrays as illumination for imaging and metrology systems* **Xinrui Cao**, TU Ilmenau, Germany	O	***p166***
15:30-16:00	Coffee Break		
Presider: Wenhao Huang, University of Science and Technology of China, China			
16:00-16:30	*Full-field optical coherence tomography with an acousto-optically tuned external-cavity laser diode* **Takamasa Suzuki**, Niigata University, Japan	I	***p158***
16:30-17:00	*Micro-optical coherence tomography for measurement of microanatomic and subcellular parameters* **Linbo Liu**, Nanyang Technological University, Singapore	I	***p158***
17:00-17:30	*Quantitative detection of biomolecules using coherent Raman microscopy* **Fake Lu**, State University of New York at Binghamton, USA	I	***p159***

August 8

Presider: Denis Dontsov, SIOS Messtechnik GmbH Ilmenau, Germany			
09:00-09:30	*Metrology in lithography: challenges and opportunities* **Arie J. den Boef**, ASML, Netherlands	I	***p159***
09:30-10:00	*Precision phase measurement based on quantum weak value amplification* **Hongliang Cui**, Jilin University, China	I	***p160***
10:00-10:15	CIOP2019-2019-000387 *Automated test station for multiwavelength laser-induced damage threshold measurements* **Jie Li**, Research Center of Laser Fusion, China Academy of Engineering Physics, China	O	***p166***
10:15-10:30	CIOP2019-2019-000066 *Ultrahigh resolution and ultrahigh precision spectroscopy and its applications* **Jinping He**, Nanjing Institute of Astronomical Optics and Technology, CAS, China	O	***p166***
10:30-11:00	Coffee Break		
Presider: Nanguang Chen, National University of Singapore, Singapore			
11:00-11:30	*Wavefront measurement in transmission of multiple-wavelength expressed by related Zernike coefficients* **Sen Han**, University of Shanghai for Science and Technology, China	I	***p160***
11:30-12:00	*Wavefront aberration measurement for lithographic projection lens* **Xiangzhao Wang**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	I	***p161***
12:00-13:30	Lunch Break		
Presider: Linbo Liu, Nanyang Technological University, Singapore			
13:30-14:00	*Advanced instrumentation and image reconstruction algorithms for optical mammography* **Nanguang Chen**, National University of Singapore, Singapore	I	***p161***
14:00-14:30	*Polarization sensitive optical coherence tomography for breast tumor margin detection* **Jianfeng Wang**, University of Illinois at Urbana-Champaign, USA	I	***p162***
14:30-15:00	*Spatially invariant resolution photoacoustic microscopy using wavefront engineering technology* **Jiamiao Yang,** California Institute of Technology, USA	I	***p163***
15:30-17:30	Poster Session & Coffee Break, 1F		

August 9

Presider: Cheng Liu, Shanghai Institute of Optics and Fine Mechanics, CAS, China			
08:30-09:00	*Identification of Chinese liquors by spectroscopic technology* **Guoqing Chen**, Jiangnan University, China	I	***p163***
09:00-09:30	*High precision surface metrology and structure characterization methods for making advanced X-ray reflective optics* **Qiushi Huang**, Tongji University, China	I	***p164***
09:30-10:00	*Development of tomographic Mueller-matrix scatterometry for nanostructure metrology* **Xiuguo Chen**, Huazhong University of Science and Technology, China	I	***p165***
10:00-10:15	CIOP2019-2019-000085 *Three-dimensional spatial resolution technique for characterizing laser-induced optical film defect damage* **Shan Chong**, Shanghai Institute of Laser Plasma, China	O	***p166***
10:15-10:30	CIOP2019-2019-000134 *One-shot common-path phase-shifting holography based on micropolarizer camera and large-shearing Wollaston Prism* **Canlin Zhou**, Shandong University, China	O	***p166***
10:30-11:00	Coffee Break		

SC10 Infrared and Terahertz Technologies

Yan Zhang, Capital Normal University, China (Chair)
Wei Shi, Xi'an University of Technology, China (Co-chair)
Chao Zhang, University of Wollongong, Australia (Co-chair)
Xi-Cheng Zhang, University of Rochester, USA (Co-chair)
Wenhui Fan, Xi'an Institute of Optics and Precision Mechanics, CAS, China
Lei Hou, Xi'an University of Technology, China
Masahiko Tani, University of Fukui, Japan
Qijie Wang, Nanyang Technological University, Singapore
Xinke Wang, Capital Normal University, China
Qiye Wen, University of Electronic Science and Technology of China, China

Location: 2F, Marseilles, Convention Centre

August 7			
Presider: Yan Zhang, Capital Normal University, China			
13:30-14:15	*Challenges and opportunities for THz wave liquid photonics* **Xi-Cheng Zhang**, University of Rochester, USA	T	***p167***
14:15-14:45	*2D materials based mid-infrared and terahertz optoelectronics* **Qijie Wang,** Nanyang Technological University, Singapore	I	***p167***
14:45-15:15	*THz technology for van der waals heterostructures* **Xinlong Xu**, Northwest University, China	I	***p168***
15:15-15:30	CIOP2019-2019-000185 *A dual band and tunable terahertz perfect absorber with grating coupled graphene ribbon array* **Fei Yan**, Harbin Institute of Technology, China	O	***p181***
15:30-16:00	Coffee Break		
Presider: Masahiko Tani, University of Fukui, Japan			
16:00-16:30	*Control of THz pulse polarization by two crossing DC fields during femtosecond laser filamentation in air* **Weiwei Liu**, Nankai University, China	I	***p169***
16:30-17:00	*Ultrafast dynamic control of emergent phases in transition metal oxides* **Jingdi Zhang**, The Hong Kong University of Science and Technology, Hong Kong, China	I	***p169***
17:00-17:30	*Non-scanning terahertz wave sub-diffraction-limited imaging enable by near-field compressive sensing* **Liguo Zhu**, China Academy of Engineering Physics, China	I	***p170***

August 8			
Presider: Liguo Zhu, China Academy of Engineering Physics, China			
08:30-09:00	*Electrical and magneto-optic properties of 3D topological materials in terahertz regime* **Chao Zhang**, University of Wollongong, Australia	I	***p171***
09:00-09:30	*Spin dynamics in magnetic materials observed by pump-probe spectroscopy and THz-TDS* **Takeshi Moriyasu**, University of Fukui, Japan	I	***p171***
09:30-10:00	*Tailoring terahertz radiation in spintronic terahertz sources* **Xiaojun Wu**, Beihang University, China	I	***p172***
10:00-10:15	CIOP2019-2019-000145 *Towards mJ-level ultrashort Terahertz generated by optical rectification with a compact Terawatt laser* **Jean-Gabriel Brisset**, Amplitude Laser Group, France	O	***p181***
10:15-10:30	CIOP2019-2019-000168 *Metamaterial beam splitter design based on new coding scheme at terahertz frequencies* **Xiaohua Xing**, Tianjin University, China	O	***p181***
10:30-11:00	Coffee Break		
Presider: Chao Zhang, University of Wollongong, Australia			
11:00-11:30	*Detection of terahertz waves by photoconductive antenna array* **Wei Shi**, Xi'an University of Technology, China	I	***p173***
11:30-12:00	*Ultrabroadband and sensitive photodetection from ultraviolet to terahertz by improved thermoelectric materials* **Yingxin Wang**, Tsinghua University, China	I	***p173***
12:00-13:30	Lunch Break		
Presider: Wei Shi, Xi'an University of Technology, China			
13:30-14:00	*All-dielectric subwavelength terahertz systems* **Weili Zhang**, Oklahoma State University, USA	I	***p174***
14:00-14:30	*Recipe for efficient EO sampling of THz waves* **Masahiko Tani**, University of Fukui, Japan	I	***p174***
14:30-15:00	*Structured silicon based spatial terahertz modulator* **Qiye Wen**, University of Electronic Science and Technology of China, China	I	***p175***
15:00-15:15	CIOP2019-2019-000253 *Circularly polarized terahertz generation in spintronic terahertz emitters* **Xinhou Chen**, Beihang University, China	O	***p181***
15:15-15:30	CIOP2019-2019-000407 *Rapid and label-free detection of pathogenic bacteria by terahertz metamaterials* **Ke Yang**, Third Military Medical University, China	O	***p181***
15:30-17:30	Poster Session & Coffee Break, 1F		

August 9			
Presider: Wenhui Fan, Xi'an Institute of Optics and Precision Mechanics, CAS, China			
08:30-09:00	*Terahertz quantum cascade laser and its applications* **Juncheng Cao**, Shanghai Institute of Microsystem and Information Technology, CAS, China	I	***p176***
09:00-09:30	*Chiral broadband terahertz wave emission from the Weyl semimetals* **Jingbo Qi**, University of Electronic Science and Technology of China, China	I	***p176***
09:30-10:00	*Spin order based THz wave generation and spectroscopy* **Guohong Ma**, Shanghai University, China	I	***p177***
10:00-10:15	CIOP2019-2019-000263 *Pump wavelength dependent terahertz emission in ferromagnetic metal/heavy metal heterostructures* **Fengwei Guo**, Beihang University, China	O	***p182***
10:15-10:30	CIOP2019-2019-000298 *Research on terahertz image denoising using quadtree-based non-local means* **Yue Wang**, Harbin Institute of Technology, China	O	***p182***
10:30-11:00	Coffee Break		
Presider: Qijie Wang, Nanyang Technological University, Singapore			
11:00-11:30	*Research on multifunctional and high performance sensor based on THz metamaterials* **Xu Chen**, Xi'an Institute of Optics and Precision Mechanics, CAS, China	I	***p177***
11:30-12:00	*High speed THz on-chip modulator with the active meta unit-cell* **Yaxin Zhang**, University of Electronic Science and Technology of China, China	I	***p178***
12:00-13:30	Lunch Break		
Presider: Qiye Wen, University of Electronic Science and Technology of China, China			
13:30-14:00	*Continuous-wave terahertz computed tomography* **Dayong Wang**, Beijing Institute of Technology, China	I	***p178***
14:00-14:30	*Generation and characterization of terahertz special beams* **Xinke Wang**, Capital Normal University, China	I	***p179***
14:30-15:00	*Terahertz read-only multi order nonvolatile rewritable photo-memory based on indium oxide nanoparticles* **Bo Zhang**, Capital Normal University, China	I	***p180***
15:00-15:15	CIOP2019-2019-000267 *All-dielectric metasurface THz absorbers and sensor applications* **Dongying Zhu**, Xi’an University of Technology & Harbin University of Science and Technology, China	O	***p182***
15:15-15:30	CIOP2019-2019-000161 *Resolving terahertz generation inhomogeneity in electro-optic bulk ZnTe crystal using laser terahertz emission microscope* **Yadong Xu**, Northwestern Polytechnical University, China	O	***p182***
15:30-15:45	CIOP2019-2019-000289 *Terahertz absorber based on graphene coating* **Panpan Ren**, Lanzhou University, China	O	***p182***
15:30-16:00	Coffee Break		

SC11 Optical Imaging, Display, and Storage

Baoli Yao, Xi'an Institute of Optics and Precision Mechanics, CAS, China (Chair)
Toyohiko Yatagai, Utsunomiya University, Japan (Chair)
Keisuke Goda, University of Tokyo, Japan & Wuhan University, China (Co-Chair)
Jinyang Liang, INRS, Canada (Co-Chair)
Changhuei Yang, California Institute of Technology, USA (Co-Chair)
Liangcai Cao, Tsinghua University, China
Jianglei Di, Northwestern Polytechnical University, China
Xiangping Li, Jinan University, China
Xinzhu Sang, Beijing University of Posts and Telecommunications, China
Xiaodi Tan, Fujian Normal University, China

Location: 2F, Paris, Convention Centre

August 7			
Presider: Baoli Yao, Xi'an Institute of Optics and Precision Mechanics, CAS, China			
13:30-14:00	*Time reversal optical focusing for deep tissue imaging* **Changhuei Yang**, California Institute of Technology, USA	I	***p183***
14:00-14:30	*Computational imaging for 3D microscopy and tissue imaging* **Guillem Carles**, University of Glasgow, UK	I	***p183***
14:30-15:00	*Compressed ultrafast photography: imaging light-speed events in a snapshot* **Jinyang Liang**, INRS, Canada	I	***p184***
15:00-15:15	CIOP2019-2019-000031 *Effect of recording location on phase-shifting radial-shearing digital holography* **You Li**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	O	***p195***
15:15-15:30	CIOP2019-2019-000047 *Motion estimation and quality enhancement for a single image in dynamic single-pixel imaging* **Shuming Jiao**, Shenzhen University, China	O	***p195***
15:30-16:00	Coffee Break		
Presider: Jinyang Liang, INRS, Canada			
16:00-16:30	*Ultrafast 3-D nanofabrication based on digital holography* **Shih-Chi Chen**, The Chinese University of Hong Kong, Hong Kong, China	I	***p185***
16:30-17:00	*Configuring superfluid Bose-Einstein condensates with sculptured light* **Tyler Neely**, University of Queensland, Australia	I	***p185***
17:00-17:15	CIOP2019-2019-000063 *Ultrafast X-ray detector with resolution of 4 ps and spatial resolution of 100 μm* **Houzhi Cai**, Shenzhen University, China	O	***p195***
17:15-17:30	CIOP2019-2019-000079 *Watermarking structured light patterns for one-shot, complete 3D scanning* **Xuanli Chen**, KU Leuven, Belgium	O	***p195***
17:30-17:45	CIOP2019-2019-000386 *Single photon counting 3D imaging implemented under signal-to-noise ratio less than one* **Yan Kang**, Xi'an Institute of Optics and Precision Mechanics, CAS, China	O	***p195***

August 8			
Presider: Jianglei Di, Northwestern Polytechnical University, China			
08:30-09:00	*Super-resolution: better, deeper, and richer information* **Peng Xi**, Peking University, China	I	***p186***
09:00-09:30	*Metalens-based integrated imaging* **Tao Li**, Nanjing University, China	I	***p187***
09:30-10:00	*Spatial-spectral volume holographic bioimaging* **Yuan Luo**, National Taiwan University, Taiwan, China	I	***p187***
10:00-10:15	CIOP2019-2019-000097 *Complex object retrieval through scattering media with a large field of view* **Meiling Zhou**, Xi'an Institute of Optics and Precision Mechanics, CAS, China	O	***p195***
10:15-10:30	CIOP2019-2019-000171 *All-fiber reflection-based scattering NSOM with low phase drift for nanophotonic waveguide characterization* **Yizhi Sun**, Jinan University & Institute of Physics, CAS, China	O	***p196***
10:30-11:00	Coffee Break		
Presider: Changhuei Yang, California Institute of Technology, USA			
11:00-11:30	*FACED: High-speed, multi-contrast and multi-dimensional microscopy with infinity mirrors* **Kevin Tsia**, The University of Hong Kong, Hong Kong, China	I	***p188***
11:30-12:00	*Multi-modality imaging and spectroscopy platform for biology* **Peng Gao**, Xidian University, China	I	***p189***
12:00-13:30	Lunch Break		
Presider: Xiangping Li, Jinan University, China			
13:30-14:00	*Fast fringe projection profilometry with a special gray-code* **Kemao Qian**, Nanyang Technological University, Singapore	I	***p190***
14:00-14:30	*Time-stretch imaging: advances and trends in biomedical applications* **Cheng Lei**, Wuhan University, China	I	***p190***
14:30-15:00	*High performance meta-holograms based on geometric phase in visible light* **Guoxing Zheng**, Wuhan University, China	I	***p191***
15:00-15:15	CIOP2019-2019-000310 *Two-angle illumination compressive holography* **Hua Zhang**, Tsinghua University, China	O	***p196***
15:15-15:30	CIOP2019-2019-000299 *Study of technology on spectral polarization imaging* **Yang Liu**, Changchun University of Science and Technology, China	O	***p196***
15:30-17:30	Poster Session & Coffee Break, 8F		

August 9			
Presider: Kemao Qian, Nanyang Technological University, Singapore			
08:30-09:00	*Metasurfaces: towards high performance depth sensing* **Yuanmu Yang**, Tsinghua University, China	Ⓘ	***p191***
09:00-09:30	*Adaptive optics methods in a 4pi single molecule switching microscope* **Jingyu Wang**, University of Oxford, UK	Ⓘ	***p192***
09:30-10:00	*Towards smarter and faster quantitative phase microscopy* **Renjie Zhou**, The Chinese University of Hong Kong, Hong Kong, China	Ⓘ	***p193***
10:00-10:15	CIOP2019-2019-000258 *Compact auto-stereoscopic display based on directional back-light using side-glowing polymer optical fiber array* **Yong He**, Huaqiao University, China	Ⓞ	***p196***
10:15-10:30	CIOP2019-2019-000545 *Imaging of a moving object with ghost imaging using intensity difference correlation* **Shuai Sun**, National University of Defense Technology, China	Ⓞ	***p196***
10:30-11:00	Coffee Break		
Presider: Jingyu Wang, University of Oxford, UK			
11:00-11:30	*Optical focusing through and inside scattering media* **Yuecheng Shen**, Sun Yat-sen University, China	Ⓘ	***p193***
11:30-12:00	*Image-activated cell sorting and beyond* **Keisuke Goda**, University of Tokyo, Japan	Ⓘ	***p194***
12:00-12:15	CIOP2019-2019-000507 *High-speed light focusing through multimode fiber for spot-scanning imaging* **Hui Chen**, Xi'an Institute of Optics and Precision Mechanics, CAS, China	Ⓞ	***p196***

SC12 Optical Communications and Networks

Ming Tang, Huazhong University of Science and Technology, China (Chair)
Xiaoping Xie, Xi'an Institute of Optics and Precision Mechanics, CAS, China (Co-Chair)
Xiangjun Xin, Beijing University of Posts and Telecommunications, China (Co-Chair)
Changyuan Yu, The Hong Kong Polytechnic University, Hong Kong, China (Co-Chair)
Lei Deng, Huazhong University of Science and Technology, China
Liang Dou, Alibaba, China
Haibo Ge, Xi'an University of Posts & Telecommunications, China
Lei Guo, Chongqing University of Posts and Communications, China
Ke Xu, Harbin Institute of Technology, Shenzhen, China
Xiang Li, China Information Communication Technologies Group Corporation, China
Bo Liu, Nanjing University of Information Science and Technology, China
Xingwen Yi, Sun Yat-sen University, China
Fan Zhang, Peking University, China
Jian Zhao, South China University of Technology, China
Yongli Zhao, Beijing University of Posts and Telecommunications, China
Qunbi Zhuge, Shanghai Jiao Tong University, China

Location: 2F, Lyon, Convention Centre

August 7			
Presider: Ming Tang, Huazhong University of Science and Technology, China			
13:30-14:15	*Optical performance monitor by digital signal processing* **Zhenning Tao**, Fujitsu, China	T	***p197***
14:15-14:45	*Chaotic encryption schemes for secure OFDM-PONs* **Chun-Kit Chan**, The Chinese University of Hong Kong, Hong Kong, China	I	***p197***
14:45-15:15	*Machine-learning for low-margin dynamic optical networks* **Shuangyi Yan**, University of Bristol, UK	I	***p198***
15:15-15:30	CIOP2019-2019-000030 *Laser communication for air and space applications - system engineering considerations* **Markus Knapek**, Mynaric, Germany	O	***p208***
15:30-16:00	Coffee Break		
Presider: Chun-Kit Chan, The Chinese University of Hong Kong, Hong Kong, China			
16:00-16:30	*Indoor near-infrared optical wireless communications with spatial diversity* **Ke Wang**, RMIT, Australia	I	***p199***
16:30-17:00	*A novel microwave photonics RF front-end with integrated OEO-based down convertor and self-Interference cancellation* **Lei Deng**, Huazhong University of Science and Technology, China	I	***p199***
17:00-17:15	CIOP2019-2019-000132 *SDM-WDM-Based multiple objects visible light positioning by using conventional monitoring system* **Can Shi**, Beijing University of Posts and Telecommunications, China	O	***p208***
17:15-17:30	CIOP2019-2019-000144 *Novel routing, spectrum and module allocation for maximizing fiber switching in software-defined AoD optical networks* **Xiaoxue Gong**, Chongqing University of Posts and Telecommunications, China	O	***p208***

August 8			
Presider: Jian Zhao, South China University of Technology, China			
09:00-09:30	*Zone-based cooperative content caching and delivery for radio access network with mobile edge computing* **Gangxiang Shen**, Soochow University, China	Ⓘ	***p200***
09:30-10:00	*Overloading 5G/IoT fronthaul networks: from principle to hardware implementation* **Paikun Zhu**, The Graduate School for the Creation of New Photonics Industries (GPI), Japan	Ⓘ	***p201***
10:00-10:30	*Application of artificial intelligence in performance monitoring of optical networks* **Xin Li**, Beijing University of Posts and Telecommunications, China	Ⓘ	***p201***
10:30-11:00	Coffee Break		
Presider: Xiaoping Xie, Xi'an Institute of Optics and Precision Mechanics, CAS, China			
11:00-11:30	*High-precision large-scale network time synchronization and its applications in optical networks* **Nan Hua**, Tsinghua University, China	Ⓘ	***p202***
11:30-11:45	CIOP2019-2019-000184 *Adaptive routing strategy based on deep neural network for datacenter interconnection* **Jiang Tao**, Huazhong University of Science and Technology & Fiberhome Telecommunication Technologies Co., China	Ⓞ	***p208***
11:45-12:00	CIOP2019-2019-000188 *Performance enhancement of EDFA based scintillation mitigation using Manchester OOK and HPF in free space optical communication* **Yan-Qing Hong**, Yonsei University, South Korea	Ⓞ	***p208***
12:00-13:30	Lunch Break		
Presider: Lei Deng, Huazhong University of Science and Technology, China			
13:30-14:00	*Advanced modulation formats for beyond 100G datacenter optical interconnects* **Fan Li**, Sun Yat-sen University, China	Ⓘ	***p202***
14:00-14:30	*Channel compensation in optical offset-QAM OFDM systems* **Jian Zhao**, South China University of Technology, China	Ⓘ	***p203***
14:30-15:00	*Carrier-to-signal power ratio measurement techniques for optical single-sideband transmission system* **Tianwai Bo**, Korea Advanced Institute of Science and Technology, South Korea	Ⓘ	***p204***
15:00-15:15	CIOP2019-2019-000189 *Interference mitigation of received multiple mobile optical signals in optical camera communication* **Sung-Jin Kim**, Yonsei University, South Korea	Ⓞ	***p208***
15:15-15:30	CIOP2019-2019-000295 *High reliability transmission system in mobile fronthaul using a maximal ratio combined receiver with direct and lite-coherent detections* **Jun Qin**, Peking University, China	Ⓞ	***p209***
15:30-17:30	Poster Session & Coffee Break, 8F		

August 9		
Presider: Tianwai Bo, Korea Advanced Institute of Science and Technology, South Korea		
09:00-09:30	*The key technologies for both digital and analog radio-over-fiber based next generation mobile fronthaul* **Haibo Li**, China Information Communication Technologies Group Corporation, China	I ***p204***
09:30-10:00	*Dynamical adjustment of lamp mounting plan to minimize dead zone in indoor visible light communication* **Jian Chen**, Nanjing University of Posts and Telecommunications, China	I ***p205***
10:00-10:15	CIOP2019-2019-000204 *Fading mitigation using a single subcarrier time delay diversity in satellite optical communications* **Jae-young Choi**, Yonsei University, South Korea	O ***p209***
10:15-10:30	CIOP2019-2019-000286 *Research on optimal persistent formation algorithm of wireless ultraviolet collaboration UAV* **Taifei Zhao**, Xi'an University of Technology, China	O ***p209***
10:30-11:00	Coffee Break	
Presider: Haibo Li, China Information Communication Technologies Group Corporation, China		
11:00-11:30	*Experimental progress in single-photon quantum key distribution* **Shuang Wang**, University of Science and Technology of China, China	I ***p206***
11:30-11:45	CIOP2019-2019-000287 *Bee colony drone formation ultraviolet non-ranging positioning method* **Peng Gao**, Xi'an University of Technology, China	O ***p209***
11:45-12:00	CIOP2019-2019-000265 *Study of the modulating efficiency of white LED with different rated powers* **Suzhen Song**, Shanghai Polytech University, China	O ***p209***
12:00-13:30	Lunch Break	
Presider: Ke Wang, RMIT, Australia		
13:30-14:00	*High capacity transmission system towards 100Tb/s* **Yi Yu**, Huawei, China	I ***p206***
14:00-14:30	*The application of machine learning in optical fiber communication* **Jing Zhang**, University of Electronic Science and Technology of China, China	I ***p207***
14:30-14:45	CIOP2019-2019-000293 *Research on light-flux fluctuations reciprocity of bidirectional atmospheric laser transmission channel* **Yi Liu**, Changchun University of Science and Technology, China	O ***p209***
15:30-16:00	Coffee Break	

Agendas

SC13 Optical Fiber and Waveguide Technologies

Yuwen Qin, Guangdong University of Technology, China (Chair)
Zhaohui Li, Sun Yat-sen University, China (Co-Chair)
Guangming Tao, Huazhong University of Science and Technology, China (Co-Chair)
Xiangjun Xin, Beijing University of Posts and Telecommunications, China (Co-Chair)
Duk-Yong Choi, The Australian National University, Australia; Jinan University, China
Weiqing Gao, HeFei University of Technology, China
Pengyu Guan, Technical University of Denmark, Denmark
Xin Jiang, Max Planck Institute for the Science of Light, Germany
Yange Liu, Nankai University, China
Ruichun Wang, Yangtze Optical Fibre and Cable Co., Ltd., China
Yingying Wang, Beijing University of Technology, China
Shuangyi Yan, University of Bristol, UK
Guiyao Zhou, South China Normal University, China
Kui Li, Beihang University, China

Location: 2F, Bordeaux, Convention Centre

August 7			
Presider: Yuwen Qin, Guangdong University of Technology, China			
13:30-14:00	*Hybrid integration of chalcogenides on silicon-based materials* **Duk-Yong Choi**, The Australian National University, Australia & Jinan University, China	I	***p210***
14:00-14:30	*Properties and manipulation of hollow-core photonic crystal fibres for ultrafast nonlinear optics* **Francesco Tani**, Max Planck Institute for the Science of Light, Germany	I	***p210***
14:30-15:00	*Stimulated Raman scattering in gases-filled hollow-core fibers* **Zefeng Wang**, National University of Defense Technology, China	I	***p211***
15:00-15:15	CIOP2019-2019-000283 *Q-switched Erbium-doped fiber laser incorporating a hybrid plasmonic microfiber knot resonator* **Bingbing Lu**, Shanghai University, China	O	***p223***
15:15-15:30	CIOP2019-2019-000317 *Ionization-induced adiabatic soliton compression in gas-filled photonic crystal fibers* **Zhiyuan Huang**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	O	***p223***
15:30-16:00	Coffee Break		
Presider: Duk-Yong Choi, The Australian National University, Australia & Jinan University, China			
16:00-16:30	*Gas detection with fiber-enhanced stimulated Raman spectroscopy* **Wei Jin**, The Hong Kong Polytechnic University, Hong Kong, China	I	***p212***
16:30-17:00	*Time-Lens based signal processing for optical communications* **Pengyu Guan**, Technical University of Denmark, Denmark	I	***p212***
17:00-17:15	CIOP2019-2019-000303 *The study of broadband OAM mode converter based on helical long period fiber grating in dispersion turning point* **Kaili Ren**, Xi'an University of Posts and Telecommunications, China	O	***p223***
17:15-17:30	CIOP2019-2019-000175 *Ultra-low-modal-crosstalk double-ring-core FMF for weakly-coupled MDM transmission* **Lei Shen**, Yangtze Optical Fibre and Cable Joint Stock Limited Company, China	O	***p223***

August 8			
Presider: Guangming Tao, Huazhong University of Science and Technology, China			
09:00-09:30	*Recent advances in soft-glass/polymer microstructured fibres* **Xin Jiang**, Max Planck Institute for the Science of Light, Germany	I	***p213***
09:30-10:00	*Ultralow loss hollow-core anti-resonant fiber* **Wei Ding**, Jinan University, China	I	***p214***
10:00-10:15	CIOP2019-2019-000216 *Investigation of whispering gallery modes in a liquid-filled hollow glass microsphere* **Bojian Shi**, Harbin Institute of Technology, China	O	***p223***
10:15-10:30	CIOP2019-2019-000306 *The cabling and splicing performance of terrestrial G.654.E Fiber* **Peng Li**, Yangtze Optical Fibre and Cable Joint Stock Limited Company, China	O	***p223***
10:30-11:00	Coffee Break		
Presider: Xin Jiang, Max Planck Institute for the Science of Light, Germany			
11:00-11:30	*The linewidth enhancement factor of multimode VCSELs and its impact in multimode fiber links* **Adrian A. Juarez**, Corning Research and Development Corporation, USA	I	***p214***
11:30-12:00	*Advanced optoelectronic and electronic multi-material fiber devices* **Wei Yan**, Massachusetts Institute of Technology, USA	I	***p215***
12:00-13:30	Lunch Break		
Presider: Adrian A. Juarez, Corning Research and Development Corporation, USA			
13:30-14:00	*Highly efficient in-fibre diffraction grating for fiber and free-space interface* **Chao Wang**, University of Kent, UK	I	***p216***
14:00-14:30	*Large nonlinear optical amplification in gases: from sensing to lasing* **Fan Yang**, EPFL, Switzerland	I	***p216***
14:30-15:00	*Large-mode-area single-mode Yb^{3+} doped fiber for high power fiber laser* **Jinyan Li**, Huazhong University of Science and Technology, China	I	***p217***
15:00-15:15	CIOP2019-2019-000064 *A novel chalcohalide glass fiber with high nonlinearity but low material zero-dispersion via extrusion* **Zheming Zhao**, Jiaxing University, China	O	***p224***
15:15-15:30	CIOP2019-2019-000208 *Theoretical investigation of the fast light at double Brillouin gain lines in an optical fiber* **Wenhao Guo**, Lanzhou University of Technology, China	O	***p224***
15:30-17:30	Poster Session & Coffee Break		

August 9

Presider: Ping Lu, Huazhong University of Science and Technology, China			
09:00-09:30	*Preparation and application of Yb: YAG crystal derived silica fibers* **Zhaojun Liu**, Shandong University, China	I	***p217***
09:30-10:00	*New approaches of producing multi-materials, multi-functional fibers—a play around viscosity* **Chong Hou**, Huazhong University of Science and Technology, China	I	***p218***
10:00-10:30	*Distributed fiber-optic acoustic sensing for petroleum geology exploration* **Jiasheng Ni**, Shandong Province Key Laboratory of Optical Fiber Sensing Technology, China	I	***p219***
10:30-11:00	Coffee Break		
Presider: Xian Zhao, Shandong University, China			
11:00-11:30	*Optical microcavity acoustic sensor technology* **Ping Lu**, Huazhong University of Science and Technology, China	I	***p219***
11:30-12:00	*Fading elimination in Φ-OTDR with coherent detection* **Zinan Wang**, University of Electronic Science and Technology of China, China	I	***p220***
12:00-13:30	Lunch Break		
Presider: Hua Lu, Northwestern Polytechnical University, China			
13:30-14:00	*Nanocrystal-doped glass and fibers for enhanced laser output* **Guoping Dong**, South China University of Technology, China	I	***p220***
14:00-14:30	*Realization of 6 kW single mode fiber laser with LD pumping and high SRS suppression* **Shaofeng Guo**, Hunan DK Laser Co., Ltd, China	I	***p221***
14:30-15:00	*Development of ultra-fine-diameter polarization-maintaining fiber and its potential application in miniaturized fiber optic gyroscope* **Zhenggang Lian**, Yangtze Optical Electronic Co. Ltd., China	I	***p221***
15:00-15:15	CIOP2019-2019-000192 *Ultrasensitive elliptic microfiber based Sagnac interferometer operating at group birefringence turning point* **Zihao Yuan**, Jinan University, China	O	***p224***
15:15-15:30	CIOP2019-2019-000020 *Researches on phase mask method-based phase-shifted fiber grating fabrication and sensing properties* **Danqing Yang**, Xi'an Shiyou University, China	O	***p224***
15:30-16:00	Coffee Break		

SC14 Biophotonics and Optofluidics

Junle Qu, Shenzhen University, China (Chair)
Ho-Pui HO, The Chinese University of Hong Kong, Hong Kong, China (Co-Chair)
Zhen Yuan, University of Macau, Macau, China (Co-Chair)
Ling Fu, Huazhong University of Science and Technology, China
Ming Lei, Xi'an Institute of Optics and Precision Mechanics, CAS, China
Liwei Liu, Shenzhen University, China
Timothy Tan, Nanyang Technological University, Singapore
Changfeng Wu, Southern University of Science and Technology, China
Sihua Yang, South China Normal University, China

Location: 2F, Nice, Convention Centre

August 7			
Presider: Junle Qu, Shenzhen University, China			
13:30-14:15	*Advances in integrated multimodality intravascular imaging for assessing and characterizing atherosclerotic plaques* **Zhongping Chen**, University of California, Irvine, USA	T	***p225***
14:15-14:45	*Nucleic acid based bioassays with active centrifugal microfluidics* **Ho-Pui HO**, The Chinese University of Hong Kong, Hong Kong, China	I	***p225***
14:45-15:15	*Deep-learning assisted stimulated Raman histology* **Minbiao Ji**, Fudan University, China	I	***p226***
15:15-15:30	CIOP2019-2019-000006 *Cytobiology and histopathology studies via confocal Raman spectral imaging* **Shuang Wang**, Northwest University, China	O	***p240***
15:30-16:00	Coffee Break		
Presider: Timothy Tan, Nanyang Technological University, Singapore			
16:00-16:30	*Biomedical photonics: from imaging to theranostic applications* **Junle Qu**, Shenzhen University, China	I	***p227***
16:30-17:00	*High speed two-photon Bessel light-sheet microscope for neural imaging* **Jun Ding**, Stanford University, USA	I	***p227***
17:00-17:15	CIOP2019-2019-000052 *Optimized detector angle for improving signal-to-noise ratio of pinhole X-ray fluorescence computed tomography* **Jing Guo**, Chongqing University, China	O	***p240***
17:15-17:30	CIOP2019-2019-000081 *Analysis of negativity artifacts in back-projection based photoacoustic tomography* **Kang Shen**, University of Science and Technology of China, China	O	***p240***

August 8

Presider: Ho-Pui HO, The Chinese University of Hong Kong, Hong Kong, China			
08:30-09:15	*Near-Infrared organic semiconducting optical platform for Theranostic Application* **Quli Fan**, Nanjing University of Posts & Telecommunications, China	T	***p228***
09:15-09:45	*Turning the tide on upconversion cross-relaxation via energy transition engineering* **Timothy Tan**, Nanyang Technological University, Singapore	I	***p229***
09:45-10:15	*Emerging two-dimensional monoelemental materials (Xenes) for biophotoincs applications* **Han Zhang**, Shenzhen University, China	I	***p229***
10:15-10:30	CIOP2019-2019-000069 *Research on zoom Prism-Coupled OI-RD system* **Bilin Ge**, Fudan University, China	O	***p240***
10:30-11:00	Coffee Break		
Presider: Zhen Yuan, University of Macau, Macao, China			
11:00-11:30	*Deep brain Calcium recording in behaving mice* **Ling Fu**, Huazhong University of Science and Technology, China	I	***p230***
11:30-12:00	*Multiscale molecular dynamics using plasmonic nanoaperture arrays* **Donghyun Kim**, Yonsei University, South Korea	I	***p231***
12:00-13:30	Lunch Break		
Presider: Ling Fu, Huazhong University of Science and Technology, China			
13:30-14:00	*Optical mapping of brain activation and connectivity: from cognition, psychiatric disorders to neurological disorders* **Zhen Yuan**, University of Macau, Macao, China	I	***p232***
14:00-14:30	*Noninvasive monitoring of nanoparticle clearance and aggregation in blood circulation by in vivo flow cytometry* **Xunbin Wei**, Shanghai Jiao Tong University, China	I	***p232***
14:30-15:00	*Photoacoustic imaging technology and clinical translation* **Sihua Yang**, South China Normal University, China	I	***p233***
15:00-15:15	CIOP2019-2019-000516 *Generating new cross relaxation pathways by coating prussian blue on NaNdF4 to fabricate enhanced photothermal agents* **Zhongzheng Yu**, Nanyang Technological University, Singapore	O	***p240***
15:15-15:30	CIOP2019-2019-000121 *On-disc ratio-adjustable droplet fusion for solution-based material synthesis* **Yuye Wang**, The Chinese University of Hong Kong, Hong Kong, China	O	***p240***
15:30-17:30	Poster Session & Coffee Break, 8F		

August 9

Presider: Jun Ding, Stanford University, USA			
08:30-09:00	*FDISCO: advanced solvent-based clearing method for imaging whole organs* **Dan Zhu**, Huazhong University of Science and Technology, China	I	***p233***
09:00-09:30	*Full-color structured illumination optical sectioning microscopy* **Ming Lei**, Xi'an Institute of Optics and Precision Mechanics, CAS & Xi’an Jiaotong University, China	I	***p234***
09:30-10:00	*Multifunctional mesoporous silica nanocarriers* **Wenfei Dong**, Suzhou Institute of Biomedical Engineering and Technology, CAS, China	I	***p235***

10:00-10:30	*Tumor microenvironment monitoring based on optical methods* **Liwei Liu**, Shenzhen University, China	Ⓘ	***p235***
10:30-11:00	Coffee Break		
Presider: Ming Lei, Xi'an Institute of Optics and Precision Mechanics, CAS, China			
11:00-11:30	*Multiscale photoacoustic microscopy* **Lei Xi**, Southern University of Science and Technology, China	Ⓘ	***p236***
11:30-11:45	CIOP2019-2019-000228 *Optofluidic laser sensor for Copper ion detection* **Zhen Sun**, Jinan University, China	Ⓞ	***p241***
11:45-12:00	CIOP2019-2019-000259 *Co-encapsulating photosensitizers and biomedical imaging regents in nanoliposomes for bioimaging guided photodynamic therapy of cancer* **Hao Xu**, Shenzhen Universtiy, China	Ⓞ	***p241***
12:00-13:30	Lunch Break		
Presider: Sihua Yang, South China Normal University, China			
13:30-14:00	*New upconversion nanoparticles for fluorescence based bioassays and bioimaging* **Yong Zhang**, National University of Singapore, Singapore	Ⓘ	***p236***
14:00-14:30	*Biomedical photoacoustic tomography and microscopy: from technology to applications* **Chao Tian**, University of Science and Technology of China, China	Ⓘ	***p237***
14:30-15:00	*Near infrared emitting nanoformulations for optical bioimaging and imaging guided drug delivery* **Tymish Y. Ohulchanskyy**, Shenzhen University, China	Ⓘ	***p237***
15:00-15:15	CIOP2019-2019-000403 *A multi-functional platform for single cell manipulation, lysis and detection using optothermal effect* **Yuanyuan Wei**, The Chinese University of Hong Kong, Hong Kong, China	Ⓞ	***p241***
15:15-15:30	CIOP2019-2019-000060 *Ease of photodynamic therapy resistance of cancer with Bcl-2 inhibitor uploaded upconversion nanophotosdensitizers* **Xiaomin Liu**, Jilin university, China	Ⓞ	***p241***
15:30-16:00	Coffee Break		
Presider: Tymish Y. Ohulchanskyy, Shenzhen University, China			
16:00-16:30	*Extracting molecular and vascular information with multi-scale photoacoustic imaging* **Chengbo Liu**, Shenzhen Institutes of Advanced Technology, CAS, China	Ⓘ	***p238***
16:30-17:00	*Near Infrared-Optogenetic Manipulation of the C. elegans Motor Circuit by Upconversion Nanoparticles* **Yan Zhang**, Huazhong University of Science and Technology, China	Ⓘ	***p239***
17:00-17:15	CIOP2019-2019-000527 *An immunoturbidimetric assay for specific proteins identification from whole blood based on multi-layered centrifugal microfluidic chip* **Jiachen Yang**, Nanjing University, China	Ⓞ	***p241***

SC15 Optical Sensors and Systems

Wei Jin, The Hong Kong Polytechnic University, Hong Kong, China (Chair)
Zuyuan He, Shanghai Jiao Tong University, China (Co-Chair)
Kazuo Hotate, Toyota Technological Institute, Japan (Co-Chair)
Ju Han Lee, University of Seoul, South Korea
Qingwen Liu, Shanghai Jiao Tong University, China
Huilian Ma, Zhejiang University, China
Xinyu Fan, Shanghai Jiao Tong University, China
Wei Ren, The Chinese University of Hong Kong, Hong Kong, China
Liyang Shao, Southern University of Science and Technology, China
Kwang-Yong Song, Chung-Ang University, South Korea
Chao Wang, Wuhan University, China
Lei Wei, Nanyang Technological University, Singapore

Location: 3F, Grand Ballroom II, Convention Centre

August 7			
Presider: Wei Jin, The Hong Kong Polytechnic University, Hong Kong, China			
13:30-14:15	*Few mode fiber & fiber laser sensors* **Byoung Yoon Kim**, KAIST, South Korea	T	***p242***
14:15-14:45	*Real time interrogation of identical weak FBG array sensors* **Chang-Seok Kim**, Pusan National University, South Korea	I	***p242***
14:45-15:15	*Off-axis fiber optic interferometry for nanoscale resolution* **Nan-Kuang Chen**, Liaocheng University, China	I	***p243***
15:15-15:30	CIOP2019-2019-000529 *Mapping dynamical magnetic responses of ultra-thin micron-size superconducting films using nitrogen-vacancy centers in diamond* **Ying Xu**, Fudan University, China	O	***p252***
15:30-16:00	Coffee Break		
Presider: Byoung Yoon Kim, KAIST, South Korea			
16:00-16:30	*Rotation measurements with a passive resonant gyroscope based on hollow-core Kagome fiber* **Fabien Bretenaker**, Laboratoire Aimé Cotton, France	I	***p243***
16:30-17:00	*Distributed acoustic sensing system based on ultra-weak fiber Bragg grating array* **Minghong Yang**, Wuhan University of Technology, China	I	***p244***
17:00-17:15	CIOP2019-2019-000311 *Perimeter monitoring of urban buried pipeline subject to third-party intrusion based on fiber optic sensing and convolutional neural network* **Renzhu Peng**, Tongji University, China	O	***p252***
17:15-17:30	CIOP2019-2019-000178 *Broadband cavity-enhanced spectroscopic multigas sensor using a 1650 nm light emitting diode* **Chuantao Zheng**, Jilin University, China	O	***p252***

August 8			
Presider: Yosuke Mizuno, Tokyo Institute of Technology, Japan			
08:30-09:00	*Optical fibre sensing revised: past present and future* **Gilberto Brambilla**, University of Southampton, UK	I	***p245***
09:00-09:30	*Development of polymer coating on optical fiber for sensing applications* **Chan Chi Chiu**, Shenzhen Technology University, China	I	***p245***
09:30-10:00	*Chaotic brillouin optical correlation domain analysis* **Mingjiang Zhang**, Taiyuan University of Technology, China	I	***p246***
10:00-10:15	CIOP2019-2019-000227 *Static strain sensing with temperature-effect compensated by dual-comb spectroscopy with FBG sensors* **Ruixue Zhang**, Tsinghua University	O	***p252***
10:15-10:30	CIOP2019-2019-000224 *Simultaneous measurement of strain and torsion based on a seven-core fiber mach-zehnder interferometer* **Fan Zhang**, Guangxi Normal University, China	O	***p252***
10:30-11:00	Coffee Break		
Presider: Fabien Bretenaker, Laboratoire Aimé Cotton, France			
11:00-11:30	*Fastest-ever distributed Brillouin sensing using glass and plastic optical fibers* **Yosuke Mizuno**, Tokyo Institute of Technology, Japan	I	***p247***
11:30-12:00	*Sensors and devices based on suspended-core fibers and photonic microcells* **Chao Wang**, Wuhan University, China	I	***p247***
12:00-12:15	CIOP2019-2019-000281 *Detection of prostate specific antigen using arc-induced long-period microfiber gratings* **Peng Xiao**, Jinan University, China	O	***p252***
12:00-13:30	Lunch Break		
Presider: Chao Wang, Wuhan University, China			
13:30-14:00	*Suppression of systematic errors in optical correlation-domain distributed Brillouin sensors* **Kwang-Yong Song**, Chung-Ang University, South Korea	I	***p248***
14:00-14:30	*Infrared photoacoustic and photothermal trace gas detection* **Wei Ren**, The Chinese University of Hong Kong, Hong Kong, China	I	***p249***
14:30-15:00	*Embedded optical micro/nanofibers and related applications* **Lei Zhang**, Zhejiang University, China	I	***p249***
15:00-15:15	CIOP2019-2019-000285 *Fiber optic surface plasmon resonance technology for detection mercury Ion* **Huizhen Yuan**, Dalian University of Technology, China	O	***p253***
15:15-15:30	CIOP2019-2019-000019 *Light addressable potentiometric sensor phase rapid detection method based on orthogonal detection* **Xiaoguang Yan**, Xi'an University of Posts and Telecommunications, China	O	***p253***
15:30-17:30	Poster Session & Coffee Break		

August 9		
Presider: Zuyuan He, Shanghai Jiao Tong University, China		
08:30-09:00	I *Fiber optic nerve systems based on brillouin optical correlation domain technologies - from basic principle to recent achievement* **Kazuo Hotate**, Toyota Technological Institute, Japan	***p250***
09:00-09:30	I *Monitoring on tendon force distribution in prestressed structures by brillouin-based optical fiber sensor* **Michio Imai**, Kajima Technical Research Institute, Japan	***p250***
09:30-10:00	I *Improvement of signal processing of passive resonant fiber optic gyroscope* **Huilian Ma**, Zhejiang University, China	***p251***
10:00-10:15	O CIOP2019-2019-000377 *Design and detection experiment of a portable platelet aggregation instrument* **Xiechen Huang**, Shenzhen Institute of Advanced Technology, CAS & China University of Petroleum (Beijing), China	***p253***
10:30-11:00	Coffee Break	

SC16 Atomic Physics, Quantum Photonics, and Quantum Information

Chaoyang Lu, University of Science and Technology of China, China (Chair)
Fuli Li, Xi'an Jiaotong University, China
Xiaolong Su, Shanxi University, China
Lijian Zhang, Nanjing University, China
Wei Zhang, Tsinghua University, China

Location: 1F, Gaoguin, Convention Centre

August 7			
Presider: Chaoyang Lu, University of Science and Technology of China, China			
13:30-14:15	*Atom-Photon quantum interface* **Shengwang Du**, The Hong Kong University of Science and Technology, Hong Kong, China	T	***p254***
14:15-14:45	*Recent progress in the optical studies of single perovskite nanocrystals* **Xiaoyong Wang**, Nanjing University, China	I	***p254***
14:45-15:15	*Recent progress in telecom wavelengths solid-state quantum emitters from InP-based photonic structures* **Mohamed Benyoucef**, Universität Kassel, Germany	I	***p255***
15:15-15:30	CIOP2019-2019-000067 *Multi-bit quantum digital signature based on quantum temporal ghost imaging* **Xin Yao**, Tsinghua University, China	O	***p264***
15:30-16:00	Coffee Break		
Presider: Shengwang Du, The Hong Kong University of Science and Technology, Hong Kong, China			
16:00-16:30	*Experimental test of error-tradeoff uncertainty relation with continuous variables* **Xiaolong Su**, Shanxi University, China	I	***p255***
16:30-17:00	*Experimental investigation of the Einstein-Podolsky-Rosen steering* **Jinshi Xu**, University of Science and Technology of China, China	I	***p256***
17:00-17:15	CIOP2019-2019-000101 *Generation of adjustable biphoton frequency comb and its spatial quantum beating* **Rong Xue**, Tsinghua University, China	O	***p264***
17:15-17:30	CIOP2019-2019-000055 *Quantum photonic justification of refraction for development of atto-second optical switches* **Hassan Kaatuzian**, Amirkabir University of Technology, Iran	O	***p264***

August 8			
Presider: Xue Feng, Tsinghua University, China			
08:30-09:15	*Quantum light source engineering towards "quantum supremacy"* **Chaoyang Lu**, University of Science and Technology of China, China	T	***p256***
09:15-09:45	*Integrated quantum dot single photon sources on Si* **Yasutomo Ota**, University of Tokyo, Japan	I	***p257***
09:45-10:15	*Multiplexed light-matter interface at telecom band based on cryogenically cooled Erbium doped fibre* **Qiang Zhou**, University of Electronic Science and Technology of China, China	I	***p258***
10:15-10:30	CIOP2019-2019-000112 *Single photon detectors based on periodically poled lithium niobate waveguides* **Mingyang Zheng**, Jinan Institute of Quantum Technology, China	O	***p264***

10:30-11:00	Coffee Break		
Presider: Feng Li, Xi'an Jiaotong University, China			
11:00-11:30	*Nanocontrolled quantum dot scanner as quantum light source and near field probe* **Xuewen Chen**, Huazhong University of Science and Technology, China	I	***p258***
11:30-12:00	*Quantifying the mesoscopic nature of the Einstein-Podolsky-Rosen nonlocality* **Qiongyi He**, Peking University, China	I	***p259***
12:00-13:30	Lunch Break		
Presider: Xiaolong Su, Shanxi University, China			
13:30-14:00	*Quantum coherence resource theory and its application* **Guoyong Xiang**, University of Science and Technology of China, China	I	***p259***
14:00-14:30	*Research of ultrahighly-sensitive phodiodes* **Xia Guo**, Beijing University of Posts and Telecommunications, China	I	***p260***
14:30-15:00	*High dimensional linear transformation with quasi-angle states and spatially coherent states* **Xue Feng**, Tsinghua University, China	I	***p260***
15:00-15:30	*Photonic spin-orbit coupling in optical microcavities* **Feng Li**, Xi'an Jiaotong University, China	I	***p261***
15:30-17:30	Poster Session & Coffee Break, 8F		

August 9

Presider: Qiang Zhou, University of Electronic Science and Technology of China, China			
08:45-09:15	*Extreme nonlinear photoemission from carbon nanotubes* **Qing Dai**, National Center for Nanoscience and Technology, China	I	***p262***
09:15-09:45	*Quantum entanglement with photonic orbital angular momentum* **Xilin Wang**, Nanjing University, China	I	***p262***
09:45-10:00	CIOP2019-2019-000159 *Design of single photon spectrum analyzer based on silicon waveguide integrated superconducting nanowire single photon detectors* **Jingyuan Zheng**, Tsinghua University, China	O	***p264***
10:00-10:15	CIOP2019-2019-000240 *Scalable multipartite EPR steering via a quantum frequency Comb* **Yin Cai**, Xi'an Jiaotong University, China	O	***p265***
10:15-10:30	CIOP2019-2019-000294 *On-chip polarization independent quantum interference device* **Feng Yu**, Jilin University, China	O	***p265***
10:30-11:00	Coffee Break		

Best Student Papers Competition

Location: 1F, Pissaro, Convention Centre

August 7		
Presider: Shigehisa Arai, Tokyo Institute of Technology, Japan		
13:30-13:45	CIOP2019-2019-000059 ◎ *Rabi-like oscillation of photonic topological valley Hall edge states* **Hua Zhong**, Xi'an Jiao Tong University	***p266***
13:45-14:00	CIOP2019-2019-000073 ◎ *White beam lasing from a hybrid micro-cavity with slab–capillary mode coupling* **Hailang Dai**, Shanghai Jiao Tong University, China	***p266***
14:00-14:15	CIOP2019-2019-000083 ◎ *Multidimensional quantum linear operations with simple and non-cascaded structure* **Shikang Li**, Tsinghua University, China	***p266***
14:15-14:30	CIOP2019-2019-000108 ◎ *Energy-time entanglement-based dispersive optics quantum key distribution networks* **Xu Liu**, Tsinghua University, China	***p266***
14:30-14:45	CIOP2019-2019-000174 ◎ *Bright-dark pulse pair and soliton bunch generation from mode-locked erbium-doped fiber laser with GIMF-SIMF-GIMF as a saturated absorber* **Zhiming Zou**, Harbin Institute of Technology (Shenzhen), China	***p266***
14:45-15:00	CIOP2019-2019-000191 ◎ *Femtosecond mode-lock fiber laser with GIMF-SIMF-GIMF structure as the saturable absorber* **Jie Shi**, Harbin Institute of Technology (Shenzhen), China	***p267***
15:00-15:15	CIOP2019-2019-000234 ◎ *Effect of laser energy and polarization on RF emission characteristics of laser induced air plasma* **Xingsheng Wang**, Changchun University of Science and Technology, China	***p267***
15:15-15:30	CIOP2019-2019-000237 ◎ *All-inorganic transparent hybrid materials for dynamic filtering of optical radiation* **Xu Feng**, South China University of Technology, China	***p267***
15:30-16:00	Coffee Break	
Presider: Feng Chen, Shandong University, China		
16:00-16:15	CIOP2019-2019-000250 ◎ *A 3-D printed saturable absorber for femtosecond mode-locking of a fiber laser at a 1.9 μm wavelength* **Jinho Lee**, University of Seoul, South Korea	***p267***
16:15-16:30	CIOP2019-2019-000291 ◎ *A Parallel Timing Synchronization Architecture for All-Digital Coherent Receiver* **Yunpeng Zhang**, Shanghai Institute of Optics and Fine Mechanics, CAS, China	***p267***
16:30-16:45	CIOP2019-2019-000365 ◎ *Multicolor two-photon microscopy by phase-shaping selective excitation using broadband fiber-continuum* **Xinyuan Huang**, Huazhong University of Science and Technology, China	***p268***
16:45-17:00	CIOP2019-2019-000408 ◎ *Molybdenum disulfide based thermo-optic phase shifter on a silicon nitride waveguide with low power consumption* **Nan Tang**, Northwestern Polytechnical University, China	***p268***
17:00-17:15	CIOP2019-2019-000514 ◎ *Three-dimensional holographic optical tweezers based on a new arbitrary-plane Gerchberg-Saxton algorithm* **Yanan Cai**, Xi'an Institute of Optics and Precision Mechanics, CAS, China	***p268***
17:15-17:30	CIOP2019-2019-000569 ◎ *Capacity increase in single sideband direct detection system with probabilistic shaping* **Lei Zhang**, Peking University, China	***p268***

Abstract of Technical Sessions

Plenary Talk

Anatoly V Zayats

King's College London, UK

Spin-orbit coupling in nanophotonics

Photonic spin-orbit coupling describes how spin angular momentum of light, associated with circular polarisation of an electromagnetic wave, is coupled to orbital angular momentum of light (associated with the energy flow and propagation direction). Being strongly enhanced in a nanostructured environment, this effect provides interesting applications in polarisation-enabled control of optical signals, or in reverse, controlling light polarisation, sensing applications and quantum optical processes. The spin-orbit coupling involving waveguided modes results in the so-called photonic spin-Hall effect, in analogy to spin-Hall effect for electrons. In this talk we will overview the effects associated with the photon spin when circularly polarised light interacts with plasmonic nanostructures and metamaterials. Spin-dependent directional excitation of guided modes, spin-orbit coupling in surface plasmon scattering associated with the unusual, transverse spin of surface polaritons, and spin-dependent optical forces will be discussed. Nonlinear optical effects controlled by spin of interacting photons will be reviewed. Photonic spin-orbit interactions provide an important tool for harvesting new functionalities and applications of circularly polarised light in numerous photonic and quantum technologies, and metrology.

Biography

Professor Anatoly V. Zayats is a Chair in Experimental Physics and the Head of the Photonics and Nanotechnology Group at the Department of Physics, King's College London, where he also leads Nano-optics and Near-field Spectroscopy Laboratory. He is also a Co-Director of the London Centre for Nanotechnology and the London Institute of Advanced Light Technologies. His current research interests are in the areas of nanophotonics, plasmonics, metamaterials, scanning probe microscopy, nonlinear and ultrafast optics and spectroscopy, spin-orbit effects in photonics, and optical properties of surfaces, thin films, semiconductors and low-dimensional structures. He is a Fellow of the Institute of Physics, the Optical Society of America, SPIE and the Royal Society of Chemistry.

Plenary Talk

Frank Effenberger

Futurewei Technologies, USA

Higher speed PON: evolution, technology, and applications

This talk considers the future evolution of PON technology through 2025, considering both the available technologies to implement them, and the apparent applications to use them. In a distinct shift from the previous linear speed-based evolution of PON, it is expected that several distinct PON systems will be developed.

The first is the continuation of single-channel TDMA PONs, this time to 50 Gb/s. This is meant to be the successor to XG(S)-PON, and aims to be a lower cost solution. Since it is an evolutionary system, its coexistence with previous generations is very important.

The second is an evolution of the TWDM-PON family of systems, also extending the per-channel line rate to 50 Gb/s. The TWDM-PON currently sees some application in business services where its special features are needed, and this extension allows the provision of multiple 10 Gb/s UNIs on each channel.

The third is a system using wavelength routing devices to increase capacity and optical efficiency beyond that possible with splitters. The near term applications of this type of system include 5G wireless fronthaul, and the “SuperPON” concept (where several TWDM PONs are combined with a wavelength router to achieve greater fiber sharing).

Beyond the physical layer technology, the talk also considers the application of SDN and NFV techniques. Counter to the popular opinion, we find very little to be gained by employing these methods. In contrast, it is the business model that requires innovation. Unbridled plug-and-play interoperability requires the equitable reallocation of development costs.

Biography

Dr. Effenberger has worked in the optical access field at Bellcore, Quantum Bridge Communications (Motorola), and Futurewei Technologies, where he is now the Vice President of the fixed access network lab. His team works on forward-looking fiber, copper, and coax access technologies, with several “world’s first” prototypes and trials. Frank is the rapporteur for ITU-T Q2/15, and chair of IEEE 802.3cp, is a Fellow of the OSA, the IEEE, and Huawei, and holds over 110 US patents.

Plenary Talk

Hongxing Xu

Wuhan University, China

Fundamentals of plasmonic nanocavity and circuits

Plasmonics is a rapidly emerging branch of photonics, which offers variable means to manipulate light using plasmon excitations on metal nanostructures. Most prominently, the huge electromagnetic enhancement of plasmonic nanocavity offers the physical basis of single-molecule SERS and many other plasmon related research fields, such as tip-enhanced spectroscopy, plasmonic antennas, plasmon hybridization, quantum plasmonics, nonlinear plasmonics, plasmonic optical forces, and plasmochemistry. In this talk, the discovery, mechanism and applications of plasmonic nanocavity are briefly introduced firstly. Then we will talk about our recent studies using plasmonic nanocavity for sub-picometer sensitivity of spatial changes, extremely high optical nonlinearity and strong coupling. Another fundamental issue about plasmon propagation at the nanometer scale will be talked: The highly tunable beating of surface plasmon modes drives plasmon propagation in nanowaveguides and nanocircuits, which can realize plasmon routing, gain, logic functions etc. for nanophotonic chips.

Biography

Professor Hongxing Xu obtained his BS in physics from Peking University, China, in 1992 and his PhD in physics from Chalmers University of Technology, Sweden, in 2002. Then he joined Lund University, Sweden as an assistant professor. In 2005, he joined Institute of Physics, Chinese Academy of Sciences (CAS) as a professor. Then he joined Wuhan University as a professor. He is currently the dean of School of Physics and Technology, and the director of Center for Nanoscience and Nanotechnology, Wuhan University. He was elected as a member of CAS in 2017. He has published more than 180 peer-reviewed papers with SCI citations >15000 and H-index 56. He was elected by Elsevier as a highly cited Chinese scholar from 2014-2018. He has given more than 60 invited presentations at international conferences, and organized more than 20 international conferences and workshops. He discovered the nanogap effect for huge electromagnetic enhancement, which is the physical basis of single-molecule SERS and many other plasmon-enhanced optical processes. He invented plasmonic logic gates and revealed the fundamental properties of plasmonic nanowire waveguides and networks.

Plenary Talk

Fumio Koyama

Tokyo Institute of Technology, Japan

VCSEL photonics for communications and 3D sensing

The 40 years' research and developments of vertical cavity surface emitting lasers (VCSELs) opened up a new world of VCSEL photonics, including, sensors, optical interconnects in data center networks, laser printers, LiDAR and high power sources. The market of VCSELs has been growing up rapidly and they are now key devices in data center networks based on multi-mode optical fibers. High speed VCSELs beyond 50 Gbps are expected for future data center networks. Also, 3D sensing has been attracting much attention for a wide range of applications such as face ID in mobile phones, LiDAR for automatic driving cars, distance sensor of robot, security camera, and motion sensors in virtual reality. A big market is prospected for 3D depth camera, which was installed in iPhone X. A non-mechanical optical beam scanner is a key element for use in various applications such as laser displays, laser sensors and free-space optical communications. A mechanical beam scanner has been widely used, but non-mechanical scanner is attracting much attention for compact solid state LiDAR applications in recent days. We proposed and demonstrated a beam steering device based on a VCSEL structure, showing the record high-resolution beam steering.

In this talk, the advances on VCSEL photonics will be reviewed. We address a lateral integration platform and new functions of VCSELs, including high speed coupled cavity VCSELs with low power consumption, high power VCSEL amplifiers of over 5W in a single-mode operation, high-resolution beam scanners, dot projectors and their integrations.

Biography

Fumio Koyama is the director-general (dean) of Institute of Innovative Research, Tokyo Institute of Technology. His research interest includes VCSEL photonics, photonic integrated devices, optical MEMS devices, optical sensing, high-power laser processing and so on. He has authored or co-authored more than 1,000 journal papers and conference papers, including over 100 invited papers. He received the IEEE Student Paper Award in 1985, the IEE Electronics Letters Premium in 1985 and in 1988, the excellent review paper award from the Japan Society of Applied Physics in 2000, Marubun Scientific Award in 1998, the Ichimura Prize in Science for Excellent Achievement from the New Technology Development Foundation in 2004, the Electronics Society Award from the IEICE in 2006, the Prize for Science and Technology from the Minister of Education, Culture, Sports, Science and Technology in 2007, IEEE/LEOS William Streifer Scientific Achievement Award in 2008, the Micro-Optics award in 2012, Izuo Hayashi Award from the Japan Society of Applied Physics in 2012, Tokyo Metropolitan Government Award in 2015, the Ichimura Prize in Industry for Excellent Achievement from the New Technology Development Foundation in 2016, Sakurai Kenjiro Memorial Award in 2017, Okawa Prize in 2018, OSA Nick Holonyak, Jr. Award and IEICE Achievement Award in 2019. He is Fellow of IEEE, IEICE and the Japan Society of Applied Physics.

SC1 Light-Matter Interactions

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Laser 3D printing and structuring of materials from nano-to-macro scales (Tutorial)

Saulius Juodkazis
Swinburne University of Technology and Melbourne Center for Nanofabrication, Australia

Abstract

Modality of 3D printing which can be used for laser structuring of materials from resolution of tens-of-nanometers to tens-of-micrometers is realised by implementing ultra-short laser pulses of sub-1 ps duration. For example, laser polymerisation can be used to form 3D suspended bridges which have cross sections of only few tens-of-nanometers by direct write approach. A typical irradiance per pulse for 3D polymerisation is 0.5-1 TW/cm^2. Laser ablation can be controlled with a similar precision at slightly higher irradiances on surface of metals, semiconductors and dielectrics. Uniquely for ultra-short laser pulses, a light – matter interaction can be controlled by wavelength, intensity, exposure dose (focal spot size and scanning speed), and chirp (spectral and temporal). This opens possibility to tailor polymerisation conditions by purely optical means via avalanche and multi-photon ionisation rather to rely on bio-toxic photo-initiators developed for resins and photo-resits polymerised under cw-laser or UV-lamp exposure. An ultra-short laser printing of photoinitiator-free polymers can find applications in bio-medical applications where resolution from sub-micrometres to tens-of-micrometres are typically required. By tightly focussed femtosecond laser pulses inside transparent glass and crystalline hosts, a 3D confined modification of micro-volumes can be created. Those modified micro-volumes patterned in a 3D interconnected fashion are used to fabricate 3D channels by chemical wet etching in glasses and crystals. High pressure (which is the energy absorbed in a localised volume) and temperature conditions creates exotic phase materials which can be retrieved to ambient conditions due to ultrafast quenching. Recent results in 3D material structuring by ultra-short laser pulses will be presented in a tutorial format with numerical estimates and illustrations of the key phenomena.

Biography

Saulius Juodkazis is a Professor and Director of the Nanotechnology facility at Swinburne's Centre for Micro-Photonics. His current research is focused on applying principles of light-field enhancement and its spectral control for applications in micro-optics, sensing, solid-state lighting, and solar energy conversion. Professor Juodkazis has contributed to the development of a three-dimensional laser printing with nano-/micro-scale precision using femtosecond laser for applications in opto-fluidic, micro-optics, optical memory, and photonic crystals. He has shown experimentally the creation of high-pressure density phases of materials using tightly focused ultra-short laser pulses. Currently, his research also includes nano-textured surfaces for sensing, bactericidal, and light harvesting applications. Professor Juodkazis received his doctorate in experimental physics and material science jointly from Vilnius University (Lithuania) and Lyon-I University (France). He has also held previous tenured positions at the University of Tokushima and Hokkaido University, Japan, and is the author of ~500 peer-reviewed journal papers, reviews, and several book chapters. He is Fellow of OSA and SPIE and ChangJiang scholar.

- 14:15-14:45, August 7 -

Multiphoton lithography for biomedical applications

Aleksandr Ovsianikov
Technische Universität Wien, Austria

Abstract
Photochemical processes induced by multiphoton absorption of femtosecond laser pulses, such as photopolymerization, photodegradation and photografting, offer numerous possibilities for precise 3D structuring of polymeric materials. The possibility to access multiple length scales down to a sub-micrometer feature size in a single process is especially relevant for biomedical applications. Some of the intrinsic bottlenecks of multiphoton lithography processes for these applications are relatively low throughput, mainly related to high spatial resolution, and potentially cyto- or phototoxic material components. In this contribution, our recent progress on the development of multiphoton lithography and related materials for biomedical applications will be discussed. The presentation is supported by numerous examples.

Biography

Prof. Aleksandr Ovsianikov is a head of the research group 3D Printing and Biofabrication at the TU Wien (Vienna, Austria) and a member of the Austrian Cluster for Tissue Regeneration (http://www.tissue-regeneration.at). His research is dealing with the use of additive manufacturing technologies and bioprinting for tissue engineering and regeneration. Dr. Ovsianikov has background in laser physics and material processing with femtosecond lasers. A particular focus his current research is the development of multiphoton lithography technologies for engineering of biomimetic 3D cell culture matrices and realization of novel tissue engineering scaffolds. He was awarded a prestigious Starting Grant in 2012 and a Consolidator Grant in 2017 from the European Research Council (ERC) for projects aimed at these topics (http://amt.tuwien.ac.at/Ovsianikov)

- 14:45-15:15, August 7 -

Femtosecond laser hyperdoping crystal: principle and applications

Qiang Wu
Nankai University, China

Abstract
Femtosecond laser has proved to be an efficient tool to process crystal materials, which are widely used in many areas. Because of the characteristics of femtosecond laser, ultrashort pulse duration and ultrahigh peak power, the interaction process of laser pulse with crystal material is extremely complicated. It is an ultrafast dynamic process with ultrastrong light-matter interaction, which can overcome some physical limits. And it can lead to material modification of the crystals, accompanying with microstructuring and hyperdoping. For hyperdoping, the dopant concentration exceeds the solid solubility limit by several orders of magnitude. Therefore, the processed materials and devices made from which show some special properties. In this presentation, I will introduce our research progress of femtosecond laser processing of semiconductor silicon and dielectric lithium niobate, including processing principle and the devices made from them. Especially, I will focus on the new results, free-standing flexible photodetectors based on sulfur-hyperdoped ultrathin silicon, high responsive tellurium-hyperdoped black silicon photodiode with single-crystalline and uniform surface microstructure, and uniform periodic surface structures on lithium niobate crystal.

Biography

Qiang Wu is a professor of physics at School of Physics & TEDA Institute of Applied Physics, Nankai University (P. R. China). He received BSc in 2000 and PhD in 2005 from Nankai University and was a postdoc at Tufts University and MIT in 2007 and 2008. He was appointed full professor in 2013. His main research interest has been focused in ultrafast photonics from 2005, and now is focusing on: 1. femtosecond laser hyperdoping crystal and devices; 2. THz phonon polariton and THz wave; 3. ultrafast dynamics and imaging. He is also serving as an advisor of Boling Class, a partner of Pilot Scheme of Talent Training in Basic Sciences of China from 2010, and a member of editor board of Scientific Reports from 2013, Laser & Optoelectronics Progress from 2019.

- 16:00-16:30, August 7 -

3D µ-printing: from structural colors to brilliant white

Georg von Freymann

Technical University of Kaiserslautern, Germany

Abstract

3D µ-printing is a versatile technology allowing to create structures to study light matter interaction. I will present two examples. First, tailored disorder in photonic structures, which decides, if a structure presents bright non-iridescent color or if it shows brilliant whiteness. I will discuss a model system, which characteristically demonstrates the influence of tailored disorder. This model system explains the optical properties of the white beetle scales' structure based on small one-dimensional Bragg reflectors with tailored disorder in layer thickness and filling fraction. Depending on the parameters it is able to also explain the noniridescent colors found, e.g. in certain butterflies. Second, I will demonstrate our first results on 3D µ-printing of metallic structures, for which we use specially developed photo resists. Spatial resolution down to 500 nm is already close to results also achieved with conventional polymeric materials.

Biography

Since 2013 Head of Department, Fraunhofer Institute for Industrial Mathematics (ITWM), Kaiserslautern Since 2010 Professor (W3), TU Kaiserslautern 2007 – 2014 CTO, Nanoscribe GmbH 2005 – 2010 Head of a DFG Emmy Noether group, KIT, Karlsruhe 2001 – 2004 Postdoc, KIT Karlsruhe and University of Toronto 1998 – 2001 Ph.D. student, University Karlsruhe (TH) 1992 – 1998 Studying physics an University Karlsruhe (TH)

- 16:30-17:00, August 7 -

Self-assembled photonic structures: induced by ultrafast laser in transparent solids and applications

Dezhi Tan

Zhejiang University, China

Abstract

The interaction between ultrafast laser and the transparent matrix has resulted in creating various three-dimensional functional photonic structures as well as inducing unprecedented phenomena. In the past years, our group observed many interesting structures and phenomena by studying this light-matter interaction. In the presentation, I will show our work about generation of self-assembled grating nanostructures by ultrafast laser micromachining. We found

that self-assembled nanogratings can be produced in different types of transparent solids, such as fused silica, GeO_2 glass and multicomponent glass. Especially, a new type of crystallite-based grating nanostructures was created in an unconventional multicomponent glass. These nanogratings were organized as periodically assembled crystalline and amorphous phases, which was in contrast with the structural deficiency-based nanogratings in the fused silica and GeO_2 glass. The crystallization-assisted component in the glass strongly contributed to the creation of nanogratings. Furthermore, picosecond laser rather than femtosecond laser was established to be much more suitable for creating nanogratings in the glass, proving the critical role of thermal accumulation during nanoscale crystallization. Finally, nanogratings were demonstrated to be a broadband variable near-infrared optical attenuator with high attenuation ratio, indicating the potential application of nanogratings in optical information processing at communication wavelengths. These findings open new avenues for fabricating nanogratings in functional glasses for advanced integrated photonics and also offer information for revealing the mechanism of nanograting formation.

Biography

Dr. Dezhi Tan got his BS and PhD in Materials Science and Engineering in the Zhejiang University in 2009 and 2014, respectively. Then, he joined in Montreal Polytechnical as a postdoctor (2015, Canada), JSPS Fellow in Kyoto University (2016-2017, Japan) and research professor in IBS (2018, Korea). He is an assistant professor in Zhejiang University now. His fabricated various functional nanomaterials and nanostructures by femtosecond laser in liquid and transparent solids in Zhejiang University. He also worked on optoelectronic properties and applications of two-dimensional materials and their heterostructures for several years. Now, he is working on generating novel functional photonic nanostructures by ultrafast laser as well as investigating the mechanisms. He is also interested in the interaction between 2D materials and light.

- 17:00-17:30, August 7 -

Enhancement of photocurrent and THz emission by femtosecond laser surface nanostructuring of semiconductors

Quanzhong Zhao

Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

Photocurrent and THz emission enhancement in several semiconductors have been observed by femtosecond laser surface nanostructuring. The ultrashort laser pulses induced subwavelength periodic ripples are responsible for the enhancement of absorption, photoconductivity and THz emission. Furthermore, the refractive index anisotropy at THz range is observed in femtosecond laser pulses ablated GaAs semiconguctor.

Biography

Dr. Quan-Zhong Zhao received his B.S. & M.S. degrees from Northwestern Polytechnical University, China in 1997 and 2000, respectively. He obtained his Ph.D. in Optical Engineering from Chinese Academy of Sciences, China in 2003. He worked as a postdoctoral researcher in Max-Planck Institute for the Science of Light, Germany, from 2005 to 2009, and he became a full professor in Shanghai Institute of Optics and Fine Mechanics, CAS in 2009. His research interest includes laser-based micro-/nanoprocessing, structuring of versatile materials, functional photonic materials and devices, physics of ultrashort pulsed laser interaction with matter, and fundamental research with potential commercialization. He has authored and co-authored two book chapters and more than 100 journal papers and 30 conference papers.

- 08:30-09:00, August 8 -

The nature of non-equilibrium ultrafast demagnetization in ferromagnetic nickel

Zhensheng Tao
Fudan University, China

Abstract

Manipulating the material states with femtosecond laser illumination is a promising routine to create new states that are not accessible in equilibrium. To harness the power of possibility to engineer materials with light, it is key to understand how the energy transfers between different degrees of freedom and how the hierarchy of the energy transfer shapes the behaviors of a material. In this talk, I will take the laser-induced ultrafast demagnetization in ferromagnetic metals as an example and show how the laser illumination leads to the loss of magnetic order in femtoseconds. Here, by combining time- and angle-resolved photoelectron spectroscopy and ultrafast magneto-optical spectroscopy, we showed that the laser-induced ultrafast demagnetization in transition metal Ni is essentially of a phase transition of the coupled electron and spin system. In our results, we not only explained the fluence-dependent time constants, but also revealed that the critical phenomena of phase transition play an important role in the phase transition, which includes the critical fluence to induce phase transition and the divergence of the heat capacity, etc. This is the first time such observations become available. Surprisingly, our results indicate a strong connection between the non-equilibrium laser-induced dynamics and the material properties under thermal equilibrium, implying potential universality of our findings. By comparing with the ultrafast magneto-optical spectroscopy results, we found possible coexistence of the ferro- and paramagnetic states at the critical point of the phase transition. This can be studied by the next-generation space-time-resolved spectroscopic technique.

Biography

2018.1 – now Department of Physics, Fudan University Professor 2014.8 – 2018.1 JILA, University of Colorado, Boulder Postdoc 2008.8 – 2014.8 Department of Physics and Astronomy, Michigan State University Ph.D 2005.9 – 2008.6 Department of Physics, Fudan University Master Degree 2001.9 – 2005.6 Department of Physics, Fudan University Bachelor Degree Honors: Humboldt research fellowship 2019 1000 Talent program 2018 Shanghai “Eastern Scholar” distinguished Professor 2017

- 09:00-09:30, August 8 -

Spatially shaped ultrafast laser micro/nano-fabrication

Xiaowei Li
Beijing Institute of Technology, China

Abstract

Ultrafast laser offers the advantages of reduced recast/microcracks and minimized heat affected zones around ablation section due to its ultra-short pulse durations and ultra-high power densities, which is obviously different from melting region caused by long-pulse laser and can considerably increase the fabrication precision and quality eventually. By manipulating the spatial shape of ultrafast laser pulses either, the electron excitation processes during laser-material interactions can be precisely controlled. As a result, high-quality, high-aspect-ratio, high-efficient micro/nano-fabrication method can be achieved, for example: we proposed to: 1) control the spatial distribution of electron density by spatially shaping the femtosecond laser pulses, with which metallic nanowires with a minimum width of 56

nm can be fabricated; 2) adjust optical near-field distribution and the corresponding electron generation on fabricated material surface, by which the periods, orientations and structures of the surface ripples can be effectively adjusted; 3) high-quality microholes with a diameter of 1.5 μm and an aspect ratio of 1000:1 are fabricated by a spatially shaped single femtosecond laser pulse. It takes 42 min to fabricate 251,001 holes in a 1 cm × 1 cm area, which is very uniform in size and shape.

Biography

Xiaowei Li is currently a Professor of Department of Mechanical Engineering at the Beijing Institute of Technology. His research activities are mainly focused on laser micro/nano fabrication and related applications. Dr. Li published 46 SCI-indexed papers in mainstream international journals. He received the Second Prize of Natural Science Award (the 5th co-PI), China in 2016, Young Elite Scientists Award, China Association for Science and Technology in 2017, and the First Prize of Natural Science Award (the 4th co-PI), Ministry of Education, China in 2014.

- 09:30-10:00, August 8 -

Structured beams generation and its application

Yuanjie Yang

University of Electronic Science and Technology of China, China

Abstract

Generally, structured beams are electromagnetic waves with specific phase or intensity profile. Vortex beam with spiral phase front, a kind of structured beam, is inherent to any wave phenomena and much interest has been focused on vortex fields in the past decades. In the past two decades, orbital angular momentum (OAM) of vortex beams has found numerous applications, including optical manipulation, quantum information processing, quantum cryptography, free-space information transfer and communications. Therefore, generating and measuring of OAM are crucial for all the fields associated with vortex beams. Besides the simple vortex beams, a superposition of OAM states has found important applications as well. In this talk, I will give a brief review of the works on the generation of structured beams and its application on manipulation of nanoparticles in our group. Firstly, I will discuss a fundamental superposition and selection principle of coaxial multiple wave fields. Based on this principle, both optical and electron vortex beams with multiple OAM modes are generated experimentally. Secondly, I will discuss the generation of two kinds of novel vortex beams, namely, anomalous vortex beams and anomalous Bessel vortex beam, and both the intensity profile and the topological charge of such beams can vary during propagation, which is totally different with normal vortex beams. After that I will show the optical trapping of nanoparticles using anomalous vortex beams. At last, I discuss the experimental study on the patterning of ordered colloidal nanostructures on a large scale based on the combination of three-dimensional (3D) confined optical tweezers array and ultra-strong optical binding between nanoparticles.

Biography

Yuanjie Yang is currently a professor of Optics in the School of Physics, University of Electronic Science and Technology of China. He got his PhD degree from Sichuan University in 2008, and after that he had ever carried out postdoctoral research at University of St Andrews (UK), University of York (UK) and National University of Singapore. His research interest mainly focuses on optical vortex beams, orbital angular momentum, electron vortex beams and optical trapping. He has published 30 papers including Science, Physical Review Letters, Nanophotonics, Optics Letters, etc.

- 11:00-11:30, August 8 -

Nepenthes inspired omniphobic slippery liquid infused porous surface (SLIPS) by femtosecond laser direct writing

Feng Chen
Xi'an Jiaotong University, China

Abstract

One-step femtosecond laser ablation can directly create porous network microstructure on various polymer surfaces, including polyethylene terephthalate (PET), polymethylmethacrylate (PMMA), polyamide (PA), polycarbonate (PC), polyethylene (PE), and polylactic acid (PLA)， polyamide-6 (PA6). Take PET for example, as shown in figure, the surface was fully covered by interconnected pores with the diameter of several hundred nanometers after femtosecond laser ablation. As the porous surface was further lowered its surface free energy and infused with lubricating liquid, a slippery surface was successfully fabricated. The SLIPS surface had excellent liquid-repellent ability since various liquids could can easily slide down the 10° tilted SLIPS. Compared to the previous reported slippery surfaces, the porous layer and the substrate layer of our SLIPS are inherent one material. Moreover, even though the SLIPS suffers from heavily physical damage, the surface can rapidly self-repair without any additional treatment and obtain slippery property again. Furthermore, the slippery PET surface could completely inhibit C6 glioma's growth. Thus, the developed SLIPS promises to contribute to the achievement of omniphobic materials in selfcleaning, antifouling, biomedical devices, and fuel transport.

Biography

Feng Chen is a full professor of Electronic Engineering at Xi'an Jiaotong University, where he directs the Femtosecond Laser Microfabrication Laboratory and has severed as deputy director of the International Joint Research Center for Micro/Nano Manufacturing and Measurement Technologies. Chen received the B.S. degree in physics from Sichuan University, China in 1991 and received the Ph. D. in Optics from Chinese Academy of Science in 1997. He began to work for Chinese Academy of Science (1991 to 2002), where he was promoted to a full professor in 1999. In 2002, Dr. Chen joined the Xi'an Jiaotong University, where he became a group leader. He had been a full Professor of Electronics Engineering at Xian Jiaotong University since 2002. His current research interests are femtosecond laser microfabrication and Bionic Microfabrication. Dr. Chen took charge in over 30 research projects, and has published more than 200 peer-reviewed papers.

- 11:30-12:00, August 8 -

Ultrafast dynamics of periodic nanoripples induced by femtosecond lasers

Tianqing Jia
East China Normal University, China

Abstract

In the last twenty years, femtosecond laser-induced periodic nanoripplesin metal, semiconductor, and dielectricshave been widely studied. At present, people mainly pay attentionsto the following problems: one is the mechanism of femtosecond laser-induced periodic ripples; the other is the efficient fabrication of periodic nanostructures and their applications in the fields of polarizing optical micro-elements, data storage, broadband absorption, enhanced photoluminescence, surface coloring, and wettability. We developed an ultrafast imaging system with high temporalresolution and high spatial resolution, and studied the ultrafast imaging of periodic ripplesinduced by a single

femtosecond laserpulseon semiconductor and metal surfaces.The results show that the periodic distribution of laser field caused by surface plasmon polarization and the periodic energy deposition play a key role in the formation of periodic ripples. We report the formation of periodic subwavelength ripples on a silicon surface induced by a single-shaped 800-nm femtosecond laser pulse. The temporally shaped femtosecond laser pulse can enhance the excitation of surface plasmon polaritons and the periodic energy deposition while reducing residual thermal effects on the silicon surface, eventually resulting in periodic ripples at the center of the ablation area. By using the interference of double column lens, a large area regular grating structure was prepared on the semiconductor and glass surface with high efficiency.

Keywords: Periodic ripples, ultrafast imaging, femtosecond laser pulse shaping, surface plasmon polarization

Biography

Jia Tianqing's research focuses on the femtosecond laser micro/nanofabrication. He reports more than 100 papers on the ultrafast dynamics of dielectrics and semiconductors ablated by femtosecond laser pulses, fs laser-induced periodeic nanostructures. Recently, he begin study the processing of cooling holes of engine leaf of air plane by using ns laser and fs laser. He obtained his doctoral degree in Tongji University, Sep, 2000. In 2000-2005, He made his research in Shanghai Institute of Optics and Fine Mechanisms. In 2005-2007, he studied in the Tokyo University as a JSPS fellow. He works as a professor at East China Normal University since September 2007.

- 13:30-14:00, August 8 -

Ultrafast laser material processing: From a technological niche to an enabling manufacturing tool

Xiaoming Yu

University of Central Florida, USA

Abstract

Over the past few decades the interaction between solid materials and ultrashort laser pulses has been a fascinating topic, and the potential of using ultrafast lasers in precision material processing was quickly recognized when high-power lasers became available. Nowadays ultrafast laser processing of materials is no longer a niche technology that finds usage only in laboratories. More and more applications have benefited from the unique characteristics of ultrafast laser induced modification and ablation. This talk will focus on the use of ultrafast lasers in manufacturing, which imposes challenges that need to be overcome by a better understanding of laser-material interaction and by technological advances of laser beam manipulation. This talk will present recent progress in ultrafast laser material processing, including micro-/nano-machining of dielectrics with a temporally-controlled pulse train, Bessel beam-induced photopolymerization, and a novel beam shaping technique using deformable mirrors. This work extends the capability of ultrafast lasers as a manufacturing tool, and puts forth a prospect of using lasers for manufacturing purposes in a more effective and productive manner.

Biography

Dr. Xiaoming Yu received his BS in Physics from Nankai University, China, in 2008, MS in Plasma Physics from Shanghai Institute of Optics and Fine Mechanics in 2012, and PhD in Industrial and Manufacturing Systems Engineering from Kansas State University in 2016. He joined the University of Central Florida in 2017. His research interest is in laser-matter interaction and laser-based advanced manufacturing.

- 14:00-14:30, August 8 -

Single shot compressed ultrafast photography

Shian Zhang
East China Normal University, China

Abstract

Capturing the transient scenes at high imaging speed has been long-term dream by scientists. Especially, the introduction of electronic imaging sensors based on charge-coupled device (CCD) or complementary metal-oxide-semiconductor (CMOS) technology can make the imaging speed up to 107 frames per second, but the frame rate of this technique is limited by the on-chip storage and electronic readout speed, and therefore further increasing frame rate is unable. In this talk, we would like to demonstrate a two-dimensional dynamic imaging technique, compressed ultrafast photography (CUP), which can capture non-repetitive transient events at up to $5x10^{12}$ frames per second. Compared with existing ultrafast imaging technique, the CUP technique has the prominent advantage of measuring transient scene with a single camera snapshot, and so it can observe the transient events with the temporal resolution in the range of picosecond. Considering CUPs ability, it hopes to be applied in both fundamental and applied sciences, including biomedical research.

Biography

Shian Zhang is currently a Professor at East China Normal University. He received his B. E. degree in Physics from Fujian Normal University in 2001 and PhD degree in Optics from East China Normal University in 2006. His research focuses on ultrafast optical imaging, including compressed ultrafast photography and nonlinear optical microscopic imaging. He has published over 120 journal papers, including Optica, JPCL, PRApplied, PR, PCCP, APL, JCP and PRA.

- 14:30-15:00, August 8 -

High efficiency 3D Femtosecond laser microfabrication based on spatial light modulation

Dong Wu
University of Science and Technology of China, China

Abstract

Femtosecond laser induced two-photon polymerization (TPP) has been proved to be a powerful microfabrication technique with high efficiency and quality. However, the main drawback of TPP technique is its low fabrication efficiency caused by the point-to-point raster scanning strategy, which seriously restricts its applications. In order to overcome the disadvantages, SLM-based (spatial light modulator) 2D-3D laser intensity patterns (e.g., mutlifoci or arbitrary patterns) were proposed to significantly speed up the fabrication process by several orders of magnitude, owing to its capability to dynamically update the intensity distributions in the focal plane by modifying the phase of incident light. A series of 2D-3D functional microdevices such as Damman grating, microfilter and flower-like microtube arrays were rapidly fabricated and showed various functions, such as beam splitting, particles filtering and cell manipulation.

Biography

Dong Wu is a professor of engineering science at University of Science and Technology of China. He obtained the fifth Chinese Thousand Youth Talents Plan. His current research interests are femtosecond laser 3D microfabrication for microoptical devices, microfluidic chips, micromachines, and biomimetic microstructures. Prof. Wu has published 80 papers in the international journals of Nature Photonics, Light: Sci & Appl.(Nature publishing group), PNAS, Laser Photon. Rev., Adv. Mater., Adv. Funct. Mater., Small, Lab Chip, Appl. Phys. Lett., Opt. Lett. and so on..

Oral Talks

CIOP2019-2019-000160 (15:15-15:30, August 7)

Polymer IR artificial compound eyes micro-optics by femtosecond laser assisted micro manufacturing

Feng Liu[1,2], Fan Zhang[1,2], Hao Bian[1,2], Minjing Li[2,3], Qing Yang[2,3], Feng Chen[1,2]

1. School of Electronics & Information Engineering, Xi'an Jiaotong University, China
2. International Joint Research Laboratory for Micro/Nano Manufacturing and Measurement Technologies, China
3. School of Mechanical Engineering, Xi'an Jiaotong University, China

Abstract: High quality, flexible, low cost polymer IR artificial compound eyes micro-optics with massive imaging sub-apertures are proposed by micro manufacturing technique consisting of femtosecond laser assisted wet etching and precision 3D nano-imprinting.

CIOP2019-2019-000187 (17:30-17:45, August 7)

Bioinspired anisotropic superhydrophobic/underwater superoleophobic surface fabricated by femtosecond laser

Fang Yao, Yong Jiale, Yang Qing, Hou Xun, Chen Feng

School of Electronics & Information Engineering, Xi'an Jiaotong University, China

Abstract: Special periodic micro-grooves arrayis constructed on PDMS by femtosecond laser irradiation. The prepared surface can realise anisotropic superhydrophobicity and underwater superoleophobicity.

CIOP2019-2019-000370 (10:00-10:15, August 8)

Compressed ultrafast spectral-temporal (CUST) photography: enabling 3.85 trillion frame rate ultrafast movies with single snapshot

Yu Lu[1,2], Lidai Wang[2], Feng Chen[1*]

1. School of Electronics & Information Engineering, Xi'an Jiaotong University, China
2. Department of Biomedical Engineering, City University of Hong Kong, Hong Kong, China

Abstract: Here, we present a compressed ultrafast spectral-temporal (CUST) photographic technique, enabling both an ultrahigh frame rate of 3.85 trillion Hz with 60 frames in single-shot.

CIOP2019-2019-000155 (10:15-10:30, August 8)

Experiment and simulation of crosstalk effects for laser irradiated IT-CCD

Xuanfeng Zhou, Qianrong Chen, Yanbin Wang, Rongzhen Zhu, Guangsen Ren, Hua Li

Luoyang Electronic Equipment Test Center of China, China

Abstract: Crosstalk effect of an IT-CCD irradiated by a 532 nm laser are studied by experiment and simulation. We divided crosstalk effect into two processes with overflowing during integral period and overflowing at readout transfer moment.

CIOP2019-2019-000300 (15:00-15:15, August 8)

Picosecond laser-induced tunable ripple structures evolution on amorphous $Ge_2Sb_2Te_5$

Zihao Han

Institute of Laser Engineering, Beijing University of Technology, China

Abstract: The morphology and crystallization evolution of LIPPS (ripple structure) on amorphous $Ge_2Sb_2Te_5$ (GST) surface induced by picosecond laser pulses

CIOP2019-2019-000017 (12:00-12:15, August 8)

Study of photonics

Xiao-fan Chen

Department of Physics, Harbin Institute of Technology, China

Abstract: Electrodynamics includes classical electrodynamics and quantum electrodynamics. Quantum optics is a branch of quantum electrodynamics, involving photons. When light is strong, quantum optics transits to classical optics. In this paper, the generation of entangled photon pairs is studied.

SC2 Plasmonics and Metamaterials

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

A new generation of photonic crystals and metamaterials (Tutorial)

Che Ting Chan
The Hong Kong University of Science and Technology, Hong Kong, China

Abstract
I will review the physical properties of a new generation of artificial photonic materials and metamaterials with optical properties not found in nature. We begin with the realization of pseudospin-1 physics using dielectric photonic crystals. We show some physical implications of the photonic crystals exhibiting an accidental degeneracy induced conical dispersion at k=0, such as the realization of zero refractive index medium. The photonic states of such photonic crystals near the Dirac-like point can be described by an effective spin-orbit Hamiltonian of pseudospin 1. The transport of waves in pseudospin-1 systems exhibits many interesting phenomena, including super Klein tunneling, robust super-collimation and unconventional Anderson localization. We will then discuss the properties of a new type of metamaterials whose properties are determined the connectivity of a network structure, not by the resonances of individual elements within a unit cell. Such metamaterials cannot be described using local effective parameters, although the unit cell is deep subwavelength. In contrast to natural materials which have their index ellipsoids centered at k=0, the non-resonant metamaterial can possess multiple index ellipsoids centered at arbitrary nonzero k-points. Such metamaterials can be used to design broadband devices.

Biography
C.T. Chan received his PhD degree from the University of California at Berkeley in 1985. He is currently Daniel C K Yu Professor of Science, Chair Professor of Physics at HKUST, the Director of Center for Metamaterial Research and the Director of Research Office of HKUST. He has been elected a Fellow of the American Physical Society and Hong Kong Physical Society. He received the Achievement in Asia Award of the Overseas Chinese Physics Association (2000) and Croucher Senior Research Fellowship (2010). He is a co-recipient of Brillouin Medal for his research in phononic metamaterials (2013). His primary research interest is the theory and simulation of material properties.

- 14:15-14:45, August 7 -

Nanophotonic control of thermal emission

Min Qiu
Westlake University, China

Abstract
Engineering thermal emission of objects enables versatile applications. In the last two decades, the emerging field of nanophtonics has offered unprecedented solutions—that are impossible with conventional approaches—to engineer thermal emission by controlling the emissivity of objects with nanostructures on object surfaces. In this talk, we report our recent research efforts in delivering novel nanophotonic-designed thermal emitters, focusing on the applications in thermal camouflage and thermal management of human bodies.

Biography

Min Qiu received B.Sc. degree (1995) and Ph.D. degree (1999) in Physics, both from Zhejiang University, China, and Ph.D. degree (2001) in Electromagnetic Theory from Royal Institute of Technology (KTH), Sweden. He joined KTH as an assistant professor in 2001 and became Professor of Photonics in 2009. He moved to Zhejiang University, China, in 2011. Since 2018, he is the Chair Professor of Photonics and Vice President for Research, Westlake University, China. His research interests include nanofabrication technology, nanophotonics, and green photonics.

- 14:45-15:15, August 7 -

Graphene plasmon mediated super-Planckian near-field thermal radiation

Yungui Ma
Zhejiang University, China

Abstract

Objects with nonzero temperature will radiate thermal energy. Consider the fact that heat is almost the last energy outlet for a physical or chemical interaction process and the waste heat energy may exist anywhere. It shall a very interesting and also important topic if we can collect and recycle the waste heat. Thermal radiation provides a possible way for this purpose. In this talk, we will show that the key factor, i.e., the radiation efficiency, could be substantially enhanced in the near-field case where two objects have a distance far smaller than the thermal wavelength. We carry out such an experimental utilizing the plasmonic coupling between two graphene sheets. A large super-Planckian thermal radiation efficiency 4.5 times larger than the blackbody limit is obtained at a vacuum gap of 430 nm. The influence of the Fermi level of graphene is discussed both theoretically and experimentally. We also indicate that the Schottky junction formed at the Gr-Si interface may play a vital role in transforming the collected heat into useful electric energy via a near-field thermophotovoltaic (TPV) cell. In the end, I will also would like to introduce our recent interesting results on the daytime passive radiative cooling.

Biography

Yungui MA, Professor, College of Optical Science and Engineering, Zhejiang University, selected by the New Century Outstanding Youth Talents Program of the Ministry of Education in 2011. He received the Bachelor degree (physics) in 2000 and doctoral degree (physics) in 2005 from Lanzhou University (China). He worked in National University of Singapore from 2005 to 2010 as a Research Fellow and later as a Research Scientist and joined in Zhejiang University from 2011. He has worked more than 10 years in the field of metamaterial/sub-wavelength optics and published more than 80 SCI papers in journals including Nature Materials, Physical Review Letters, Nature Communications, etc. He received the first prize in natural science research of Zhejiang Province in 2018 and currently he serves as the editorial committee member of the journal “Progress in Electromagnetics Rsearch Letter—PIER”.

- 16:00-16:30, August 7 -

The role of quantum and optical interaction in the giant spectral splitting in a strongly-coupled plasmon-molecules system

Zhiyuan Li
South China University of Technology, China

Abstract

The vacuum Rabi splitting, which stems from a single photon interaction with a quantum emitter (a single atom, molecule, or quantum dot), is a fundamental quantum phenomenon. Intrinsically this effect is reflected in the

internal energy splitting of quantum emitter state, while extrinsically it is reflected by the spectral splitting in either photoluminescence, or fluorescence, or scattering, or absorption spectrum. Many reports have claimed that using J-aggregates coupling to highly localized plasmon can produce giant Rabi splitting (in scattering spectra) which is proportional to √N, where N is the number of excitons in J-aggregates, and this splitting originate purely from quantum interaction between excitons and plasmons. In this work we show that compared with the fluorescence which is a sign of molecular internal states and can really reflect the molecular energy-level splitting, the scattering spectra is far sensitive to the surrounding matter. The giant spectral splitting stems both from the quantum interaction of single-molecule with plasmons (Rabi splitting) and from the classical optical interaction of multiple molecules with plasmons. We develop a Lorentzian model to describe molecules and plasmon and find that collective optical interaction is dominant to generate the giant splitting (in scattering spectra), which is also proportional to √N, upon the quantum interaction of single-molecule Rabi splitting. Simply speaking, the observed giant spectral splitting is not a pure quantum Rabi splitting effect, but rather a mixture contribution from the large spectral modulation by the collective optical interaction of all molecules with plasmons and the modest quantum Rabi splitting of single-molecule strongly coupled with plasmons.

Biography

Prof. Zhi-Yuan Li is a professor in College of Physics and Optoelectronics, South China University of Technology, Guangzhou. Before this he worked in Institute of Physics, CAS Beijing as a principal investigator. Prof. Li's research interests include theory, experiment, and application of photonic crystals, nonlinear and ultrafast optics, plasmonics, optical tweezers, quantum optics, and quantum physics. He is the author or coauthor of more than 400 peer-reviewed papers in physics, optics, chemistry, and materials science journals. These papers have been cited by about 21,000 times. He serves as a Co-Editor of EPL and the editorial board member of Acta Optica Sinica, and Advanced Optical Materials. He has presented over 100 invited talks in international and domestic conferences.

- 16:30-17:00, August 7 -

Dynamically-tunable plasmonic devices based on phase transition of vanadium dioxide

Ruwen Peng

Nanjing University, China

Abstract

Recently, tunable nanophotonic devices have drawn intense attention with great promise for practical applications. In this work, we have experimentally demonstrated several dynamically-tunable plasmonic devices based on phase transition of vanadium dioxide, which include dynamic plasmonic color generators, dynamically switchable polarizers, and dynamically tunable bowtie nanoantennas. We have fabricated periodic arrays of silver-nanodisks on a vanadium dioxide film to realize different colors, relying on the excitation of localized and propagating surface plasmons. Based on insulator-metal transition of vanadium dioxide, the plasmonic colors can be actively tuned by varying temperature. This approach of dynamic color generation can easily realize diverse color patterns, which makes it beneficial for display and imaging technology. We have also designed a system consisting of anisotropic plasmonic nanostructures with vanadium dioxide that exhibits distinct reflections subjected to different linearly polarized incidence at room temperature and in the heated state. The composite structure can thus be used to realize a dynamically switchable infrared image, wherein a pattern can be visualized at room temperature, while it disappears above the phase transition temperature. Besides, we have made the dynamically tunable bowtie nanoantennas integrated on a vanadium dioxide thin film. The investigations here can be applied in dynamic digital displays, optical data storage, and imaging sensors.

Biography

Professor Ruwen Peng received her BS, MS and Ph.D. degrees in condensed matter physics from Nanjing University in 1989, 1992, and 1998, respectively. Currently she is a distinguished professor in Nanjing University and a principal investigator at National Laboratory of Solid State Microstructures. She was honored the Chinese Young Women Scientists' Award in 2011, and Xie Xide Award in 2013. Her current research interests include plasmonics and nanophotonics, metamaterials, photonic quasicrystals, phononic transport and heat transfer in nanostructures.

- 08:30-09:15, August 8 -

Information metasurfaces (Tutorial)

Tiejun Cui
Southeast University, China

Abstract

Information metasurfaces are described by digital elements 0 and 1 with the opposite electromagnetic (EM) responses (e.g. anti-phases), instead of by the effective medium parameters. By designing different coding states of the digital elements, the EM waves can be controlled by the information metasurfaces in the desired way. We have shown that, when digital coding metasurfaces are space-encoded, the spatial-wave fields and beams can be manipulated in programmable manner; when the digital metasurfaces are time-encoded, the frequency spectra of EM waves (e.g. harmonics and their power distributions) can be manipulated. With space-time digital coding, the information metasurfaces attain simultaneous manipulation of EM waves in both space and frequency domains. The information metasurfaces set up a bridge between the physical world and digital world, and hence could produce new information systems. As relevant applications, I report several new imaging systems and novel architectures of wireless communication systems based on the information metasurfaces. In the new architectures, the traditional modules of analog-digital converter, mixers, filters, and amplifiers are no longer needed. The proposed method will have more impacts to the future information technologies.

Biography

Tie Jun Cui is the Chief Professor of Southeast University, Nanjing, China. He authored two books and published over 400 peer-review journal papers, which have been cited by more than 24000 times (H-Factor 77, from Google Scholar). Dr. Cui received the Natural Science Award (First Class) from Ministry of Education, China, in 2011, and the National Natural Science Awards (Second Class) in 2014 and 2018, respectively. His researches have been selected as one of the "10 Breakthroughs of China Science in 2010", "Best of 2010" in New Journal of Physics, and "Optics in 2016" by OSA, and has been reported by Nature News, MIT Technology Review, Scientific American, Discover, New Scientists, etc. Dr. Cui is an IEEE Fellow.

- 09:15-09:45, August 8 -

Recent experimental progress in invisibility cloaks

Hongsheng Chen
Zhejiang University, China

Abstract

The concept of an invisibility cloak is a fixture of science fiction, fantasy, and the collective imagination. Here I will review the recent experimental progress in invisibility cloaks. In particular, I will discuss the experimental realization of a remote cloaking device that makes any object located at a certain distance invisible at direct current frequency, a 3D cloak that functions for plain sight at optical frequency, and broad band surface wave cloaks.

Biography

Dr. Hongsheng Chen received the Ph.D. degree from Zhejiang University in 2005. He is currently a Chang Jiang Scholar distinguished professor in the Electromagnetics Academy at Zhejiang University in Hangzhou, Zhejiang, China. He was a Visiting Scientist (2006-2008), and a Visiting Professor (2013-2014) with the Research Laboratory of Electronics at Massachusetts Institute of Technology, USA. He is the Vice-Dean of the College of Information Science and Electronic Engineering, Zhejiang University. He is the coauthor of more than 200 international refereed journal papers. He serves on the Topical Editor of Journal of Optics, the Editorial Board of the Scientific Reports, and Progress in Electromagnetics Research. His current research interests are in the areas of metamaterials, invisibility cloaking, transformation optics, and theoretical and numerical methods of electromagnetics.

- 11:00-11:30, August 8 -

Metasurfaces for controlling terahertz waves

Lei Zhou

Fudan University, China

Abstract

The unrestricted control of terahertz (THz) waves is important in science and applications, but conventional THz devices suffer from issues of bulky size and low efficiency. Metasurfaces, ultrathin metamaterials that consist of planar subwavelength units (e.g., meta-atoms) with tailored electromagnetic (EM) responses, have demonstrated unprecedented capabilities in controlling EM waves. In this talk, I will summarize our latest efforts in constructing metasurfaces and metadevices for controlling THz waves, both statically and dynamically, generating fascinating physical effects such as high-efficiency photonic spin-Hall effect, background-free Bessel-beam generation, high-efficiency (spoof) surface-plasmon excitation, and dynamically controlled beam steering, etc.

Biography

Zhou, Lei received his PhD in Physics from Fudan University, Shanghai, China, in 1997. He then went to Institute for Material Research in Tohoku University (Sendai, Japan) for postdoctoral research. In 2000 - 2004, he was a visiting scholar in Physics Department of the Hong Kong University of Science and Technology. He joined Physics Department of Fudan University in 2004 as a professor, and became a “Xi-De” Chair Professor since 2013. Starting from 1993, Professor Lei Zhou has been working in the fields of magnetism, meta-materials, photonic crystals and plasmonics, and he has published over 160 papers in scientific journals including Nature Materials, Phys. Rev. X, Phys. Rev. Lett., Nano Lett, Light: Science & Applications. He successfully held several international conferences as general chair, co-initiated the A3 metamaterials forums, and was invited to give invited/keynote/plenary talks in many top international conferences. Professor Lei Zhou got many awards, including the NSFC “Grant for Outstanding Young Scientist” (2007), the “Chang Jiang Scholars Program” Chair Professorship (2009), the “OSA Young Scientist Award” (2016) and the “APS Outstanding Referee” (2017). He was elected as an OSA fellow in 2019.

- 11:30-12:00, August 8 -

Some recent experiments on transformation optics

Huanyang Chen

Xiamen University, China

Abstract

In this talk, we will share some of our recent experiments on Transformation Optics. In particular, a self-focusing lens and a multimode waveguide crossing based on conformal mappings; a geodesic lens and a topological deflector based on curved surfaces; a field concentrator based on Fabry-Pérot resonances.

Biography

Huanyang Chen received the B.Sc. and Ph.D. degrees in physics from Shanghai Jiao Tong University, Shanghai, China, in 2005 and 2008 respectively. From 2006 to 2009, he was a Research Assistant and a Postdoctoral Fellow in the Hong Kong University of Science and Technology, Hong Kong. He was a Professor in Soochow University from 2009 to 2016 and in Xiamen University since 2016. His research covers photonic/photonic crystals, metamaterial designs, and transformation optics/acoustics. He has authored or coauthored more than 100 papers. His papers have been cited for more than 5000 times, and he has an H-index of 35.

- 13:30-14:00, August 8 -

Towards ideal transformation optical devices

Yu Luo

Nanyang Technological University, Singapore

Abstract

Controlling light is the dream of scientists for centuries. Transformation optics offers a possible route to this dream. It provides a picture that is as intuitive as the ray optics but is exact at level of Maxwell's equations, and therefore can be applied to light control at any length scale. However, the designs of ideal transformation optical devices require three-dimensional and inhomogeneous metamaterials, which are extremely difficult if not impossible to realize with traditional approaches. These problems hinder the realizations of ideal transformation optical devices for decades. In this talk, I'll first give an overview of recent progress in transformation optics, and then summarize existing problems in this field, and finally show that the 'photonic doping' approach enables a powerful platform to realize ideal transformation optical devices. A number of examples, such as ideal ultrathin retroreflector, flat magnified superlens, and ideal omnidirectional invisibility cloak, are realized with this approach.

Biography

Yu Luo received the B.E. degree in Electronic & Information Engineering from Zhejiang University, China, in 2006, and Ph.D. in physics from Imperial College London, UK, in 2012. He then remained in Imperial College London as a research associate after graduation. In 2015, he joined the School of Electrical and Electronic Engineering, Nanyang Technological University, as an assistant professor. Luo's research interests focus on metamaterials and plasmonics ranging from the design of invisibility cloaks and plasmonic light-harvesting devices to the study of nonlocal and quantum phenomena in mesoscopic plasmonic systems. He has published more than 90 international refereed journal papers which have received over 3000 citations.

- 14:00-14:30, August 8 -

On-chip free electron light sources

Fang Liu

Tsinghua University, China

Abstract

Some interesting phenomena and novel devices are arising by having free electrons interact with various nano-structures. Here we demonstrate the first on-chip integrated free electron light source by greatly decreasing the electron energy for generating Cherenkov radiation (CR), the Smith-Purcell radiation (SPR) in deep UV region by passing an electron beam through a nano-slot of grating, and the free electron excited SPASER by passing an electron beam over a plasmonic cavity. The work opens up the possibility of exploring high performance on-chip integrated free electron light source and optoelectronic devices, and provides a way for realizing integrated free electron laser in ultraviolet frequency region.

Biography

Fang LIU was born in 1980. He received the B.S.degree from Beijing Institute of Technology, China, in 2003, and Ph. D degree from Tsinghua University, China, in 2008. In July 2008, he joined the Electronic Engineering Department, Tsinghua University, China, and was promoted as an Associate Professor and Specially Appointed Researcher in Dec. 2011 and Feb. 2016, respectively. In 2015, he was a visiting scholar in the Electrical Engineering and Computer Science Department, University of California, Berkeley, USA. His current research interests is plasmonic optoelectronic devices and their applications. He published about 90 peer-review journal papers, which was cited by more than 700 times. He proposed and realized the hybrid plasmonic-dielectric coupler, integrated plasmonic bio-sensor, plasmonic metal nanoparticle enhanced thin-film solar cells, and two surface-plasmon-polariton absorption based nano-lithography, which were published by Applied Physics Letters, Sensors and Actuators B, Scientific Reports, and Optics Express. Recently, he demonstrated for the first time the threshold-less Cherenkov radiation and realized the first on-chip free-electron light source in the world. The paper was published as the "home-page paper" by Nature Photonics in May, 2017. In the same issue, a news/views paper "A low-energy Cherenkov glow" reported his achievements and commented. This work was selected as "10 Breakthroughs of China Optics in 2017".

14:30-15:00, August 8

High power continuous wave operation of 1.3-μm quantum-dot PCSEL

Sicong Tian

Changchun Institute of Optics, Fine Mechanics and Physics, CAS, China

Abstract

1.3-μm surface-emitting lasers are key devices for long distance optical interconnects. However, presently the low output power of several milliwatts limits their application. In this study, by introducing a special two-dimensional photonic-crystal and using InAs quantum dots as active material, a continuous-wave output power of more than 13.3 mW, at a wavelength of 1301 nm, for a single-mode photonic-crystal surface-emitting laser under room-temperature is achieved. The increased output power results from a flat band structure of the photonic crystal and an extra feedback mechanism. The surface emission is realized by the diffraction of the photonic crystal and thus no distributed Bragg reflector is needed. Our results promise to overcome present limitations for applications, which suffer from low-power.

Biography

Si-Cong Tian received his B. Sc. and Ph. D. degree in Physics from Jilin University, China. Then he joined CIOMP, CAS in 2012. In 2016-2017 he studied in Arkansas University, US, as a visiting scholar. Currently, he is an Associate Professor at "Bimberg Chinese-German Center for Green Photonics", CIOMP, CAS. His research interest includes Vertical-cavity surface-emitting lasers, photonic crystal lasers and quantum optics.

- 08:30-09:00, August 9 -

Plasmonics for sensors and optical filters

Junpeng Guo

University of Alabama in Huntsville, USA

Abstract

Metal nanostructures are plasmonic optical resonators which can store electromagnetic energy at the localized plasmonic resonance modes. To utilize localized surface plasmon resonance, various surface plasmon resonance sensors have been proposed and investigated. However, these surface plasmon resonance sensors rely on optical

spectrometers for localized surface plasmon resonance measurement. In this talk, I will present a new surface plasmon resonance sensor platform based on super-period metallic nano-gratings. The new plasmonic sensor platform can measure localized surface plasmon resonance without using optical spectrometers. Additionally, optical filters based on metal thin film structures will be discussed in this talk.

Biography

Junpeng Guo received a Ph.D. degree from the University of Illinois at Urbana-Champaign and a Bachelor of Science degree from the Peking University, Beijing. He started his career as a Research Scientist with the Rockwell International Science Center in Thousand Oaks, California and later joined the Sandia National Laboratories in Albuquerque, New Mexico. He joined the faculty as a Professor of Electrical Engineering and Optics at the University of Alabama in Huntsville in 2005. Prof. Guo is a Fellow of the International Society for Optics and Photonics. He currently serves as an Associate Editor of Photonics Research and also serves as an Associate Editor of Journal of Nanophotonics. His areas of research are nanophotonics, plasmonics, and metamaterials devices for biosensors, optical filters, and solar energy harvesting.

- 09:00-09:30, August 9 -

Light manipulation by dispersion tuning from elliptic to hyperbolic structures

Hong Chen
Tongji University, China

Abstract

Manipulating the topological property of iso-frequency contour (IFC) from a closed ellipsoid to an open hyperboloid will provide a unique control for the interaction between light and matter. In this talk, I will discuss our recent studies on manipulation of light by topological tuning of IFC in the following two examples: (1) Light emission control by topological tuning of IFC. Based on metamaterials made of transmission lines, we experimentally demonstrate the magnetic topological transition of dispersion in anisotropic two-dimensional metamaterials. Different emission patterns from a point source are observed in microwave experiments as the result of the topological transition. (2) Band gap control by topological tuning of IFC. A mechanism for dispersion control of band gap is proposed based on phase compensation effect between hyperbolic and elliptic structures. Band gap with designed properties, such as blue or red shift, and even invariant of the band gap with the incident angles, are realized in 1-D stacked structures consisted of hyperbolic and elliptic materials.

Biography

Hong Chen, distinguished professor in the school of physics science and engineering at Tongji University. He received his B.Sc. degree in physics from Fudan University in 1982 and Ph.D. degree in condensed matter physics from Shanghai Jiaotong University in 1986. His research interests include photonic crystals, metamaterials, plasmonics, and artificial microstructures for manipulation of classical and quantum waves. For his work, Hong Chen has received several awards. In 1997 he received the Outstanding Young Scientist Award from National Nature Science Foundation of China and in 1999 he received the National Award for Natural Sciences by the State Council of China.

- 09:30-10:00, August 9 -

Pseudo-local metamaterials with extraordinary parameters and applications

Yun Lai
Nanjing University, China

Abstract

Metamaterials are often described by effective media with unusual effective parameters. Due to the deep sub-wavelength scale of the metamaterial structures, the effective parameters of metamaterials usually do not have spatial dispersion. However, when the structure is at the wavelength scale, spatial dispersion emerges in metamaterials. In this talk, I will demonstrate a new type of pseudo-local metamaterials which exhibits both frequency and spatial dispersions. Interestingly, under some circumstances, such metamaterials behave exactly like the local media and can be described by extraordinary parameters that are difficult to realize in the standard metamaterial approach. While in some other cases, the unique feature of nonlocality can enable some extraordinary applications that are not possible by traditional metamaterials as local effective media.

Biography

Prof. Yun Lai obtained his PhD degree in physics in Hong Kong University of Science and Technology (HKUST) in 2005. He worked as a research associate in HKUST from 2005-2011 and a professor in Soochow University from 2011-2017. Prof. Lai has joined the school of physics in Nanjing University since 2018. Prof. Lai proposed various concepts and theories in metamaterials, such as illusion optics, double zero media, ultratransparent media, hybrid elastic solids, percolation of light, hybrid cloaks, etc. He has published more than 60 peer-reviewed papers on SCI journals, including 2 on Nature Materials, 7 on Physical Review Letters/X, 2 on Nature Communications, etc. Total citation number exceeds 2000. Some findings were reported by Science、Nature、Nature Materials、Discovery Channel, etc. Prof. Lai was enrolled in the first patch of Thousand Youth Talents Program in China.

- 11:00-11:30, August 9 -

Topological photonics in synthetic spaces

Hui Liu
Nanjing University, China

Abstract

The notion of synthetic dimensions has been expanded the realm of topological physics to four dimensional (4D) space lately. In this work, non-Hermiticity is used as a synthetic parameter in PT-symmetric photonic crystals to study the topological physics in 4D non-Hermitian synthetic parameter space. We realize a 3D exceptional hypersurface (EHS) in such 4D parameter space, and the degeneracy points emerge due to the symmetry of synthetic parameters. We further demonstrate the existence of exceptional degenerate points (EDPs) on the EHS that originates from the chirality of exceptional points (EPs), and the exceptional surface near EDPs behaves like a Dirac cone. We further show that a very narrow reflection plateau can be found near these EDPs, and their sensitivity towards the PT-symmetry breaking environmental perturbation can make these degeneracy points useful in optical sensing and many other nonlinear and quantum optical applications.

Biography

Hui Liu, Professor at Nanjing University, Associate director of National Key Laboratory of Solid State Microstructures. National Science Foundation for Outstanding Young Talents of China. Hui Liu received his Ph.D. in 2003 from Department of Physics, Nanjing University in China. In 2004-2005 he did postdoctoral research at University of California at Berkeley. Since 2006, he is a professor of physics at Nanjing University in China. His research interest includes optical metamaterials, transformation optics, and curved space-time in photonic chips. He has published over 70 SCI papers, including Nature Photonics, Nature Communications, Phys. Rev. Lett, etc. He has taken charge of several national projects, including "863" key projects and NSFC projects.

- 11:30-12:00, August 9 -

Guiding and routing the light in valley topological nanophotonics

Jianwen Dong

Sun Yat-sen University, China

Abstract

The discovery of topological photonics provides a new degree of freedom to control the flow of light, enabling novel optoelectronic functionalities and devices in silicon-on-insulator (SOI) platform. However, the subwavelength strategy at micro-nano scale remains challenge. Recent developments of valley photonic crystals pave an alternative way to achieve SOI topological nanophotonic devices with high performance. We have a theoretical proposal on all-dielectric valley photonic crystals (VPCs) with nonzero valley Chern number by employing valley degree of freedom, as well as turn such proposal VPCs into reality by using all-dielectric rods at microwave region. Recently, we have realized a VPC in a silicon wafer on the top of silicon dioxide substrate, i.e. SOI slab. Valley-dependent topological edge states operate below the light cone so that the photonic crystal slab can strongly confine the propagating waves in the plane of chip. Benefit from near-quarter-wavelength periodicity, our VPC can develop a high-performance topological photonic device with a compact feature size. We have fabricated flat-, Z- and Omega-shape topological channels and measured their flat-top high-transmittance spectra with relatively large bandwidth. Such phenomena give evidences for the observation of robust transport at telecommunication wavelength. Finally, we have experimentally demonstrated on-chip topological photonic routing, based on the VPC chiral channel. With introducing a subwavelength microdisk to serve as phase vortex generator, the valley-chirality-locked edge state is selectively excited. The work shows a prototype of on-chip photonic devices based on topological modes and photonic analog of quantum information processing.

Keywords: Topological photonics, Nanophotonics, Valley

Biography

Jian-Wen DONG, NSFC Excellent Young Scientists, Cheung Kong Scholar Youth Professor, is now the Professor in Sun Yat-sen University, Guangzhou, China. Research of the Dong group focuses on the fundamental physics and optical information applications of topological photonics, nanophotonics, photonic crystal and metasurface. Dr. Dong has published several original works in high impact journals including Nature Materials, Physical Review Letters, Nature Communications, two of which are selected as ESI highly-cited papers, and the "top ten progress of Chinese optics in 2017 - basic research".

- 13:30-14:00, August 9 -

Angular momentum-dependent topological transport

Meng Xiao

Wuhan University, China

Abstract

Recent efforts to realize classical wave topological materials have given rise to the emerging field of topological photonics. The classical counterpart of the quantum Hall effects are typically achieved by breaking time reversal

symmetry, while the nontrivial topologies of the quantum spin Hall effect are usually realized through spin-orbital coupling. Due to the absence of intrinsic Kramers' degeneracy in classical waves, the classical analogs of the quantum spin Hall effect are realized by constructing pseudo-spins. Apart from polarization (spin), the angular momentum of classical waves also offers an alternative way to control wave propagation. Here in this talk, we show that the non-trivial topology of a system can also be realized using orbital angular momentum through a coupling between the angular momentum and the wave vector. To be more specific, we demonstrate that a system can exhibit angular momentum-dependent topological properties through angular-momentum-orbital coupling. Similar as other topological nontrivial systems, the boundary of such a system possesses one-way edge states that are locked to the angular momentum. Meanwhile, time reversal symmetry is kept in this system. We also provide a proof-of-principle experimental demonstration using a transmission line network. Inside finite systems, we will see that local Chern numbers can be used to characterize the topology of a small cluster of such network systems for each angular momentum subspace. The idea discussed in this work can in principal be generalized to other waves.

Biography

Meng XIAO is currently an assistant professor in Wuhan University. Before that, he was a postdoc working with Prof. Shanhui Fan in the electrical engineering department of Stanford University. He got his Ph. D. from the Hong Kong University of Science and Technology (Supervisor: Prof. C. T. Chan) and bachelor's degree from Wuhan University. Dr. Xiao is now working on topics such as wave functional material, topological photonics and topological phononics.

- 14:00-14:30, August 9 -

Pseudospin and topological phenomena in photonic graphene

Daohong Song
Nankai University, China

Abstract

Photonic graphene, the photonic analog of graphene constructed with waveguide arrays arranged in honeycomb lattice (HCL) geometry, has provided a useful platform to emulate graphene physics and topological phenomena that would otherwise be inaccessible in real graphene. In recent studies, artificial HCLs have been successfully employed to investigate a variety of fundamental phenomena such as strong sublattice symmetry breaking, strain-induced pseudomagnetic fields, Berry curvature effects and photonic topological insulators. Pseudospin, inherent sublattice degree of freedom, is commonly considered as only a mathematical analogy with electron spin, but recent theoretical studies and experimental observations suggested that pseudospin is also gifted with a real angular momentum. In this talk I will present some of our recent work related to pseudospin-mediated vortex phenomena arising from pseudospin to orbital angular momentum conversion in photonic graphene, including pseudospin dependent vortex generation, topological charge flipping and topological charge transformation. Moreover, the valley vortex states and degeneracy lifting related to the valley degree of freedom in momentum space will also be discussed.

Biography

Daohong Song is an associated professor at school of Physics, Nankai University. He received his B.S and P.H.D degree from Nankai University in 2004 and 2009, respectively. His current research interests focus on novel optical phenomena in Dirac-like periodic structures. He has published many papers in prestigious journals including Nature Materials, Nature Communications, and Physical Review Letters.

Oral Talks

CIOP2019-2019-000086 (15:15-15:30, August 7)

Nanofabrication via synergistic effect of plasmonic heating and optical forces

Tao Ding

Wuhan University, China

Abstract: Optical forces combined with plasmonic heating can induce particle deformation and nanolithography of polymer films. These effects strongly modify the plasmon resonances and enrich the toolbox of nanofabrication and nanomanipulation.

CIOP2019-2019-000142 (17:00-17:15, August 7)

Plasmonic tip excited by radial vector beam for surface enhanced raman spectroscopy

Min Liu, Fanfan Lu, Wending Zhang, Ting Mei

School of Science, Northwestern Polytechnical University, China

Abstract: Radial vector beam excited silver-film coated fiber tip is presented to enable significantly enhancing Raman intensity. The Raman intensity of malachite green is 15 times as strong as that excited via the linear polarization beam.

CIOP2019-2019-000087 (17:15-17:30, August 7)

A low-loss graphene plasmonic resonance device working at a few hundred GHz

Tong Ye[1,2,3], Bo Wang[1,3], Chun Wang[1,3], Zhiyuan Li[4], Zhenwei Zhang[5], Kuijuan Jin[1,3], Li Wang[1*], Yan Yin[1,3*]

1. Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, CAS, China
2. School of Optical and Electronic Information, Huazhong University of Science and Technology, China
3. School of Physical Sciences, University of Chinese Academy of Sciences, China
4. College of Physics and Optoelectronics, South China University of Technology, China
5. Department of Physics, Capital Normal University, China

Abstract: A low-loss graphene plasmonic resonant modulator is demonstrated and operates at a few hundred GHz and 1 THz. The modulation depth is in excess of 35%. Lifetimes are 100-200 fs, and approach the intrinsic limitation.

CIOP2019-2019-000517 (09:45-10:00, August 8)

Transformation optics based on metasurfaces

Chong Sheng

Nanjing University, China

Abstract: Here we propose and experimentally demonstrate a quantum evolution in close proximity to an artificial black hole on a photonic chip. We successfully observe the quantum creation and evolution processes of a fermion pair: a single-photon wave packet with positive energy escapes from black hole while negative energy is captured. Our platform not only provides a route to access quantum field theory in curved space, but also has the potentiality to investigate quantum gravity.

CIOP2019-2019-000269 (10:00-10:15, August 8)

Analysis of the coupling between surface plasmon polariton mode and dipole mode at terahertz metasurface absorber

Zijian Cui[1,2], Yue Wang[1,2*], Zhu Dongying[1,2], Yue Lisha[1]

1. Xi'an University of Technology, China
2. Harbin University of Science and Technology, China

Abstract: By using the vacuum Rabi splitting model, the interaction of surface plasmon polariton (SPP) mode with dipole mode at terahertz perfect metasurface absorber was investigated.

CIOP2019-2019-000169 (10:15-10:30, August 8)

Plasmonic chiral metasurface induced chiral purcell effect

Yu Peng, Wang Zhiming
University of Electronic Science and Technology of China, China

Abstract: We use chiral metasurfaces to investigate photon interaction in a chiral optical resonator.

CIOP2019-2019-000190 (15:00-15:15, August 8)

Nonlinear microscopy of nanostructures with cylindrical vector beams

Xiaorun Zang, Godofredo Bautista, Léo Turquet, Martti Kauranen
Photonics Laboratory, Physics Unit, Tampere University, FI-33014 Tampere, Finland, Finland

Abstract: Tight focusing of cylindrical vector beams gives rise to unique focal field distributions. Such focal field distributions can be utilized to uniquely characterize nonlinear optical effects from individual nanoparticles and their microscopic assemblies.

CIOP2019-2019-000165 (15:15-15:30, August 8)

Optical traction based on Photonic crystal structures

Hang Li, Weiqiang Ding
Harbin Institute of Technology, China

Abstract: Optical traction is an interesting phenomenon. Exploring this effect in Photonic crystal structures can help to study the momentum transformation, which provide a new degree of freedom for modulating optical force.

CIOP2019-2019-000029 (10:00-10:15, August 9)

Topological phase in optical waveguide arrays with anti-PT symmetry

Shaolin Ke
Laboratory for Optical Information Technology, Wuhan Institute of Technology, Wuhan 430205, China

Abstract: We investigate the topological bound modes in a binary optical waveguide array with anti-parity-time symmetry. The topological phase transition in anti-PT-symmetric arrays is closely related to the imaginary part of band structure rather than its real part, which is different from the case in Hermitian and PT-symmetric systems.

CIOP2019-2019-000037 (10:15-10:30, August 9)

Topological edge state in the X-ray regime

Zhiwei Guo, Qiushi Huang, Jiaju Wu, Haitao Jiang, Zhanshan Wang, Zhong Zhang, Hong Chen
Tongji University, China

Abstract: This work extends the topological photonics to the X-ray regime and provide insightful guidance to the design of novel X-ray devices such as high-resolution X-ray filters or X-ray quantum optics with topological protections.

CIOP2019-2019-000326 (14:30-14:45, August 9)

Narrow linewidth plasmonic optical filter

Rong He
Fu Dan University, China

Abstract: This project is based on nanoscale plasma-resonance ultra-surface narrowband high-resolution optical filter which varies with space and its application in multi-spectral imaging, which has carried out preliminary exploration and research for the future explaration of Mars and the moon.

CIOP2019-2019-000239 (14:45-15:00, August 9)

Plasmonic voltage tunable filter based on H-type resonators

Zhihao Guo, Guanmao Zhang, Litao Qiao, Yaping Zhao, Panpan Ren
School of Information Science and Engineering, Lanzhou University, China

Abstract: The plasmonic voltage tunable filter based on organic Electro-Optical materials DAST is proposed by using the side-coupled method, the transmission characteristics of the filter can be adjusted by changing the structural parameters and control voltage.

SC3 Ultrafast and Nonlinear Phenomena

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Complexity, topology, and machine learning in nonlinear optics (Tutorial)

Claudio Conti
University Sapienza of Rome, Italy

Abstract
Complexity is a notion that has several denotations. When applied to wave propagation, in highly nonlinear regimes, we first consider statistical phenomena, as rare events, and lastly, we resort to strongly interacting dynamics, as in turbulence and spin glasses. Nonlinear optical phenomena cover all the aspects of modern complexity, leading to impressive results as the first observation of replica-symmetry breaking. The tour also includes the more recent topological concepts, which are useful in classifying extreme waves, like shocks, rogues, and soliton gases. Nowadays, one can also benefit from machine learning and artificial intelligence, as the highly nonlinear and disordered models have a remarkable rule in large-scale deep neural networks. One can use waves to solve computationally demanding tasks, as in the optical Ising machines. Reservoir computing in multiple scattering media may open the way to new applications in quantum optics and biomedicine. I will review all these links between nonlinear waves and complexity.

SC3

Biography
Prof. Claudio Conti (Department of Physics, University Sapienza, Rome, Italy) is the Director of the Institute for Complex Systems of the Italian Research Council (ISC-CNR). Formerly New Talent of the Enrico Fermi center, grantee of the European Research Council, and Humboldt fellow, his main research interests include nonlinear spatiotemporal bullets and X-waves, nonlocal nonlinear optics, extreme phenomena as rogue waves and optical turbulence, Anderson localization of light, and topological photonics. More recently he led the experiments demonstrating the first observation of replica symmetry breaking in random lasers and nonlinear optical propagation. Other recent work includes the realization of Ising machines and deep learning with nonlinear optics. He published more than 200 articles in international journals with more than 30 papers in Physical Review Letters and ten papers in Nature journals.

- 14:15-14:45, August 7 -

Optical force and nonlinear phenomena in biological suspensions

Zhigang Chen
Nankai University, China

Abstract
In the past decade, the development of artificial materials exhibiting novel optical properties has become one of the major scientific endeavors. One system of particular interest is with bio-soft-matter, which play a central role in numerous fields ranging from life sciences to chemistry and physics. In this talk, I will present a brief overview of our work on a few types of soft-matter systems with synthetic optical nonlinearities, including dielectric and plasmonic nanosuspensions. I will then focus on discussion about our recent work on nonlinear optics with biological suspensions, including self-trapping and guiding of light in colloidal suspensions of algal cells and human red blood cells, where the tunable nonlinearity is largely attributed to the optical forces acting on the cells.

Biography

Zhigang Chen earned his Ph.D. from Bryn Mawr College and did his postdoctoral research at Princeton Univ before joining the faculty at San Francisco State Univ in California. He is currently a specially appointed professor at Nankai University, China. He has published over 200 papers in refereed journals including some 20 PRLs, with an h-index of 48 (according to Web of Sci.). Dr. Chen is a Fellow of the Optical Society of America and a Fellow of the American Physical Society. He is a Topical Editor for *Optics Letters*, and served as a Program/General Chair for CLEO-Fundamental Science in 2016/18.

- 14:45-15:15, August 7 –

Multiphoton energy absorption and deposition in strong-field ionization of molecules

Jian Wu

East China Normal University, China

Abstract

The primary phase of the light-molecule interaction is the photon energy absorption and deposition. Although the electron is much lighter than the nuclei, there is a strong electron-nuclear correlation for molecules exposed to strong laser fields. Here, we experimentally reveal the correlated electron-nuclear dynamics by measuring the electrons and nuclear fragments ejected from a single molecule in coincidence. Our experimental results show that the electron and nuclei in a molecule share the absorbed multiphoton energy in a correlative manner. The molecule as a whole absorbs the photon energy. The electron-nuclear energy sharing assisted by the rescattering lead to the observation of long-term predicted photon-energy spaced above threshold dissociation spectrum of breaking molecules, which is the interference of the periodically emitted electron-nuclear wavepacket in the oscillating strong laser fields. Interestingly, for molecules in strong laser fields, a liberated electron can be recaptured by the ejected ionic fragments, leading to the formation of the excited Rydberg fragments. We real-time observe and further directionally control the dissociative frustrated double ionization of hydrogen molecules. The frustrated double ionization of molecules can be generally understood in a multiphoton route by considering the correlated dynamics of electrons and nuclei of the molecule.

Biography

Wu Jian, Professor of the State Key Laboratory of Precision Spectroscopy, East China Normal University (ECNU). He received his B.S. and Ph.D. degrees from ECNU. He was appointed as an Associated Professor at ECNU in 2007 and promoted to be a full Professor in 2010. With a grant from the Alexander von Humboldt Foundation, he carried out his postdoctoral research at the Goethe University Frankfurt. He was selected as the Distinguished Young Scholars of NSFC (2014), Ten-thousand Talents Program (2019), National Youth Top-notch Talents (2015), the New Century Excellent Talents in University (2013), and the Eastern Scholar of Shanghai Municipal Education Commission (2013). He was invited to serve as the International Advisory Board of the Journal of Physics B (Royal Society of Physics). His research focuses on the measurement and control of the ultrafast dynamics of molecules in strong laser fields. He has published more than 100 papers in peer-reviewed journals, including 19 PRL, 1 PNAS, 1 PRX, and 5 Nature Communications.

- 16:00-16:30, August 7 -

The Stern-Gerlach effect in nonlinear optics

Ady Arie

Tel Aviv University, Israel

Abstract

The Stern-Gerlach effect, separating the electron spin components of Silver atoms that pass in a transversely varying

SC3

magnetic field, is considered one of the cornerstones of quantum mechanics. I will discuss an analogue effect in nonlinear optics, based on the mixing of two different light waves (signal and idler waves) in a quadratic nonlinear crystal.
The dynamics of the nonlinear sum frequency generation process is similar to that of many other two-level systems, and in particular to spin-1/2 particles in magnetic field. Therefore, light beams that carry signal-idler superposition states can be spatially separated by transversely varying the nonlinear optical coupling. When non-classical light, consisting of a signal-idler two-photon pair, is sent into the nonlinear Stern-Gerlach device, these photons emerge together at one of the two output ports, thus representing the frequency domain analogue of the famous Hong-Ou-Mandel interference experiment. Furthermore, this concept can be further extended to higher dimensions in the frequency domain, by using quasiperiodic crystals that support two sum frequency generation processes.

Biography

Prof. Ady Arie received his Ph.D. degree in Electrical Engineering from Tel-Aviv University, Israel, in 1991. Between 1991 and 1993 he was a Wolfson and Fulbright postdoctoral scholar at Stanford University, U.S.A. In 1993 he joined School of Electrical Engineering at Tel-Aviv University and became a Full Professor in 2006. He served as the Head of the School of Electrical Engineering in the years 2013-2017. Currently he is the Head of the Tel Aviv University Center for Light-Matter Interaction and the incumbent of the Marko and Lucie Chaoul Chair in Nano-Photonics.
Prof. Arie is a Fellow of the Optical Society of America. In the years 2008-2014 he served as a Topical Editor of *Optics Letters* and since 2018 he is an Associate Editor in *Optica*. His research in the last years is in the areas of nonlinear optics – in particular periodic and quasi-periodic nonlinear photonic crystals, nonlinear beam shaping and control – as well as in electron microscopy and plasmonics.

- 16:30-17:00, August 7 -

Characterization of laser-pulse parameters by strong field ionization

Liangyou Peng
Peking University, China

Abstract

The interaction of strong laser pulses with atoms can induce highly nonlinear processes such as above-threshold ionization and high-order harmonic generation. The differential distribution of the ionized electron or the harmonic radiation is sensitively dependent on the specific laser parameters. In this talk, we will discuss several examples of how one can use the strong field ionization to accurately characterize some specific parameters of the laser pulse. The first example is how one can in situ measure the ellipticity of the pulse based on sub-cycle ionization dynamics by two time-delayed identical counterrotating elliptically polarized laser pulses. The second one is how to extract the tiny electron displacement that can be induced by a short laser pulse by using a ruler formed by the interfering spirals in the photoelectron momentum distribution generated by two oppositely circularly polarized pulses. Finally, we will discuss the possibility to retrieve the waveform of an IR pulse by the attosecond streaking of a degenerate state.

Biography

Liang-You Peng is currently a Boya Professor of Physics at Peking University, Beijing, China. In 1998, Dr. Peng was awarded bachelor degree in physics from Central China Normal University, Wuhan, China. He received his PhD in 2005 from Queen's University Belfast, UK, after which he did his postdoctoral research at the University Nebraska-Lincoln, USA. Since 2007, he has been a faculty member in the School of Physics, Peking University. His main research interest focuses on the theoretical and computational studies on the dynamics of the laser-matter interaction, in particularly those processes in the few-body atomic and molecular systems and the solid targets.

- 09:00-09:30, August 8 -

Gigawatt soft-x-ray attosecond super-continuum

Eiji J. Takahashi
RIKEN, Japan

Abstract

A stable multi-TW three-channel optical waveform synthesizer is demonstrated and used for reproducibly generating a high-order harmonics super-continuum in the soft-x-ray region. This synthesizer is composed of pump pulses from a 10-Hz repetition rate Ti:sapphire pump laser and signal and idler pulses from an infrared two-stage optical parametric amplifier driven by this pump laser. With the full active stabilization of all relative time delays, relative phases, and carrier-envelope phase, a shot-to-shot stable intense continuum harmonic spectrum is obtained around 60 eV with a pulse energy above 0.24 μ. The peak power of the soft-x-ray continuum is evaluated to be beyond 1 GW with 140 as transform limit duration, which indicates the feasibility to perform pump-probe spectroscopy with isolated attosecond pulses in the soft-x-ray region.

Biography

Eiji J. Takahashi is a Senior Research Scientist in the Extreme Photonics Research Group, RIKEN. His research interests include high-intensity laser-matter interactions, generation of coherent soft-x-ray/XUV pulses, attosecond science, and high-power laser technology.

SC3

- 09:30-10:00, August 8 -

MIR femtosecond laser

Yuxin Leng
Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

High energy carrier envelope phase (CEP) stable near-single-cycle pulse in the mid-infrared (MIR) 3-5 μm spectral range attracted much attention in many areas of unexplored strong field physics, such as high harmonic generation (HHG) for extending cutoff energy to keV range to generate broadband and isolated ultrashort coherent soft x-ray pulse.

We have demonstrated the 800nm few cycle laser pulse compression, and extend the working wavelength to 1.8 μm with carrier envelope phase (CEP) stability. Recently, a CEP stable near-single-cycle 4 μm laser system is demonstrated, which can deliver laser pulse with 2.6 mJ/21.5 fs operating at 100 Hz repetition rate with 2 optical cycle pulse duration. The system is based on a collinear OPCPA and a hollow-core-fiber (HCF) based further compression scheme. In this laser, OPCPA is used which has tremendous potential for higher output capability with higher pump, and HCF based post-compressor is employed for further compression which can be applied for MIR laser with longer wavelength.

Further, we developed two beam OPCPA MIR femtosecond laser outputs with synchronization. The coherent beam combination based on HCF has been demonstrated.

Biography

Yuxin Leng, Ph.D. he is a professor in State Key Laboratory of High Field Laser Physics at SIOM. He is currently investigating development and application of high field ultrafast laser, including optical parametric chirped pulse amplification (OPCPA); the ultra-intense and ultra-short laser based on Ti:sapphire chirped pulse amplifier; and carrier-envelopment phase (CEP) stabilized tunable high intense ultra-short infrared coherent radiation source; new laser source and its applications.

- 11:00-11:30, August 8 -

Nonlinear optical properties and ultrafast carrier dynamics in $PtSe_2$ and PtS

Jun Wang
Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

The demand for an ultrabroad optical material with a bandgap tunable from zero to at least 1~2 eV has been one of the driving forces for exploring new 2D materials since the emergence of graphene, transition metal dichalcogenides and black phosphorus. As ultra-broadband 2D materials with energy bandgap ranging from 0 to 1.4 eV, layered $PtSe_2$ and nonlayered PtS show much better air stability than black phosphorous. In this work, both high quality of centimeter scale $PtSe_2$ and PtS films with controllable thicknesses were prepared through thermally assisted conversion method. The nonlinear optical performance and ultrafast dynamics have been systematically studied experimentally and theoretically. In the layered $PtSe_2$, the optical bandgap increased with the sample thickness decreasing, which is opposite in the nonlayered PtS films. Besides, we found a transition from semiconductor to semimetal in $PtSe_2$, however, we have not observed this phenomenon in PtS. Combining with rate equation, first principle calculation, electrical measurements and a model based on quantum mechanical wave function, we provide a comprehensive understanding on the evolution of nonlinear optical properties and ultrafast carrier dynamics. These results are important to explore nonlinear optical devices based on the 2D materials, such as saturable absorber, optical switches, etc.

Biography

Jun Wang is a professor with Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences (CAS). He obtained the PhD degree from the Chinese University of Hong Kong in 2006. Then he was granted an IRCSET postdoctoral fellowship and worked at Trinity College Dublin, Ireland. In 2011, he relocated his research activities to SIOM under the financial support from the 100-Talent Program of CAS. In 2018 and 2015, he was awarded by the National 10000-Talent Program and National Natural Science Foundation-Outstanding Youth Foundation, respectively. His research interests are focused on nonlinear optics in low-dimensional materials. So far, he has published more than 130 peer-reviewed SCI journal papers in Nature Nanotech., Prog. Mater. Sci., Adv. Mater., Nature Commun., ACS Nano, Laser Photon. Rev., etc., including 8 ESI papers and having over 4000 citations.

- 11:30-12:00, August 8 -

Light, sound and microwave induced modulation in a microcavity Brillouin laser

Wenjie Wan
Shanghai Jiao Tong University, China

Abstract

Optical waves, acoustic waves, and microwaves usually do not mix together in the same physical platform due to their inherent distinct wave nature. However, at the microscopic scale, these waves can unexpectedly interact with the same microstructure through resonant enhancement, making it unique hybrid micro-system for new application across multiple physical channels. Here we experimentally demonstrate an optomechanical microdevice based on Brillouin lasing operation in an optical microcavity as a sensitive unit to sense external light, sound, and microwave signals in the same platform. These waves can induce modulations to the microcavity Brillouin laser in a resonance-enhanced manner through either the pressure forces including the optical radiation pressure force or the thermal absorption according to its physical nature, allowing several novel applications such as broadband none-photovoltaic detection of light, sound-light dual channel communication and deep-subwavelength microwave imaging. These results pave the way towards on-chip integrable optomechanical solutions for sensing, free-space secure communication, and microwave imaging.

Biography

Wenjie Wan received the B.E. from the Hong Kong University of Science and Technology in 2004 and Ph. D from at Princeton University in 2010, both in Electrical Engineering. After one year postdoctoral training at Yale University, he joint UM-JI as Assistant Professor and jointly appointed by Department of Physics, SJTU. Dr. Wan's publications include Science, Nature Physics, Nature Photonics and Physical Review Letters. He is the recipient of the 2009 Chinese Government Award for Outstanding Self-Financed Students Abroad. In 2011, he is awarded "1000 people's plan (youth)" by Chinese Government.

- 13:30-14:00, August 8 -

An anatomy of strong-field ionization-induced air lasing

Ya Cheng

East China Normal University, China

Abstract

It is known that in an intense laser field of a sufficiently high strength combined with a sufficiently long wavelength, i.e., in the regime of the Keldysh parameter $\gamma<1$, photoionization of atoms and molecules can be realized through a quantum tunnel process. The tunnel ionization preferentially occurs from the orbital with the lowest ionization energy, thus the majority of the generated ions will stay on the ground state. It is surprising that tunnel ionization of nitrogen molecules with mid- and near-infrared intense laser fields can initiate strong laser-like emissions, indicating generation of stimulated emissions in molecular nitrogen ions. The physical mechanism behind the observation is still under debate. Here, we review the major progresses we made in the past a few years. The focus is placed on investigations on the lasing action at 391 nm wavelength initiated by either mid-infrared strong laser fields in the wavelength range from 1.2 to 2 μm or near-infrared intense laser fields around 800 nm wavelength. We reveal that the mechanisms of lasing actions are different for the pump lasers in the above two spectral regions. We also show that the coherent wave packets of molecular nitrogen ions generated in the intense laser fields uniquely allow for efficient nonlinear interaction with light at resonance frequencies.

Biography

Professor Ya Cheng's research mainly focuses on ultrafast nonlinear optics and femtosecond laser micro- and nanofabrication. Currently, he is the Dean of the School of Physics and Materials Science, East China Normal University, and the Professor of Shanghai Institute of Optics and Fine Mechanics, CAS.

- 14:00-14:30, August 8 -

Ultrafast tunable photonic microstructure materials

Xiaoyong Hu

Peking University, China

Abstract

Tunable photonic microstructure materials play an important role in the fields of integrated photonic devices and circuits. Ultrafast response time could be reached by using all-optical control method based on third-order optical nonlinearity. Several photonic microstructure materials, including photonic crystal topological insulator, metamaterials, and plasmonic nanostructure were fabricated and all-optical tunability was realized.

SC3

Biography

Xiaoyong Hu is the professor of physics at Peking University. He worked as a postdoctoral fellow with Prof. Qihuang Gong at Peking University from 2004 to 2006. Then he joined Prof. Gong's research group. Prof. Hu's current research interests include photonic crystals and nonlinear optics.

- 14:30-15:00, August 8 -

Determination of the carrier-envelop phase of PW laser pulses

Jianxing Li
Xi'an Jiaotong University, China

Abstract

The impact of the carrier-envelope phase (CEP) of an intense multi-cycle laser pulse on the radiation of an electron beam during nonlinear Compton scattering is investigated. We have identified a CEP effect specific to the ultrarelativistic regime. When the electron beam counterpropagates with the laser pulse, pronounced high-energy x-ray double peaks emerge near the backward direction relative to the initial electron motion. This is achieved in the relativistic interaction domain, where both the electron energy is required to be lower than for the electron reflection condition at the laser peak and the stochasticity effects in the photon emission to be weak. The asymmetry parameter of the double peaks in the angular radiation distribution is shown to serve as a sensitive measure for the CEP of up to 10-cycle long laser pulses and can be applied for the characterization of extremely strong laser pulses in present and near future laser facilities.

SC3

Biography

Prof. Dr. Jianxing Li received his Ph.D. degree in 06.2011 at Nankai University, China. Afterwards, he moved to Max-Planck Institute for Nuclear Physics, Germany, for postdoctoral research until 08.2017. Since he did great research achievements in the topics of strong laser QED and laser plasma interaction, he received a full-professor position in Xi'an Jiaotong University, China at 09.2017. Right now, he is leading a strong laser QED group there. Recently, he and his colleagues developed a new method to detect robust signatures of quantum radiation reaction in focused ultrashort laser pulses [Phys. Rev. Lett. 113, 044801 (2014); Phys. Rev. A 98, 052120 (2018)], proposed a laser-electron-reflection regime to generate attosecond and vortex Gamma-ray pulses via nonlinear Compton scattering in the radiation-dominated regime, respectively [Phys. Rev. Lett. 115, 204801 (2015); Phys. Rev. Lett. 121, 074801 (2018)], presented a potential radiation-stochasticity-effects observation method via photon angle-resolved spectra [Sci. Rep. 7, 11556 (2017)], and invented an approach for the determination of the carrier-envelope phase of current available and under construction PW laser pulses [Phys. Rev. Lett. 120, 124803 (2018); Phys. Rev. A 99, 013850 (2019)].

- 08:30-09:00, August 9 -

Nucleation and dissociation of methane clathrate embryo at the gas/water interface

Chuanshan Tian
Fudan University, China

Abstract

Among natural energy resources, methane clathrate has attracted tremendous attention because of its strong relevance to current energy and environment issues. Yet little is known about how the clathrate start to nucleate and disintegrate at the molecular level, because such microscopic processes are difficult to probe experimentally. Using surface-specific sum-frequency vibrational spectroscopy, we have studied in situ the nucleation and disintegration

of methane clathrate embryos at the methane gas/water interface under high pressure and different temperatures. Before appearance of macroscopic methane clathrate, the interfacial structure undergoes three stages as temperature varies, namely, dissolution of methane molecules into water interface, formation of cage-like methane-water complex, and appearance of microscopic methane clathrate, while the bulk water structure remains unchanged. We find a clear vibrational spectral feature of the methane-water complex, which is the intermediate microscopic structure appears in induction time. Its structure is rather stable in a wide temperature window, the existence of which is associated with the so-called “memory effect” during re-crystallization from a melted solid clathrate. Our findings not only provide a better microscopic understanding on the nucleation mechanism of clathrates, but also open up an opportunity for rational control of their formation and disintegration.

Biography

TBA

- 09:00-09:30, August 9 -

3D ferroelectric domain engineering with ultrafast light

Yan Sheng

Australian National University, Australia

Abstract

Ferroelectric materials exhibit natural tendency to form finite size (macroscopic) domains of electric polarization. These domains have different orientations and coexist in the medium being separated by domain walls. Domain formation has been a subject of continuous research interest and investigations because of a number of actual and potential applications of domain structures in a variety of fields, including linear and nonlinear optics (e.g. optical signal modulation, frequency conversion, nonlinear volume holography), future electronics, non-volatile memories, photovoltaics. In this talk we present our latest study of ferroelectric domain formation and engineering with tightly focused femtosecond laser beams. The unique features of this, discovered by us, domain formation process based on interaction of high-intensity ultrashort light pulses with ferroelectric, allows one not only to study the fundamental physics of micro- and nano-engineered domains in the important class of materials of ferroelectrics, but also to overcome the insurmountable challenge of the other traditional poling techniques by doing it in 3-D without any restrictions imposed on the material orientation and the domain pattern geometry to be inscribed.

Biography

Dr. Yan Sheng received her PhD degree in Optical Physics from the Institute of Physics, Chinese Academy of Science (Beijing, China) in 2007. After this she undertook a two-year postdoctoral position at Max-Planck Institute for Polymer Research (MPIP), Mainz, Germany. This period involved versatile research programs in nonlinear optics and materials. In March 2010, she joined Laser Physics Center, Australian National University as an Australian Postdoctoral Fellow (APD) to continue her research in nonlinear optics. Dr. Sheng currently is a Fellow at the Australian National University and her research interests include nonlinear photonic crystals, quasi-phase matching, and direct femtosecond laser writing technique.

- 09:30-10:00, August 9 -

High-flux attosecond pulse generation

Xinkui He
Institute of Physics, CAS, China

Abstract
In this talk I will report our work on high flux attosecond generation. We propose a new approach for producing high flux isolated attosecond pulses (IAP) based on non-collinear geometry of high-order harmonic generation (HHG). By combining a main driving pulse and an ultrashort gating pulse in the interaction medium to form a tilt wavefront in a narrow overlapping time region, the attosecond pulses generated in this region are spatially separated from the original beam in the far field. It gives a way of extracting IAP as well as fully characterizing attosecond pulse train (APT). Since the new approach set no restriction on the pulse duration of the main driving pulse, it is particularly suitable for high flux IAP generation by high energy laser which usually has multicycle pulse duration.

Biography
He Xinkui received his PH. D. in high intense field laser physics at Shanghai Institute of Optics and fine Mechanics Chinese Academy of Sciences in 2005. From 2005 to 2007, He worked as a postdoc in the Institute of Solid State Physics in the University of Tokyo. From 2007 to 2010, He was a postdoctoral researcher supported by the prestigious Marie Curie Incoming International Fellowship working at atomic physics department Lund laser centre of Lund University. In 2011, he got his present position, associate professor in the Institute of Physics Chinese Academy of Sciences.

His scientific research field is high intense laser physics, including development of ultra-fast high power laser and study of the intense laser matter interaction. Currently he is concentrating on high-order harmonic generation from odd gas driven by ultra-fast high power laser. Develop usable table-top XUV source by improving and optimizing high harmonic generation. Investigate the application of this exciting source such as XUV imaging, nonlinear optics in XUV range. The most important application of the high order harmonic generation is attosecond physics, which is now his main research content. Including the generation and characterizations of attosecond pulses and using the generated pulses to investigate the ultrafast dynamics of the electric wave package with attosecond time resolution.

- 11:00-11:30, August 9 -

Ultrafast energy transfer in hydrated biomolecule complex via intermolecular Coulombic decay

Xueguang Ren
Xi'an Jiaotong University, China

Abstract
Intermolecular Coulombic decay (ICD) in clusters plays an important role for the production of highly active secondary species like low-energy electrons. ICD has been studied in numerous systems, e.g. in the Van-der-Waals clusters, hydrogen-bonding water dimers and larger water clusters as well as in the biochemically relevant systems associated with water. Here, we investigate ICD in mixed clusters consisting of water and bio-relevant molecules. The biomolecule employed here is tetrahydrofuran (THF, C_4H_8O) which is often regarded as being an analog of the sugar ring in the DNA backbone linking the phosphate groups and the DNA bases. Experiments were carried out using a multi-particle imaging spectrometer (reaction microscope) in which the kinetic energies of final state electrons and ions are measured. The projectile electron energy of 66 eV is chosen to be in the range of the mean energy of secondary electrons which are produced in great numbers by any high-energy ionizing radiation.

Biography

Professor Xueguang Ren is an experimentalist working in the research field of atomic, molecular and cluster science. E.g. Electron momentum spectroscopy, electron-impact ionization dynamics of atoms, molecules and clusters etc.; developments of (e, 2e) coincidence techniques and reaction microscope or multi-particles coincidence momentum spectrometer induced by electron-impact and ion collisions. Professor Ren has engaged international collaboration in the experimental and theoretical study of ionization dynamics including countries from France, Germany, USA, Czech Republic, etc.

- 11:30-12:00, August 9 -

Strong-field double ionization of atoms: timing recollision and the role of recollision excitation cross section

Huipeng Kang

Friedrich Schiller University Jena, Germany

Abstract

As one dramatic manifestation of electron-electron correlation in nature, strong laser field-induced nonsequential double ionization (NSDI) has continued to receive intense experimental and theoretical attention. The interpretation of NSDI is now based on the recollision scenario, which is also responsible for many other strong field phenomena. We experimentally investigate atomic NSDI and show that the recollision impact direct double ionization by elliptical polarized laser pulses can be used to timing the ultrafast dynamics of recollision and correlated electron energy sharing processes therein. Additionally, we find that recolliding electron impact excitation cross section is vital in describing wavelength dependent NSDI of magnesium atoms, which is different from the well-studied rare gases.

Biography

Dr. Huipeng Kang is a Postdoctoral Research Fellow at Friedrich Schiller University Jena in Germany. He received his PhD in Atomic and Molecular Physics from Wuhan Institute of Physics and Mathematics of Chinese Academy of Sciences, and he was a postdoc supported by the Alexander von Humboldt Foundation at Goethe Universität Frankfurt before joining Friedrich Schiller University Jena. His research interests are ultrafast dynamics of atoms and molecules exposed to intense femtosecond laser pulses. Combined with S-matrix simulations and semi-classical model, his recent researches aim at interpreting the underlying physics of strong-field ionization of atoms and molecules, and ultrafast quantum control electrons by shaping the laser pulses. His research results have been published in Physical Review Letter, Physical Review A, Optics Express as the first or co-author (citation>300).

- 13:30-14:00, August 9 -

CEP uncertainty extracted by phase deviation analysis

Kun Zhao

Institute of Physics, CAS, China

Abstract

The f-2f interferometry is the most common method in measuring the Carrier Envelope Phase (CEP) of femtosecond laser pulses. It is mainly used to detect the CEP jitter in a feedback loop. For the pulse to be measured, one octave spanning spectrum is necessary, but the spectral broadening process would worsen the pulse coherence and introduce phase uncertainty. The phase noise is significantly affected by the characteristics of input pulses, and cannot be suppressed by the feedback loop. Current CEP jitter locked by the f-2f feedback loop is the result of CEP jitter which contains the noise introduced by the entire system instead of the laser alone. In order to eliminate the disturbance,

we simulated the phase deviation introduced by the spectral broadening process and the measurement uncertainty caused by limited detector resolution. Combined with the error analysis, a method for measuring the true CEP jitter value of the laser itself was proposed. Furthermore, different spectral broadening process are applied to compare and verify the truly CEP deviation of the laser. This method will provide a more accurate standard for time domain control of ultrafast laser pulses.

Biography

Dr. ZHAO received his B.S. in Physics at Peking University in 1995 and Ph.D. in Chemical Physics at University of Maryland in US in 2006. Afterward, he worked as a postdoc at University of Nebraska and Kansas State University. In 2011, he joined University of Central Florida as an assistant professor, and was elected to be a senior member of the Optical Society (OSA). He came back to China in 2014 to join the Institute of Physics, Chinese Academy of Sciences. In 2018, he became a committee member of the International Conference of Attosecond Science and Technology. His primary research area is ultrafast optics, including attosecond optics, strong field ionization, femtosecond lasers, and ultrafast dynamics. His major achievements include the generation and characterization of 67-attosecond (2012) and 53 attosecond (2017) XUV pulses, and supercontinuum and few-cycle femtosecond pulse generation in solid thin plates. He has published over 60 journal papers, conference proceedings, book chapters, and patents, which have been cited over 1100 times.

SC3

- 14:00-14:30, August 9 -

Attosecond photoelectron holography in strong field tunneling ionization

Yueming Zhou

Huazhong University of Science and Technology, China

Abstract

Tunneling ionization of atoms or molecules by a strong laser field generates an electron wavepacket. This electron wavepacket could reach the detector directly or undergoes rescattering by the parent ion, giving rising to the interference in the photoelectron momentum distribution (PEMD), referred as photoelectron holography in strong field tunneling ionization. This holograms can be used to probe the structural and dynamic information of the targets. We will demonstrated the application of this holography in the extracting the phase of elastic scattering amplitude. This holography also possesses the attosecond time resolution and could be used to trace the valence electron motion in molecules. We will also show how the information of valence electron motion is encoded in the hologram of the PEMD and theoretically demonstrate that the attosecond charge migration in H_2^+ is directly visualized with picometer spatial and attosecond temporal resolutions in a single-shot measurement. Moreover, this photoelectron holography could provide information about the tunneling ionization process itself. Adding a weak perturbation in orthogonal to the strong fundamental field, the hologram is shifted. By analyzing the response of the hologram to the perturbation, the real part of the tunneling ionization time, which denotes the instant when the electron exits the potential barrier, and the imaginary part of the tunneling ionization time, which has been interpreted as a quantity related to electron motion under the potential barrier, can be also precisely determined.

Biography

Yueming Zhou is a professor in Huazhong University of Science and Technology. He received his Ph.D. Degree in 2013 at HUST. Then he carried out his postdoc in the University of electro-communications in Japan, with the grant from JSPS. His mainly research field is the interaction of strong laser field with atoms and molecules, in particularly the correlated electron dynamics in strong field double ionization, and attosecond photoelectron holography in strong field tunneling ionization.

- 14:30-15:00, August 9 -

On-chip zero-index metamaterials for nonlinear optics

Yang Li
Tsinghua University, China

Abstract

Isotropic refractive index near zero relaxes certain phase-matching limits, allowing for more flexible configurations of nonlinear devices with dramatically reduced footprints. We designed and fabricated an on-chip integrated metamaterial with a refractive index of zero in the optical regime, opening the door to exploring the physics of light propagation in zero-index media. We demonstrated that the index of refraction is zero, by observing the refraction of light though a prism made of this metamaterial and by directly observing the (infinite) effective wavelength in a zero-index waveguide. The zero-index metamaterial can be fabricated using standard planar processes over a large area and in any shape, and can be impedance matched to other optical components, so it can be readily integrated in nonlinear photonic circuits.

Biography

Yang Li received B.S. degree in telecommunication engineering (2006) and M.S. degree in electromagnetic field and microwave technology (2008) from Huazhong University of Science and Technology, China, and Ph.D. degree in Electrical Engineering (2012) from Iowa State University. From 2013 to 2018, Yang Li was a Postdoctoral Fellow of Mazur group at Harvard University. Yang Li's current research interests include integrated metamaterials, nanophotonics, quantum photonics, electromagnetic nondestructive evaluation. Yang Li received the IEEE Antennas and Propagation Society Doctoral Research Award and was nominated for the R.W.P. King Award. Yang Li was a Co-PI of several NSF and Samsung grants.

Oral Talks

CIOP2019-2019-000328 (15:15-15:30, August 7)

Topological photonics in a synthetic 2D space including both frequency and OAM axes of light

Luqi Yuan
Shanghai Jiao Tong University, China

Abstract: A synthetic two-dimensional space including frequency and orbital angular momentum axes of light is proposed. An effective gauge potential has been created, and hence one can explore topological photonics in such synthetic space.

CIOP2019-2019-000058 (17:00-17:15, August 7)

Spatial control of topological edge state in polariton topological insulators

Yiqi Zhang[1], Yaroslav V. Kartashov[2]
1. Xi'an Jiaotong University, China
2. Russian Academy of Sciences, Russia

Abstract: We report the spatial control of topological edge state in polariton topological insulators. We will report our recent progresses in this topic.

SC3

CIOP2019-2019-000327 (17:15-17:30, August 7)

Cascaded sum-frequency generation and electro-optic polarization coupling in the PPLNOI ridge waveguide

Dan Wang
Shanghai Jiao Tong University, China

Abstract: Quasi-phase matched sum-frequency generation (SFG) and electro-optic (EO) polarization coupling has been realized simultaneously in a periodically poled lithium niobate on insulator (PPLNOI) ridge waveguide. The driving voltage is low and the operating wavelength is flexible.

CIOP2019-2019-000521 (10:00-10:15, August 8)

Controllable generation of second-harmonic vortex beams through nonlinear supercell grating

Huijun Wang[1], Dunzhao Wei[1], Xiaoyi Xu[1], Mengying Wang[1], Guoxin Cui[1], Yanqing Lu[1], Yong Zhang[1*], Min Xiao[1,2]
1. Nanjing University, China
2. University of Arkansas, USA

Abstract: We propose and experimentally demonstrate the simultaneous control of the energy distribution and topological charge of the second harmonic vortex beam using a nonlinear fork grating with a supercell structure.

CIOP2019-2019-000210 (10:15-10:30, August 8)

Enhanced optical nonlinearities and optical limiting properties of SnO_2 materials by vector light field

Lei Yan[1], Jiawei Liu[1], Zhongquan Nie[1*], Mingming Fan[2*]
1. Key Lab of Advanced Transducers and Intelligent Control System, Taiyuan University of Technology, China
2. College of Physics and Optoelectronics, Taiyuan University of Technology, China

Abstract: In this work, we study third-order optical nonlinearity and optical power limiting of SnO_2 samples with three different morphologies by canonical Z-scan technique utilizing linearly and radially polarized femtosecond laser (532 nm, 330 fs).

CIOP2019-2019-000195 (15:00-15:15, August 8)

Noise-like pulses with H-shape from a 2 μm mode-locked fiber Oscillator

Jingru Wang[1], Xiang Chen[1], Xue Cao[1], Qianqian Wu[1], Yangyu Liu[1], Zhixiang Ge[1], Wei Zhou[1*], Haotian Wang[1], Dingyuan Tang[1], Deyuan Shen[1*], Haitao Huang[2], YIshan Wang[2]

1. Jiangsu Normal University, China
2. Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China

Abstract: We report on a novel type of noise-like-pulses (NLP) with h-shape envelope from a mode-locked thulium fiber laser with spike duration of 440 fs and envelope up to 7.1 ns, output power of 1.3 W.

CIOP2019-2019-000340 (10:00-10:15, August 9)

Slow and fast light enhanced light drag in a moving microcavity

Tian Qin[1], Wenjie Wan[1,2*]

1. The State Key Laboratory of Advanced Optical Communication Systems and Networks, University of Michigan-Shanghai Jiao Tong University Joint Institute, Shanghai Jiao Tong University, Shanghai 200240, China
2. MOE Key Laboratory for Laser Plasmas and Collaborative Innovation Center of IFSA, Department of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai 200240, China

Abstract: Light can be dragged by moving media according to the theory of relativity. We demonstrated such dragging effect in a moving optical microcavity with significant slow and fast light enhancement induced by stimulated Brillouin scattering.

CIOP2019-2019-000367 (10:15-10:30, August 9)

Nonlinear frequency conversion in $BaMgF_4$, a Vacuum ultraviolet ferroelectric crystal

Shuo Yan

School of Physics and Astronomy, Shanghai Jiao Tong University, China

Abstract: $BaMgF_4$ is ferroelectric fluoride crystal with an extraordinary transparency ranging from the deep ultraviolet (≈126 nm) to the mid infrared (≈13 μm). Its ferroelectric and high $\chi^{(3)}$ properties enable Cherenkov-Radiation and Third-Harmonic Generation.

CIOP2019-2019-000561 (15:00-15:15, August 9)

Surface and bulk contribution to sum-frequency vibrational spectroscopy of surface of single crystal ice

Xiaofan Xu[1], Y. Ron Shen[1,2], Chuanshan Tian[1*]

1. Department of Physics, State Key Laboratory of Surface Physics, Fudan University, China
2. Department of Physics, University of California, Berkeley, USA

Abstract: Surface and bulk contribution to sum-frequency vibrational spectroscopy (SFVS) of surface of single crystal ice is clarified through phase-sensitive measurements in combined reflection and transmission geometries and modification of ice surface.

CIOP2019-2019-000266 (15:15-15:30, August 9)

Dissipative soliton resonance in an erbium-doped mode-locked fiber laser with a nonlinear amplifying loop mirror

Long Han, Tianshu Wang, Runmin Liu, Yan Lou, Huilin Jiang[*]

Changchun University of science and technology, China

Abstract: Dissipative soliton resonance in an erbium-doped mode-locked fiber laser with a nonlinear amplifying loop mirror. Through experimental analysis, the square wave pulses are dissipative soliton resonance (DSR). At the maximum pump power, the maximum output average power of square wave is 26.7 mW. As a result, the pulse energy is 5.03nJ.

SC4 Solid State, Fiber, and Other Laser Sources

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Opportunities open by high-power modelocked thin-disk lasers (Tutorial)

Clara Saraceno
Ruhr-University Bochum, Germany

Abstract

We will review the recent state-of-the-art of high-power ultrafast disk lasers with a special emphasis on recent achievements in the area of modelocked thin-disk oscillators. These compact high-power modelocked lasers achieve higher average power (up to 350 W) and pulse energy (up to 80 μJ) than any other modelocked oscillator, offer unique possibilities for applications requiring highest pulse energies at Megahertz repetition rate, from compact one-box amplifier-free laser systems. Lasest results show that this is a promising high-power alternative to Ti:Sa amplifiers. We will present the latest technological advances and results as well as new application areas open by progress in the technology, for example for the generation of high-power THz pulses for time-domain spectroscopy.

Biography

Clara Saraceno was born in 1983 in Buenos Aires, Argentina. In 2007 she completed a Diploma in Engineering and an MSc at the Institut d'Optique Graduate School, Paris. She completed a PhD in Physics at ETH Zürich in 2012, for which she received among others the EPS-QEOD thesis prize in applied aspects in 2013. From 2013-2014, she worked as a Postdoctoral Fellow at the University of Neuchatel and ETH Zürich, followed by a postdoc position from 2015 – 2016 at ETH Zürich. In 2016, she received a Sofja Kovalevskaja Award of the Alexander von Humboldt Foundation and became Associate Professor of Photonics and Ultrafast Science at the Ruhr University Bochum, Germany. In 2018 she received an ERC Starting Grant and is currently an OSA Ambassador (2019). The current main research topics of her group include high-power ultrafast lasers and Terahertz science and technology.

- 14:15-14:45, August 7 -

Few cycle pulse generation through pulse dynamics manipulation in a fiber laser

Minglie Hu
Tianjin University, China

Abstract

A short introduction for the mode-locking and a brief review of recent work on high power femtosecond fiber laser are demonstrated, which shows that few cycle laser pulse can be obtained by optimization of nonlinear process in fiber laser system. Pulse dynamics optimization also bring great impact on the time jitter of the pulse train. These new laser resources provide convenience for novel applications in the fields of high precision fabrication and measurement, experimental quantum physics, functional materials, etc.

Biography

Prof. Minglie Hu received the B. Eng. in Opto-electronics and Ph.D in Optic engineering degrees from Tianjin University in 2000 and 2005, respectively. For his PhD thesis, he studied the propagation of femtosecond laser pulses in photonic crystal fibers. After receiving his PhD from Tianjin University, Prof. Hu started to work in the ultrafast laser lab of Tianjin University from associate professor to full professor. Since then Prof. Hu focus on the pulse dynamics in the femtosecond fiber laser and amplifier. Prof. Hu authored or coauthored over 200 peer reviewed publications plus 3 book chapters. Moreover, he holds 23 patents. His current research interests include mode-locking laser oscillators and amplifiers, fiber lasers, linear and nonlinear propagation in photonic crystal fibers, and microstructure optical device.

- 14:45-15:15, August 7 -

Research progress of high-power ultrafast Yb solid-state lasers

Jiangfeng Zhu
Xidian University, China

Abstract

Yb solid-state lasers have the potential to generate high power ultrashort femtosecond pulses due to the excellent spectroscopic and thermal properties of the Yb^{3+}-doped laser materials. However, only several tens to hundreds mW average power was achieved from a conventional diode-pumped Kerr-lens mode-locked (KLM) Yb solid-state lasers, which is mainly limited by the pumping diode and the critical laser configuration. In order to scale the average power to watt-lever while maintaining the sub-100 fs pulse duration for various applications, such as seeding the solid-state amplifier, nonlinear frequency conversion and multi-photon microscopy, we have developed two methods to generate high power femtosecond pulses from Yb solid-state lasers via KLM technique. By employing the high beam quality 976 nm fiber laser as the pump source, we have realized stable KLM operation in the Yb:CYA laser, with as high as 4.2 W average power and 148 fs pulse duration. By enhancing the nonlinearity in the cavity and extra-cavity pulse compression, we've got 2 W, 36 fs pulses, which is the highest power for sub-40 fs solid-state Yb lasers. Further power scaling is proposed by multimode laser diode (LD) as the pump. By inserting another Kerr medium in the cavity to build a double-confocal cavity, we have achieved 6.2 W, 59 fs pulses from a LD pumped Yb:CYA oscillator, with the single pulse energy of 124 nJ and peak power of 2.1 MW, respectively.

SC4

Biography

Dr. Zhu received the Ph.D. degree in ultrafast optics from the Institute of Physics, Chinese Academy of Sciences, Beijing, China, in 2008. He was with the Department of Applied Physics, Hokkaido University, Sapporo, Japan, from 2008 to 2011, as a Post-Doctoral Fellow. Since 2011, he has been with the School of Physics and Optoelectronic Engineering, Xidian University, Xi'an, China. Currently he is professor and dean of Department of Laser technology. His research interests include novel ultrafast laser technology, nonlinear frequency conversion, and their applications. He has authored and co-authored more than 100 peer-reviewed journals; more than 40 contributed and invited talks at international meetings. He serves as Topical Editor of "Chinese Optics Letters" and "Acta Optica Sinica", Youth Editorial Board of Chinese Laser Press and "Journal of Applied Optics".

- 16:00-16:30, August 7 -

Repeatable high energy laser development at Osaka University

Junji Kawanaka
Osaka University, Japan

Abstract

A high energy laser has been used for basic science with laser-induced plasmas for a long time and has generated several kinds of high energy particles (electrons, positrons, neutrons and ions) and high energy radiations. Such high energy sources are attracting much attention to open new industrial and medical applications, such as space debris remove, gamma-ray non-destructive inspection, neutron source/BNCT, ion-beam therapy and so on. In such advanced

applications, a repeatable high energy laser is strongly required instead of the conventional single-shot or low rep. rate high energy lasers, including Ti:sapphire laser and OPCPA. And the big laser system size should be miniaturized to be suitable for the new applications. Developing the repeatable high energy laser, the most significant issue is a thermal problem in the optical devices, especially, a laser amplifier first. A laser material is decided by the required laser characteristics of pulse energy, pulse duration and wavelength. On the other hands, laser amplifier structure and system concept have a high flexibility in designing to suppress the thermal effects. In regard to the amplifier structure, we are focusing on an active mirror amplifier, which has an excellent feature of no wavefront distortion after laser amplification, in addition to excellent power scaling in both pulse energy and repetition rate. Also, a multi-module concept emphasizes the power scaling further. In my talk, our grand plan of the high energy laser facility in fs~ns, based on 100 J/100 Hz laser technology, will be reported.

Biography

1. Doctor of Science, University of Electro-Communications, at Tokyo in 1993, with doctorate thesis of collision with laser cooled and trapped lithium neutral atoms.
2. Assistant Professor of Miyazaki university, at Miyazaki from 1993, discharge-pumped Rare gas exicimer laser in VUV.
3. Researcher Deputy Chief of Japan Atomic Energy Research Institute (JAERI), at Kyoto from 1999, cryogenic laser with Yb-doped material in diode pump.
4. Associate Professor of Osaka university, at Osaka from 2004, kilo-joule, ps laser development (LFEX), Joule-class/100Hz DPSSL with cryogenic ceramic, and ultra-broadband OPCPA.
5. Professor of Osaka university.

- 16:30-17:00, August 7 -

High performance multicolor femtosecond laser pulses and their applications

Jun Liu

Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

As the extending and deeply applications of femtosecond laser pulses in ultrafast spectroscopy, nonlinear optic microscopy, and ultra-intense laser physics etc research fields. Many researches need several femtosecond pulses with different wavelengths or multicolor femtosecond pulses at the same time. Here, we will report the generation of more than 15 multicolor femtosecond pulses at the same time by simply using a thin glass plate through cascaded four-wave mixing process. The generated multicolor femtosecond pulses have high performances in frequency, time, and spatial domain. Then, it is used in the generation of seed pulses with high temporal contrast for PW laser system. Using the generated first-order multicolor femtosecond pulse as sampling pulse, novel four-order cross-correlator for single-shot temporal contrast measurement was proposed with high dynamic range, high fidelity, and high time resolution simultaneously.

Biography

Jun Liu received his PhD degree in optics from Shanghai Institute of Optics and Fine Mechanics, CAS, China in 2007. From 2007 to 2011, he worked in the University of Electro-Communications, Tokyo, Japan as a postdoc and then an assistant professor, where he won the fifth “Kondo Award” of Osaka University, Japan in 2011. From Aug. 2011 until now, he is working in the State Key Laboratory of High Field Laser Physics, SIOM, CAS as a professor, where he was selected into the Hundred Talents Program of CAS in 2011 and the Thousand Talents Program of China in 2012. Right now, his research work is focused on femtosecond laser technology and its applications, light sheet microscopy and its applications in photodynamic therapy, and optical imaging through scattering media. He has published more than 70 scientific journal papers, and obtained more than 15 national invent patents.

- 17:00-17:30, August 7 -

Extending SESAM technology into the mid-infrared

Fengqiu Wang
Nanjing University, China

Abstract

There is tremendous technological needs for compact and efficient pulsed lasers operating in the mid-infrared range. While recent advances in mid-infrared gain platforms (including QCLs and mid-infrared rare earth doped fibers) are exciting, the lack of a capable optical switching device in the MIR has significantly limited the field. Following great efforts in low-dimensional materials, such as graphene and carbon nanotubes, we have recently identified a new class of quantum material –Topological Dirac Semimetal- which show promise for mid-infrared optical switching devices. The material shows good absorption as well as excellent tunability in key optical characteristics in the MIR, and can be fabricated into SESAM devices that greatly facilitates mass processing.

Biography

Prof. Fengqiu Wang obtained his B.S. in Electronic Engineering from Peking University and then a PhD from Cambridge University. He joined Nanjing University in 2013 and has since focused on the investigation of light-matter interaction in emerging low-dimensional materials. In particular, emphasis is placed on exploiting effects with relevance to applied photonics, where disruptive or better-performing devices can be developed. Examples include ultrafast optical switching devices with unprecedented bandwidth and tunability; 2D heterostructure devices operating across multiple spectral ranges, providing functionalities such as photo-detection, light-wave modulation, as well optical information processing. Dr. Wang has published over 100 papers and contributed 30 oral presentations at international conferences. His publications have drawn a total citation of >6000. He is program committee member for CLEO, CLEO-pacific rim, and ACP. He was awarded youth-1000-talent fellowship (2013) and Distinguished Young Scholars of Jiangsu Province (2017) and is principal investigator of two NSFC projects and work package chair for one State Key Project of Research and Development.

- 08:30-09:00, August 8 -

MXenes and MAX phases for ultrafast fiber lasers

Ju Han Lee
University of Seoul, South Korea

Abstract

Femtosecond fibre lasers have attracted huge technical attention in many applications such as fundamental scientific research, material processing, medicine, and sensing in recent years. One commonly used approach for the implementation of femtosecond fibre lasers is to use a mode-locking technique based on a passive nonlinear optical device, called a "saturable absorber (SA)". Recently, the saturable absorption properties of MXenes, such as Ti_3CT_x and $Ti_3C_2T_x$, have been extensively investigated and their excellent performance comparable to those of other 2-dimensional (2-D) materials has been well demonstrated. In this presentation we review our recent investigation results on MXene and MAX phases as effective saturable absorption media that can generate femtosecond pulses from fiber lasers.

Biography

Ju Han Lee received the B.S. and M.S. degrees in electronics engineering from Seoul National University, Republic of Korea, in 1995 and 1998, respectively. He received a Ph.D. from the ORC at University of Southampton, UK in 2003. He was a senior member of the technical staff in Korea Institute of Science and Technology (KIST) from 2004 to 2007. He was a research fellow at the University of Tokyo, Japan, from September 2004 to October 2005. He was a visiting researcher at the IPAS in University of Adelaide, Australia from 2013 to 2014. Presently, he is Professor at the School of Electrical and Computer Engineering, University of Seoul, Seoul, Republic of Korea. His research interests include ultrafast fiber lasers, nonlinear fiber optics, all-optical signal processing, microwave photonics, and optical communications. He is an author or coauthor of more than 150 international journals and 150 technical conference papers.

- 09:00-09:30, August 8 -

Dynamics of ultrafast fiber soliton lasers

Xueming Liu
Zhejiang University, China

Abstract

We report a compact all-fiber laser system mode-locked by Nano-materials such as nanotube and graphene. The proposed laser can deliver the multiple wavelengths and the central wavelengths are tunable. Nanomaterial-based mode-locking fiber laser emits the dissipative solitons with higher pulse energy. These results may provide helpful theoretical and experimental fundamentals for the in-depth study of new high-energy pulses, and bring the new understandings about nonlinear phenomenon of ultra-short high-energy pulses under extreme conditions.

Biography

Prof. Liu received the PhD degree in 2000. Successfully, He had engaged in the post-doctoral research in Tsinghua University and Seoul National University from 2000 to 2004. From May 2004 to Oct. 2005, He was a Scientist in Agency for Science, Technology and Research, Singapore. From Apr. 2007 to Jun. 2007 and from Nov. 2007 to Oct. 2008, He was a visiting scholar and research professor in the Chinese University of Hong Kong and Gwangju Institute of Science and Technology (GIST), respectively. From Mar. 2012 to Sep. 2012, He was a senior visiting scholar in the University of Cambridge. He has authored or coauthored papers more than 150. He was honored to the National Science Fund for Distinguished Young Scholars.

- 09:30-10:00, August 8 -

High repetition rate ultrafast VUV sources

Zhigang Zhao
Shandong University, China

Abstract

Vacuum ultraviolet (VUV) beam sources (λ= 100–200 nm, i.e., hυ= 6.20–12.40 eV) are indispensable for laser-based angle-resolved photo-emission spectroscopy (ARPES). Results on 10-MHz femtosecond enhancement cavity based, and 1-MHz single pass configuration based high harmonic generation will be introduced. Combined with ARPES, electron signal has been detected. Further consideration on how to improve the system performance will also be presented.

Biography

Zhigang Zhao, born in 1984, is professor with school of information science and engineering (ISE), Shandong University (Qingdao Campus). He got his bachelor degree from Shandong University in 2006, Ph.D. from Zhejiang University in 2011. Afterward, he spent one year as postdoc in Technische Universität Berlin, Germany. Since November 2012, he became researcher in the Institute for Solid State Physics (ISSP) in the University of Tokyo, where he developed high power fiber chirped pulse amplifier with average power exceeding 100 W at repetition rate of 1 MHz, mW-level VUV source for ARPES investigation, and high-power UV laser at 258/221/193 nm. His current interests include high power ultrafast laser system, nonlinear frequency conversion, high repetition rate VUV sources generation, and laser processing.

- 11:00-11:30, August 8 -

High-power 2.8 μm erbium fiber lasers and their applications

Shigeki Tokita
Osaka University, Japan

Abstract

High power lasers with wavelengths around 3 μm have many potential applications, for example, in laser processing for materials which have low absorption at the near-infrared and the visible wavelength range, and in dentistry and surgery because the absorption coefficient of biological tissue containing water is very high at around 3 μm. Recently, output power and efficiency of Er-doped fluoride-glass fiber lasers with a wavelength of 2.8 μm have been significantly improved. Here, we review briefly the high-power 2.8 μm Er-doped fiber lasers and their application of laser processing and infrared solid-state lasers.

Biography

Shigeki Tokita is an associate professor of the Institute of Laser Engineering (ILE), Osaka University. After receiving his Dr. Eng. from the Osaka University in 2006, he was an assistant professor at the Institute for Chemical Research, Kyoto University in 2006–2013. His research interests are in high-power fiber lasers and laser-plasma interactions. He conducts research in efficient high-average-power Yb-doped lasers, Er-doped mid-infrared fiber lasers, control of energetic electron beam produced by ultrahigh-intensity laser pulses and strong terahertz wave generation by laser-plasma interactions.

- 11:30-12:00, August 8 -

Radially polarized and mode-locked fiber laser

Jianlang Li
Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

Radially polarized beam, characterized by spatially axis-symmetrical polarization and doughnut-shaped intensity pattern, shows the feature of tight focusing, and thus has wide applications in laser processing, high-resolution microscopy and so on. In this study, we presented a continuous-wave mode-locked (CWML) and radially polarized Yb-doped fiber laser. The fiber laser emitted CWML pulse with a maximum output power of 366 mW, a repetition rate of 3.05 MHz and pulse width of 27 ns at the pump power of 1.68 W. By inserting a quarter-wave plate in the laser cavity, the stability of laser, the beam quality and purity of radial polarization were significantly improved.

Biography

Jianlang Li is a professor at Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences. His research interests focus on novel fiber and solid-state laser. He developed the first radially polarized fiber laser, and thereafter extended it to the high-power and pulsed operation. He also realized the efficient, high-power and vector solid-state laser in end-pumped microchip laser geometry. In recent years, he developed highly efficient vortex solid-state laser, and invented the maglev and optically-driven rotary disk laser.

- 13:30-14:00, August 8 -

Coherent pulse combination by phase controlled polarization switching

Zhigang Zhang
Peking University, China

Abstract

Pulse combination in space and time domain is one of the solutions for both high pulse energy and high repetition rate. Pulse combination in time domain (also called “pulse stacking) stacks the energy from a train of pulses in one pulse. Not only the polarization, but also the phase of the individual pulses has to be controlled for sequential pulse combination. Our group has developed coherent pulse combination system based on our 1GHz repetition rate fiber laser. By phase control and delay compensation, we have stacked four pulses together. More pulse stacking is possible and is in progress. The talk will introduce the progress, difficulties and perspective.

Biography

Prof. Zhigang Zhang received his PhD degree in Physics from Monash University, Australia, in 1992. He joined the Institute of Research and Innovation Japan, the Electrotechnical Labs in 1992 and 1996 respectively. In 1999, joined Tianjin University as a “Cheung Kong Scholar”. In 2005, he moved to Peking University as a full professor at the Department of Electronics, Peking University. His has published more than 120 journal papers in peer reviewed international journals and a book “Femtosecond laser technology”. His current research interest is femtosecond fiber laser frequency combs, low noise microwave extraction from combs, coherent pulse stacking beam combination and femtosecond laser micromachining. Prof. Zhigang Zhang is a Fellow of Optical Society of America

- 14:00-14:30, August 8 -

High power low noise single frequency fiber laser at 2 μm for gravitational wave detection

Pu Wang
Beijing University of Technology, China

Abstract

Gravitational wave detection is a new window to observational cosmology. Gravitational waves have been directly observed for fifteen times by the Advanced Laser Interferometer Gravitational-wave Observatory (Advanced LIGO) until recently. The next generation of gravitational wave detection will need a 2 μm single frequency fiber laser as laser source to reduce thermal noise and high frequency quantum noise of the detection. What’s more, the noise of the 2 μm single frequency fiber laser is a main noise source of the detection system. On the aim to be used for next generation of gravitational wave detection we demonstrate a low-noise narrow-linewidth single frequency fiber laser at 2 μm, which consist a pair of homemade fiber bragg grating (FBG) and a segment commercial thulium-doped silica fiber. By optimizing the pumping scheme, cavity designing, and temperature controlling, we have realized the output of 2 μm single frequency fiber laser with lower relative intensity noise (RIN) and narrower linewidth. Even after three-stage fiber amplification, the power is amplified to hundred watts, the RIN and linewidth don’t increase significantly.

Biography

Wang Pu graduated from the physics department of Shandong University with a bachelor’s degree in 1986. In 2000, he graduated from Macquarie University in Australia with a PhD in laser physics from the Center for Lasers & Applications. He joined Institute of Laser Engineering of Beijing University of Technology in Nov. 2009. His main research interests are novel high power ultrafast fiber lasers, fiber amplifiers, novel nanosecond pulsed fiber lasers, novel fiber-based optical devices and high peak power based nonlinear frequency conversion and so on. He has published more than 60 journal papers

- 14:30-15:00, August 8 -

Spatiotemporal manipulation of pulse helps solving the pulse-contrast challenge in ultrafast intense lasers

Jingui Ma
Shanghai Jiao Tong University, China

Abstract

Pulse contrast is a crucial parameter of high peak-power lasers since the prepulse noise may disturb laser–plasma interactions. Pulse-contrast requirement increases with laser intensity, but the practical pulse contrast degrades with amplification. How to enhance the pulse contrast remains a challenge for high peak-power laser. In this report, I will introduce our attempts for solving the pulse-contrast challenge, including the generation mechanisms of noise, the single-shot characterization of pulse contrast and the in-band noise filtering. These works show the potential of tackling pulse-contrast challenge in the spatiotemporal 2D domain.

Biography

Jingui Ma received his Ph.D. in Optics at Fudan University, Shanghai, China, in 2014. From 2014-2016, he is a Postdoctoral Researcher in Shanghai Jiao Tong University, where he is now a distinguished associate researcher in School of Physics and Astronomy. He has published over 40 peer-reviewed papers and owned 13 technical patents (including 7 US patents). His Research interests include nonlinear optics, ultrafast measurements, intense lasers and mid-infrared lasers.

- 08:30-09:00, August 9 -

Possible method for a single-cycle 100 petawatt laser with wide-angle non-collinear optical parametric chirped pulse amplification

Zhaoyang Li
Osaka University, Japan

Abstract

A single-cycle 100 petawatt laser pulse is obtained theoretically by dramatically increasing the spectrum, accordingly reducing the pulse duration, of the optical parametric chirped pulse amplification (OPCPA) with a new designed wide-angle non-collinear OPCPA (WNOPCPA). While comparing with two other recent popular methods of the energy-further increased single-beam femtosecond petawatt laser and the spatiotemporally coherent combination of multiple-beam femtosecond petawatt lasers, we believe that the proposed method is another choice for sub-exawatt lasers.

Biography

Zhaoyang Li currently is an assistant professor at Institute of Laser Engineering, Osaka University, Japan. He received BS. degree from Beijing Institute of Technology in 2005, MS. degree from the graduate school of China Academy of Engineering Physics in 2008, and PhD. degree from Nanjing University of Science and Technology in 2015. From 2008 to 2016, he was a Research Assistant/Associate at Joint Lab on high power laser & physics and State key Lab of high field laser physics at SIOM. As a core member, he co-developed the Chinese first petawatt laser of SG-II-ps-PW and co-designed the Chinese first 10-PW laser of SULF. Two original techniques he proposed have already been successfully applied in two 10-petawatt-class laser facilities of ELI-Beamlines in Europe and SULF in China. Up to now, he has 24 first-author peer-reviewed papers on Opt. Lett., Opt. Express, etc., 6 first-inventor patents, 6 PI national grant-projects, and several invited talks. He also served as a frequent reviewer for more than 10 optics journals. His recent research interests include the next generation of ultra-intense and high-average-power lasers, optical field measurement and control, nonlinear optics, etc.

- 09:00-09:30, August 9 -

Vortex laser and applications in free-space communications

Guoqiang Xie

Shanghai Jiao Tong University, China

Abstract

In this talk, we will introduce single and multiple vortex beam generation from laser and the applications in free-space communications. By laser inscribing of cavity mirror, we can generate order-tunable vortex beam from laser. We built the numerical relationship between vortex topological charge and inscribed hole radius, which provides a design criterion for intracavity vortex laser generation. With the method, we realized intracavity vortex beam generation up to 288th-order. The generated vortex beam from laser is stable with propagation. Furthermore, we demonstrated multiple vortex beam generation from laser by laser inscribing of cavity mirror. Numerical simulation shows that one can control multiple vortex modes to simultaneously oscillate in the laser. The multiple vortex laser could be self-mode-locked and generated high-repetition-rate picosecond pulses. Finally, we demonstrate free-space communications with the multiple vortex laser, showing the potential of multiple vortex laser for spatial and temporal encoding.

Biography

Guoqiang Xie is a professor at the School of Physics and Astronomy of Shanghai Jiao Tong University. His current research interests include mid-infrared ultrashort and intense laser, vortex laser.

- 09:30-10:00, August 9 -

High performance GaSb-based FP lasers and SDL

Yu Zhang

Institute of Semiconductors, CAS, China

Abstract

High-performance infrared diode lasers offer exceptional properties which are exploited in many applications fields such as medicine and material processing, as well as the pumping sources for fiber lasers. We fully studied the fabrications of F-P cavity edge-emitting lasers (FP laser) and optically pumped infrared disk lasers (SDL), both of which were grown on Te-doped (001) oriented GaSb substrate by molecular beam epitaxy. The FP laser with InGaSb/AlGaAsSb double-quantum-well in the core area shows the peak power conversation efficiency more than 26% and efficiency higher than 16% at 1W. The maximum output power of the 2-mm-long, 100-μm-wide single emitter reaches to more than 1.6 W at 7A and a 19-emitter bar with the maximum efficiency higher than 20% show 16 W at 70 A. The SDL chips were optically pumped by a fiber coupled commercial laser diode emitting at 1470 nm and an intra-cavity SiC heat spreader was attached to the chip for effective thermal management. Continuous-wave output power of over 1 W operating at room temperature is achieved at 2.03 μm and as the effective region temperature increases, the envelope of multimode spectrum shifts to longer wavelengths as the pump power increases, thus increasing the output power. The M2 factors along the horizontal axis and vertical axis for the SDL are 1.30 and 1.66, showing a great beam quality.

Biography

Zhang Yu, associate researcher, The State Key Laboratory of Superlattice and Microstructures, Institute of Semiconductors, Chinese Academy of Sciences. Mainly engaged in the epitaxy growth of antimony semiconductor lasers and the micro-fabrication of devices. His research was focused on high power GaSb-based diode laser, bars and high performance DFB, DBR single-mode lasers.

- 10:00-10:30, August 9 -

Sub-100-fs bulk solid-state lasers near 2-micron

Valentin Petrov
Max Born Institute, Germany

Abstract

Mode-locked lasers emitting ultrashort pulses in the 2-micron spectral range at high (100-MHz) repetition rates offer unique opportunities for time-resolved molecular spectroscopy and are interesting as pump/seed sources for parametric frequency down-conversion and as seeders of ultrafast regenerative laser amplifiers. Passively mode-locked lasers based on Tm^{3+}- and Ho^{3+}-doped bulk solid-state materials have been under development for about a decade. In 2009 we demonstrated the first steady-state operation of such a Tm:KLu$(WO_4)_2$ laser using a single-walled carbon nanotube (SWCNT) saturable absorber (SA) generating 10-ps pulses at 1950 nm. In 2012 it produced for the first time femtosecond (140-fs) pulses at 2037 nm. More recently, the study of numerous active media with different SAs resulted in the generation of sub-100-fs (sub-10-optical-cycle) pulses. Materials with broad and smooth spectral gain profile were selected, naturally emitting above 2-micron to avoid water vapor absorption/dispersion effects, including anisotropic materials, strong crystal-field distortion in hosts that do not contain rare-earths, crystals with structural or compositional (i.e. mixed compounds) disorder that exhibit inhomogeneous line broadening, mixed laser ceramics, and Tm,Ho-codoping of ordered and disordered crystals and ceramics. A broad absorption band in semiconducting SWCNTs spans from 1.6 to 2.1-micron whereas the absorption of graphene extends into the mid-IR and scales for multilayers, increasing the modulation depth. Compared to GaSb-based semiconductor SA mirrors (SESAMs), the carbon nanostructures exhibit broader spectral response and can be fabricated by simpler and inexpensive techniques. Chirped mirrors were implemented for group-velocity dispersion compensation, to generate the shortest pulses, down to 55-fs at 2048 nm.

Keywords: mode-locked lasers, infrared lasers, solid-state lasers, carbon nanostructures

SC4

Biography

1978 – 1983 M.Sc. Degree in Nuclear and Elementary Particle Physics, Sofia University, Diploma work on laser Raman spectroscopy. 1983 - 1984 Institute for CO_2 lasers: Full modelling of pulsed CO_2 lasers. 1984 - 1988 Ph.D. Thesis: Dept. of Nonlinear Optics, Friedrich-Schiller-University, Jena: Experimental and theoretical studies of passively mode-locked dye lasers. 1988 - 1991 Assistant Professor, Dept. Quantum Electron., Sofia University, Teaching: Experimental Laser Physics and Principles of Quantum Electronics. 1991 – 1992 Guest Scientist (DAAD fellowship), Dept. of Physics, University of Regensburg: Coherent self-locking and passively mode-locked dye lasers. since 1992 Department A3 of the Max Born Institute, Senior Research Associate

- 11:00-11:30, August 9 -

The generation and detection of intense ultrafast vortex pulses

Shixiang Xu
Shenzhen University, China

Abstract

A rotating optical ring-shape lattice is generated by overlapping a pair of 20 Hz, 800 nm chirped pulses with a Michelson interferometer (MI). Its rotating rate can be up to ten trillion radians per second (Trad/s), which can be flexibly tuned with a mirror in the MI. Besides, its fold rotational symmetry structure is also changeable by controlling the difference from the topological charges of the pulse pair. Experimentally, we have successfully got a two-petal lattice with a tunable rotating speed of 7.9 Trad/s or 14 Trad/s, which is confirmed by our single-shot ultrafast frame imager basing

on non-collinear optical parametric amplification with its frame rate up to 15 Tfps. This work is available at relativistic, even ultra-relativistic intensity by using an ultrashort but ultra-intense laser system operating at low repetition rate, so it may be interesting for laser plasma-based accelerators, the strong terahertz radiations and celestial phenomena.

Biography

Shixiang Xu, born in 1965, completed his PhD in 1998 from Shanghai Institute of Optics and Fine Mechanics, China. In 2006, he was awarded Shanghai Pujiang talent Fund. His current position is a professor of Shenzhen University, and his research interests include ultrashort pulse laser, ultrafast imaging and terahertz optics. Now, he also serves as a member of Laser Professional Committee of Chinese Optical Society, and one of the Councils of Guangdong Optical Society of China. Up to date, he has published more than 110 papers in peer-reviewed journals and authorized more than 25 patents.

- 11:30-12:00, August 9 -

Semiconductor lasers with novel concepts developed for optical communications

Weihua Guo
Huazhong University of Science and Technology, China

Abstract

Progress on several semiconductor lasers developed in our group will be reviewed. For narrow linewidth thermally tuned multi-channel interference widely tunable lasers, linewidth below ~200 kHz and side-mode suppression-ratio higher than 50 dB across the C-band have been achieved. For two-section high speed directly modulated O-band DFB lasers, 25 Gb/s signal transmission through 10 km fiber from -20 degree C to 80 degree C has been achieved. For 850 nm surface-grating surface emitting lasers, single mode lasing with side mode suppression ratio above 40 dB and threshold current below 10 mA has been achieved.

SC4

Biography

Prof. Guo received his PhD degree from Institute of Semiconductors, Chinese Academy of Sciences in 2004. Afterwards he joined the school of Physics, Trinity College Dublin Ireland as a research fellow. In 2010 he joined Prof. Coldren' group as a project scientist in the Electrical and Computer Engineering department of University of California Santa Barbara. In 2014 he joined Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology as a professor and received the support from the 1000 talented youth plan. Now he is mainly working on optoelectronic integrated devices with novel concepts. His group has developed new laser concepts such monolithic widely tunable laser based on multi-channel interference, surface emitting lasers based on surface gratings, DFB lasers with active distributed reflector, etc.

- 13:30-14:00, August 9 -

Manipulation the optical field of random distributed feedback fiber laser

Pu Zhou
National University of Defense Technology, China

Abstract

Random distributed feedback fiber lasers have been drawing more and more research interesting due to their research and application potentials in broadband application fields, such as remote sensing, imaging, biotechnology, nonlinear frequency converter as well as new pump source. In this talk, we will review the recent research progress on optical field manipulation in our group. Manipulating the polarization, optical spectrum, spatial mode would be covered as well as power-scaling performance and analysis.

Biography

Pu Zhou received Ph.D degree in Optical Engineering from National University of Defense Technology (NUDT), China, and now he is a professor and supervisor for Ph.D student in NUDT. His recent research interests include fundamental investigation on high power fiber laser and beam combining. He is leading or has completed over ten projects funded by National Natural Science Foundation of China and others. As the first author or corresponding author, he has published more than 150 peer-reviewed papers. He is the reviewer of more than 30 peer-reviewed journals and has been recognized as outstanding reviewer of OSA (2017) and CLP (2017, 2018).

- 14:00-14:30, August 9 -

Wavelength-agile fiber amplifiers for quantum technology

Yan Feng

Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

The development of quantum science and technology has become an international race. High power single frequency lasers at various wavelengths, usually not easy to obtain, are required in laser cooling of atoms, optical standards, precision measurement etc. In this talk, we report our progress in developing high power low noise single frequency Yb, Er, and Raman fiber amplifiers for various specific applications, usually including frequency doubling to visible and ultraviolet regime. As a result, we can produce lasers at virtually any wavelength from 0.25 to 2 micron.

Biography

Currently a professor at Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences (CAS). He got his Ph.D. degree from the Physics Department of Nankai University in 2000. He spent two postdoctoral research positions at Institute of Physics, CAS, and Institute for Laser Science, University of Electro-communications, Japan. From 2005 to 2009, he was a laser physicist at European Southern Observatory and developed the technology of Raman fiber amplifier based sodium guide star laser. He joined SIOM in 2010 under the support of the 100-talent program of CAS, and is the deputy director of Shanghai Key Laboratory of Solid-state Laser and application. He works on precision fiber lasers and nonlinear fiber optics with important contributions in Raman fiber lasers and sodium guide star lasers. He has published more than 100 papers on referenced journals and edited the first and only reference book on Raman fiber lasers. His contributions have been recognized with awards of Berthold Leibinger Innovation Prize, Excellent Supervisor of CAS, and Contribution Award of Returned Chinese.

- 14:30-15:00, August 9 -

Very long wave infrared (≥14 μm) quantum cascade lasers based on novel design

Junqi Liu

Institute of Semiconductors, CAS & University of Chinese Academy of Sciences, China

Abstract

There are more intrinsic technological challenges for the very long wave infrared (≥14 μm) quantum cascade lasers (QCLs). First, for photon energies larger than the reststrahlen band, population inversion is more difficult to attain as the upper state lifetime decreases with the emitted photon energy, due to a higher LO phonon scattering rate. Second, the nonradiative injection carrier leakage into the lower laser level increases.Third, the lower state lfetime remains practically unchanged and leads to low voltage efficiency. In this research, we presents a new design of active region for high-performance very long wave infrared QCLs. Guaranteed by efficient electron injection to the upper laser level and fast electron extraction through miniband from the lower laser level, high performance has been obtained at

emission wavelength above 15 μm. The QCL structure was grown on a n-doped (Si, $2x10^{17}$ cm^{-3}) InP substrate wafer by solid-source molecular beam epitaxy (MBE). The doping level in the active region was empirically adjusted so that roll over current density of was approximately equal to 3 kA/cm^2. The complete structure include 4 μm lower InP cladding layer (Si, $3x10^{16}$ cm^{-3}), 300 nm thick n-$In_{0.53}Ga_{0.47}As$ layer (Si, $4x10^{16}$ cm^{-3}), 55 stages of the active/injector region, 300 nm thick n-$In_{0.53}Ga_{0.47}As$ layer (Si, $4x10^{16}$ cm^{-3}), 5 μm upper cladding layer (Si, $3x10^{16}$ cm^{-3}), 150 nm gradually doped layer (changing from $1x10^{17}$ to $3x10^{17}$ cm^{-3}) and 800 nm highly doped cladding layer (Si, $5x10^{18}$ cm^{-3}). The double channel waveguides with an average ridge width of 40 μm were fabricated by photolithography and wet chemical etching. After etching, a 450-nm thick SiO_2 layer was deposited by plasma enhanced chemical vapor deposition (PECVD) for electrical insulation. A 200 nm thick Ti/Au layer was deposited by e-beam evaporation to realize the electrical contact. In order to reduce thermal resistance, an additional 5 μm thick Au layer was subsequently electroplated. With thinning and annealing, the wafer was then cleaved into 4 mm long laser bars and mounted epilayer side down on the copper heat sink with indium solder.

Keywords: long-wave infrared; quantum cascade laser; semiconductor laser

Biography

Junqi Liu is currently a Professor at the Institute of Semiconductors, Chinese Academy of Sciences. He is also a Post Professor in Materials Physics and Chemistry in College of Materials Science and Opto-Electronic Technology, University of Chinese Academy of Sciences. He received his degree in Materials Science and Technology and his PhD degree from University of Chinese Academy of Sciences and joined the faculty of the Institute of Semiconductors, Chinese Academy of Sciences in 2007. In recent years, his research has focused on quantum cascade lasers and published more than 130 related papers and 40 invention patents.

Oral Talks

CIOP2019-2019-000117 (15:15-15:30, August 7)

Microfiber-enabled dissipative soliton laser at 2 μm

Yuhang Li
Tsinghua University, China

Abstract: We report a dissipative soliton fiber laser at 2 μm enabled by an optical microfiber with a spectral bandwidth of 50 nm, a dechirped pulse duration of 195 fs and pulse energy of 0.5 nJ.

CIOP2019-2019-000196 (17:30-17:45, August 7)

Thermal simulation and structure design of thermally tuned multi-channel interference (MCI) laser

Miao Zhang, Quanan Chen, Chun Jiang, Qiaoyin Lu, Weihua Guo
Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China

Abstract: We simulate the thermal-tuning efficiency of thermally-tuned multi-channel interference (MCI) lasers. Simulations predicted thata 5.4 mW microheater power is needed for π-phase shift of a 100 μm-longthermal tuning waveguide, which is consistent with the experiments.

CIOP2019-2019-000091 (10:00-10:15, August 8)

Generation of complex structured beams with selective modes

Shiyao Fu, Chunqing Gao
Beijing Institute of Technology, China

Abstract: A presentation about how to generate various structured beams, including scalar optical vortices, vector beams, vectorial vortex beams, vortices arrays and so on.

CIOP2019-2019-000156 (10:15-10:30, August 8)

Lateral mode tailoring in broad area diode lasers based on laterally coupled passive waveguide

Jingjing Yang, Xiaohui Ma, Jie Fan, Yonggang Zou
Changchun University of Science and Technology, China

Abstract: The edge-emitting broad area diode lasers with laterally coupled passive waveguide structures is presented, which can effectively eliminate the high-order lateral modes and achieves a single lateral mode output.

CIOP2019-2019-000575 (12:00-12:15, August 8)

Generations of cylindrical vector beam in the Rotary Nd:YAG disk laser

Sanbin Chen[1,3], Jianlang Li[1,2], Hongyu Ma[1]
1. Xidian University, China
2. Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China
3. Science and Technology on Solid-State Laser Key Laboratory, (North China Research Institute of Electro-optics), China

Abstract: Efficient excitations of cylindrical vector beam with azimuthal and radial polarizations were realized in a rotating Nd:YAG disk laser for the first time.

CIOP2019-2019-000212 (15:00-15:15, August 8)

Noise-like pulses with low repetition rate in an all-polarization-maintaining mode-locked figure-of-9 Er-doped fiber laser

Yan Pei[1], Yue Zhou[1], Jie Yin[2], Kun Xu[1]
1. Beijing University of Posts and Telecommunications, China
2. Beijing Institute of Satellite Information Engineering, China

Abstract: We have experimentally generated low-repetition-rate Gaussian-shape noise-like pulses at 1550 nm in a self-started passively mode-locked figure-of-9 erbium-doped fiber laser by using an all-polarization-maintaining nonlinear amplifying loop mirror configuration.

CIOP2019-2019-000157 (15:15-15:30, August 8)

Low threshold current, narrow linewidth surface emitting distributed feedback lasers

Yina Hai, Xiaohui Ma, Yonggang Zou, Jie Fan

Changchun University of Science and Technology, China

Abstract: The low threshold, narrow line-width SE-DFB semiconductor laser with second-order Bragg grating and asymmetric waveguide structure has been realized in theoretical design and experiment.

CIOP2019-2019-000515 (15:30-15:45, August 8)

High-efficiency and high-purity Laguerre-Gaussian laser based on intracavity spin-orbital angular momentum conversion

Dunzhao Wei[1,2], Yong Zhang[1], Xiaopeng Hu[1], Shining Zhu[1], Min Xiao[1]

1. National Laboratory of Solid State Microstructures, College ofEngineering and Applied Sciences, and School of Physics, Nanjing University, Nanjing 210093, China

2. School of Physics, Sun Yat-sen University, Guangzhou, China

Abstract: Based on principle of intracavity spin-orbital angular momentum conversion of light, we have experimentally demonstrated a low-threshold solid-state laser that can directly generate high-purity Laguerre-Gaussian modes and cylindrical vector beams with high efficiency and controllability.

CIOP2019-2019-000374 (12:00-12:15, August 9)

MHz-level energetic ultrafast laser source tunable between 940-1250 nm for multi-photon microscopy

Yang Yu[1,2], Shaobo Fang[2], Hao Teng[2], Jiangfeng Zhu[1], Junli Wang[1], Guoqing Chang[2*], Zhiyi Wei[1,2,3]

1. School of Physics and Optoelectronic Engineering, Xidian University, Xi'an 710071, China, China

2. Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China, China

3. School of Physical Science, University of Chinese Academy of Sciences, Beijing, 100049, China, China

Abstract: We demonstrate a 1-MHz ultrafast fiber-optic source that produces ~100-fs pulses tunable from 940 nm to 1250 nm with up to 33-nJ pulse energy. Such a source is ideal for driving multi-photon microscopy.

CIOP2019-2019-000147 (15:15-15:30, August 9)

Polarization-stabilized tunable VCSEL with an internal-cavity sub-wavelength grating

Xiaolong Wang, Yonggang Zou, Zhifang He, Chunyang Gong, Xiaohui Ma, Guojun Liu

Changchun University of Science and Technology, China

Abstract: In this paper, we present a 850 nm tunable VCSEL with a internal-cavity sub-wavelength grating structure to achieve wide wavelength tuning range and stable TE polarization mode output.

CIOP2019-2019-000679 (15:30-15:45, August 9)

Stannic sulfide (SnS_2) nanosheets as saturable absorber for high-order soliton molecules generation in Er-doped fiber resonator

Tianci Feng, Xiaohui Li, Qyyum Abdula, ZhaoJiang Shi

Shaanxi Normal University, China

Abstract: In this study, we deposit SnS_2 on microfiber for the first time to study its nonlinear characteristics in erbium-doped fiber laser (EDFL).

SC4

SC5 Silicon Photonics

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Silicon photonic devices for optical signal processing in wavelength, polarization and mode (Tutorial)

Yikai Su
Shanghai Jiao Tong University, China

Abstract

We discuss silicon photonic devices for optical signal processing in different physical dimensions. In wavelength domain, we will talk about optical filtering and switching, including a suspended nanobeam filter with a high tuning efficiency of 21 nm/mW, and a 2 x 2 nanobeam optical switch with a 0.16-mW tuning power. For polarization handling, we show a 30-dB high extinction-ratio silicon PBS, and an ultra-compact PSR with an 8.77-μm coupling length. In mode processing, we demonstrate a 11-channel mode multiplexer with insertion losses 2.6 dB and crosstalk values -15.4 dB at 1545 nm.

Biography

Yikai Su received the Ph.D. degree in EE from Northwestern University, Evanston, IL, USA in 2001. He worked at Crawford Hill Laboratory of Bell Laboratories and he joined the Shanghai Jiao Tong University as a Full Professor in 2004. His research areas cover silicon photonic devices for information transmission and switching. He has over 400 publications in international journals and conferences, with more than 4000 citations (scopus search). He holds 6 US patents and ~50 Chinese patents. Prof. Su served as an associate editor of APL Photonics (2016-) and Photonics Research (2013-2019), a topical editor of Optics Letters (2008-2014), and a guest editor of IEEE JSTQE (2008/2011). He is the chair of IEEE Photonics Society Shanghai chapter, a general co-chair of ACP 2012, a TPC co-chair of ACP 2011 and APCC 2009. He also served as a TPC member of a large number of international conferences including CLEO (2016-2018), ECOC (2013-2017), OFC (2011-2013, 2020-), OECC 2008, CLEO-PR 2007, and LEOS (2005-2007).

- 14:15-14:45, August 7 -

All-silicon lasers with a wide gain range

Xiang Wu
Fudan University, China

Abstract

With the development of advanced nano-manufacturing methods, the manipulation of photons down to the nanoscale in silicon integrated optical chips has become a feasible and promising solution for next-generation data processing as electronic chips reach their fundamental limit. As the most important active devices that generate photons for all other working photonic components, silicon lasers are the last barrier to achieving silicon integrated optical chips. Although optical gain in silicon nanocrystals (Si-NCs) was observed in 2000, the progress in realizing all-Si lasers has been very limited due to the inferior optical gain compared to traditional gain materials. In this work, highly luminescent thin films of Si-NCs with a photoluminescence quantum yield (PLQY) of 57% were developed. The broadband photoluminescence (PL) covered the wavelength range from 650 nm to 900 nm, and wide-range optical gains were identified, indicating the feasibility of a tunable laser. Distributed feedback (DFB) all-Si lasers were fabricated using these thin films and

pumped by femtosecond pulses at a wavelength of 400 nm. Characteristic lasing behaviors, including threshold effects, significant narrowing of spectral widths, polarization effects, laser spots and speckle patterns of lasing, were observed. In addition, three different DFB grating periods were selected, and the lasing peak could be tuned by over 100 nm. The lasing thresholds ranged from 1.0 to 6.4 mW/cm^2. The linewidths of lasing peaks are less than 2 nm. This work demonstrates the lasing and wavelength tunability of all-Si DFB lasers based on highly luminescent Si-NC thin films with broadband optical gains.

Biography

Xiang Wu received his Ph.D. degree in optical engineering at Zhejiang University in 2004. He worked as a postdoc in Fudan University from 2004 to 2007 and appointed lecturer in 2007. He became an associate professor in 2010 and a professor in 2014. He was a visiting scholar in Hamamatsu Inc. in Japan from 2001 to 2002, in University of Missouri Columbia in 2009, and University of Michigan, Ann Arbor from 2013 to 2014. His research fields include biomedical photonics and silicon photonics.

- 14:45-15:15, August 7 -

A miniature interrogator for multiplexed FBG strain sensors

Wenjia Zhang

Shanghai Jiao Tong University, China

Abstract

This talk will present a high-resolution and miniature multi-wavelength FBG interrogator based on a thermally tunable microring resonator (MRR) array. A phase detection method using dithering signals is exploited to generate an antisymmetric error signal curve, which is utilized for the feedback locking of the MRR with the FBG sensor. Dynamic strain sensing of both single FBG and multiple FBGs are experimentally demonstrated, with a dynamic strain resolution of 30 nε/√Hz over 100 Hz to 1 kHz. The proposed interrogator shows the great improvements in both resolution and wavelength accuracy compared with the reported MRR-based interrogators, and is promising for scalable multiplexed sensing applications.

SC5

Biography

Dr. Wenjia Zhang, associate professor with Shanghai Jiao Tong University, received the B.S. and Ph.D. degrees from Beijing University of Posts and Telecommunications in 2007 and 2012 respectively. He visited the Lightwave Research Laboratory, Columbia University, from Sep. 2010 to Mar. 2012, working on optical interconnected high-performance data center. After graduation, he joined Singapore-MIT Alliance for Research and Technology (SMART) as a postdoc researcher from Aug. 2012 to Jun. 2014, leading a project of optical network-on-chip based on the III-V over Si platform. From Jun. 2014 to Dec. 2015, he was a senior optical engineer with Finisar Shanghai, where he worked on the 40G/100G module design for the next-generation active optical cable. After that, he joined Shanghai Jiao Tong University and his research topics cover integrated optical systems for the high-performance optical interconnects and sensing.

- 16:00-16:30, August 7 -

Er silicate amplifier and laser for silicon photonics

Xingjun Wang

Peking University, China

Abstract

In the process of information technology, as Moore's law becomes more and more close to the limit, it has become

inevitable and the consensus to combine microelectronics and optoelectronics to develop silicon-based large-scale optoelectronic integration technology. As the most important part of silicon photonic devices, silicon-based light source still attracted great efforts. In the traditional research, the erbium-doped materials have played an important role in silicon-based light sources. Recent studies demonstrated that the erbium silicate compound had a high net gain attributable to its high erbium concentration that has no insolubility problem. This paper focuses on the theory, designs, simulations, preparation methods, process and device optimizations of the erbium silicate compound optical waveguide amplifier and laser. The erbium silicate compound materials with large optical gains can serve as potential candidates for future silicon-based scale-integrated light-source applications.

Biography

Xingjun Wang received the B.E., M.E. and Ph.D. degrees from the Dalian University of Technology, China in 1999, 2002 and 2005, respectively. From 2007 to 2009, he was a JSPS postdoctoral follow in Department of Electronic Engineering, University of Electro-Communications, Japan. In 2009, he joined Peking University, and is currently a full professor at Peking University, Beijing, China. In 2015, he was selected first Young Yangtse River Scholar of China. Now he is devoted into Si photonics, including the Si based light source and Si optoelectronic integration chip for high speed optical communication. He has published more than 150 papers on international journals and conference proceedings. The 80 papers have been SCI indexed. The citation reaches 800 times.

- 16:30-17:00, August 7 -

Recent advances in dispersion engineering of integrated optical waveguides

Lin Zhang

Tianjin University, China

Abstract

Chromatic dispersion is one of fundamental properties of optical waveguides, and dispersion engineering has been extensively studied in the past years. Integrated waveguides with a high index contrast have suffered from strong waveguide dispersion which may be stronger than that in optical fibers by more than hundred times. Dispersion engineering is thus of great interest in integrated photonics community for optical communications, signal processing and broadband nonlinear applications. In this talk, we will review some recent advances in dispersion engineering mainly focusing on dispersion flattening for a flat and low dispersion over a broad spectral band. We will specifically talk about the possibility of producing extremely low dispersion over a bandwidth more than one octave, with five or six zero-dispersion wavelengths, and dispersion flattening with the limited number of design freedoms particularly for friendly device fabrication. A roadmap of dispersion flattening technology in the future will be discussed as well. It will also be reviewed how to use the obtained flat dispersion for broadband supercontinuum and frequency comb generation on a chip, both exhibiting an octave-spanning spectral coverage.

Biography

Lin Zhang received his B.S. and M.S. degrees with honors from Tsinghua University, China, in 2001 and 2004, respectively. He received the Ph.D. degree from University of Southern California, USA, in 2011. Then, he worked as a post-doc researcher at Massachusetts Institute of Technology, USA. Since 2015, he is a professor at Tianjin University in China. His research interests include integrated nano-photonics, on-chip nonlinear ultrafast phenomena, micro-resonator devices and system applications, chip-scale optical interconnects, sensing, and photonic crystal fibers. He has published over 240 peer-reviewed journal articles and conference papers, including 25 invited papers, and 2 book chapters. He has 7 patents issued. His H-index is 32. He is a senior member of the Optical Society of America (OSA) and a member of the IEEE Photonics Society and the International Society for Optical Engineering (SPIE). Prof. Zhang received the Tianjin "Youth 1000-Talent" award in 2014 and the national "Youth 1000-Talent" award and "Peiyang Scholar - Outstanding Talent Oversea" award in 2015.

- 09:00-09:45, August 8 -

Multimode silicon photonics (Tutorial)

Daoxin Dai
Zhejiang University, China

Abstract
Multimode silicon photonics is attracting more and more attention because the introduction of higher-order modes makes it possible to increase the channel-number for data-transmission in mode-division-multiplexed (MDM) systems as well as improve the flexibility of device designs. On the other hand, the design of multimode silicon photonic devices becomes very different compared with the traditional case with the fundamental mode only. Great progresses have been achieved on multimode silicon photonics in the past years. In this tutorial talk, a review is given for recent progresses of multimode silicon photonic devices and circuits. The first part is multimode silicon photonics for MDM systems, including on-chip multi-channel mode (de)multiplexers, multimode waveguide bends, multimode waveguide crossings, reconfigurable multimode silicon photonic integrated circuits, multimode chip-fiber couplers, etc. In the second part, we give a discussion about the higher-order-mode-assisted silicon photonic devices, including on-chip polarization-handling devices with higher-order modes, add-drop optical filters based on multimode Bragg gratings, and some emerging applications.

Biography
Daoxin Dai received the B.Eng. degree from the Department of Optical Engineering, Zhejiang University (ZJU), Hangzhou, China, and the Ph.D. degree from the Royal Institute of Technology, Stockholm, Sweden, in 2000 and 2005, respectively. He joined ZJU as an Assistant Professor in 2005 and became an Associate Professor in 2007, and a Full Professor in 2011. He visited the Chinese University of Hong Kong in 2005, and Inha University, South Korea, in 2007. He was with the University of California, Santa Barbara, USA, as a Visiting Scholar in the years of 2008-2011. Currently he is the QIUSHI Distinguished Professor at ZJU and is leading the Silicon Integrated Nanophotonics Group. He has published >180 refereed international journal papers in Nature, Nature Comm., Light Sci. Appl., Laser Photon. Rev., Optica, etc. Dr. Dai is one of Most Cited Chinese Researchers in 2015-2019 (Elsevier). He has given >70 keynote/invited talks and served as the TPC Chair/Member for prestigious international conferences (e.g., OFC). He is also serving as the Associate Editor of the Journals of IEEE Photonics Technology Letters, Photonics Research, and Optical and Quantum Electronics. He also served as the Guest Editor of special issues of IEEE JSTQE (2018) and IEEE JLT (2019).

- 09:45-10:15, August 8 -

III-V Nano-lasers directly grown on silicon

Kei May Lau
Hong Kong University of Science and Technology, Hong Kong, China

Abstract
Energy efficient and compact III-V light sources directly grown on (001) Si substrates are desirable for silicon photonics. Scaling the laser footprint to nanometer scale improves the integration density and reduces power consumption of Si-based photonic integrated circuits, and opens up numerous new applications. In this talk, we report monolithically integrated in-plane InP/InGaAs nano-laser array on (001) silicon-on-insulator (SOI) platforms with emission wavelengths covering the entire C-band (1.55 μm). Multiple InGaAs quantum wells were embedded in high-quality InP nano-ridges by selective-area growth on patterned (001) SOI. Combined with air-surrounded InP/Si optical cavities, room-temperature operation at multiple telecom bands is obtained by defining different cavity lengths with lithography. The demonstration of telecom-wavelength monolithic nano-lasers on (001) SOI platforms presents an important step towards fully integrated Si photonics circuits.

Biography

Professor Kei May Lau is the Fang Professor of Engineering at the Hong Kong University of Science and Technology (HKUST). She received the B.S. and M.S. degrees in physics from the University of Minnesota, Minneapolis, and the Ph.D. degree in Electrical Engineering from Rice University, Houston, Texas. She was on the ECE faculty at the University of Massachusetts/Amherst and initiated MOCVD, compound semiconductor materials and devices programs. Since the fall of 2000, she has been with the ECE Department at HKUST. She established the Photonics Technology Center for R&D effort in III-V materials, optoelectronic, high power, and high-speed devices. Professor Lau is a Fellow of the IEEE (2001), a recipient of the US National Science Foundation (NSF) Faculty Awards for Women (FAW) Scientists and Engineers (1991), Croucher Senior Research Fellowship (2008), and the IEEE Photonics Society Aron Kressel Award (2017). She is an Editor of the IEEE EDL and former Associate Editor of IEEE TED, Applied Physics Letters and Journal of Crystal Growth.

- 11:00-11:30, August 8 -

Advances in twisting light on silicon platform

Jian Wang

Huazhong University of Science and Technology, China

Abstract

Twisted light having helical phase front carries orbital angular momentum (OAM). The distinct features of OAM-carrying twisted light have given rise to many developments in manipulation, trapping, tweezer, microscopy, imaging, metrology, sensing, nonlinear interactions, astronomy, quantum information processing and optical communications. For all these twisted light enabled applications, the generation of twisted light is of great importance. Twisting light by photonic integrated devices is promising. Silicon photonics is one of the most promising photonic integration platforms owing to its high-index contrast, small footprint, low power consumption, and availability of complementary metal-oxide- semiconductor (CMOS) fabrication technology for low-cost mass production. In this talk, we will report recent progress in twisting light on silicon platform. After a brief introduction of basic concept of twisted light and well-established techniques and devices twisting light, we will focus on twisting light using silicon photonic integrated devices. Twisting light using dielectric metasurfaces on silicon platform, generating and synthesizing twisted light using compact silicon chip, generating broadband polarization diversity twisted light using sub-wavelength surface structure (superposed holographic fork gratings) on silicon platform are demonstrated in the experiment, showing favorable performance.

Biography

Jian Wang received the Ph.D. degree from Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China, in 2008. He worked as a Postdoctoral Research Associate in Optical Communications Laboratory, University of Southern California, USA, from 2009 to 2011. He is currently a professor at Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China. His research interests include optical communications, silicon photonics, and photonic integration. He has more than 300 publications on Science, Nature Photonics, Science Advances, Light: Science and Applications, Optica, Laser & Photonics Reviews, etc. He is a topical editor of Optics Letters and Chinese Optics Letters.

- 11:30-12:00, August 8 -

Chip-based silicon light-emitting device

Kaikai Xu
University of Electronic Science and Technology of China, China

Abstract

Silicon light source is one of the most important electronic components in monolithic integration of silicon optoelectronics. Research on all-silicon optoelectronic devices and integration technology has been implemented, achievements are represented by two creative points: 1) electro-optic modulation method: achieving the frequency of 45 GHz under reverse current to avalanching, applied by the US in MOSFET devices and by the UK in TFT devices. 2) silicon light-emitting device's structures: improving the electric field distribution, realizing extra carrier injection, and then increasing the photon emission intensity (up to 200 nW/um^2), applied by the TSMC in SPAD. Such a chip-based silicon light-emitting device will be a key component for silicon-photonic-integrated circuits for future computing I/O applications.

Biography

Kaikai Xu received the Ph.D. degree from the University of California, Irvine CA. Currently, he is the Professor and Doctoral Supervision (with the title of the "UESTC 100 Talent Plan" Distinguished Professor) in the University of Electronic Science and Technology of China (UESTC), Chengdu, China, also a distinguished researcher scientist affiliated with the State Key Laboratory of Electronic Thin Films and Integrated Devices in the same university. His research interest includes semiconductor optoelectronic device and its integration technologies. Related works are published on IEEE Journals, with more than 30 of them are published as the first author, including two as ESI Hot Papers (TOP 0.1%), two ESI Highly Cited Papers (TOP 1%), one selected as "Back Cover" by the Wiley, one highlighted by Institute of Physics as "IOP Select" in 2018, one listed by SPIE as one of "TOP TEN DOWNLOADS" (one of five non open-access articles) in April 2018, one listed by OSA as one of "TOP TEN DOWNLOADS" in November 2017. One published in J. Applied Physics (JAP) in March 2013 was among the TOP 25% most download, name as "JAP Outstanding Author". Prof. Xu has served on the editorial board for several peer-review journals: establishing Journal of Physics Communications, guest-editing the OSA Applied Optics feature issue "Near- to mid-IR (1-13 µm) III-V semiconductor lasers" and IEEE Transactions on Electron Devices special issue "Compact Modeling for Circuit Design";, is the associate editor for IET Electronics Letters, serving on Journal of Applied Physics Editorial Advisory Board, IEEE Senior Member, Chair of IEEE Nanotechnology Council Nano-Optics, Nano-Photonics, and Nano-Optoelectronics Committee, Member of IEEE Reliability Standards Working Groups.

- 13:30-14:00, August 8 -

High coherence semiconductor lasers for next generation silicon photonics

Frédéric Grillot
Télécom ParisTech, France

Abstract

High coherence semiconductor lasers are highly needed for coherent communications, on-chip atomic clocks and sensors related activities like in frequency modulated continuous wave LIDAR. As silicon waveguides are low loss, the silicon photonics platform is particularly well adapted for manufacturing such lasers. In this presentation, I will discuss about a novel type of hybrid III-V on silicon semiconductor laser based on a high quality factor. The cross section of the hybrid laser structure combines a silicon photonic layer to a quantum well gain material. The geometry is optimized such that the mode is buried into a rib silicon waveguide with a shallow grating of 30 nm deep teeth. The width of the grating is tapered longitudinally to create an effective confining potential which allows a single, bell-shaped

longitudinal mode within the stop band of the distributed feedback laser. In particular, I will show that a very large quality factor, typically in the 106 range can be achieved, which corresponds to a very long photon lifetime (1 ns). Such a large photon lifetime transforms into a flat intensity noise characteristics with a level below -147 dB/Hz. Last but not the least, I will show that this high coherence hybrid laser exhibits a very narrow spectral line below 30 kHz as well as a remarkable robustness against external optical feedback. In the latter, 10 Gbps floor-free transmissions under optical feedback are demonstrated thereby paving the way to isolator-free photonics integrated circuits.

Biography

Frédéric Grillot received the Ph.D. degree from the University of Besançon (France) and the Thesis Habilitation in Physics from the University of Paris VII (France). He is currently a Full Professor at Télécom ParisTech (France) and at the University of New-Mexico (USA). His current research interests include advanced quantum confined devices using new materials such as quantum dots, light emitters based on intersubband transitions, nonlinear dynamics and optical chaos in semiconductor lasers and silicon photonics applications. Dr. Grillot has coauthored 93 journal papers and more than 200 contributions in international conferences and workshops. He is an Associate Editor for Optics Express (OSA), a Fellow Member of the SPIE and a Senior Member of the IEEE Photonics Society.

- 14:00-14:30, August 8 -

Photon lifetime dependent reduction of VCSEL energy consumption

Gunter Larisch

Bimberg Chinese-German Center for Green Photonics of the Chinese Academy of Sciences at Changchun Institute of Optics, Fine Mechanics, and Physics, China

Abstract

The energy required to transmit information by optical data bits within and between electronic and photonic integrated circuits, data centers, and ultimately across the earth from one point to another one must be minimized. This energy spans from typically tens of picojoules-per-bit to well over tens of millijoules-per-bit for intercontinental distances. Given the large number and high density of optical interconnects in data centers, they belong to the dominant energy consumers in the world-wide power grid. Most energy in a data center is consumed by optical transmitters based on VCSELs up to distances of several hundred m. The data rate across these interconnects must be increased and at the same time their energy consumption decreased, obviously contradictory demands. Our novel photon lifetime tuning technology for VCSELs allows to increase their max bit rate and to reduce their power consumption, in particular at large bit rates. Wavelength division multiplexing in combination with optimized VCSELs allows to develop optimization strategies presented here for +200 Gb/s data links.

Biography

Gunter Larisch received the physics Diploma degree in applied physics from the Technische Universität Berlin, Germany, in 2011 and a Ph.D. in science in 2017. He continued working as Postdoctoral Researcher at Technische Universität Berlin, Germany. Currently he is Associate Professor at the "Bimberg Chinese-German Center for Green Photonics" at Chinese Academy of Sciences and head of its High Frequency Lab.

- 14:30-15:00, August 8 -

Realizing Lorentzian, Fano and EIT resonance lineshapes in a microring resonator

Xuetao Gan
Northwestern Polytechnical University, China

Abstract

Microring resonators, as a fundamental building block of photonic integrated circuits, have been well developed into numerous functional devices, whose performances are strongly determined by microring's resonance lineshapes. In this talk, we propose tow compact structures to reliably realize Lorentzian, Fano, and electromagnetically induced transparency (EIT) resonance lineshapes in a microring resonator. In the first structure, by simply inserting two air-holes in the side-coupled waveguide of a microring, a Fabry-Perot (FP) resonance is involved to couple with microring's resonant modes, showing Lorentzian, Fano, and EIT lineshapes over one free spectral range of the FP resonance. The quality factors, extinction ratios, and slope rates in different lineshapes are discussed. At microring's specific resonant wavelength, the lineshape could be tuned among these three types by controlling the FP cavity's length. Experiment results verify the theoretical analysis well and represent Fano lineshapes with extinction ratios of about 20 dB and slope rates over 280 dB/nm. In the second structure, a single air-hole is inserted into the bus-waveguide coupled with a microring, which functions as an inline MZI. Fano resonance lineshapes are obtained at each resonant wavelengths. The obtained slope rate and extinction ratio of the Fano resonant lineshapes are 22.2 dB and 557.33 dB/nm, respectively. The reliably and flexibly tunable lineshapes in the compact structure have potentials to improve microring-based devices and expand their application scopes.

Biography

Xuetao Gan received the B.S. and Ph.D. degrees from Northwestern Polytechnical University, Xi'an, China, in 2007 and 2013, respectively. From 2010 to 2012, he was a visiting scholar at Columbia University, New York, USA. He is currently a professor of applied physics in Northwestern Polytechnical University. His research interests mainly include nanophotonics, optoelectronics in graphene and other layered materials, and applications of photonic crystals. As the first-author and corresponding author, has published more than 20 papers, including Nature Photonics, Nano Letters, ACS Photonics, Laser Photonics Reviews, Advanced Optical Materials, Optica.

- 09:00-09:30, August 9 -

Manipulating mesoscopic mechanical vibrations with an optomechanical toolbox

Gustavo Wiederhecker
University of Campinas, Brazil

Abstract

The interaction between light and phonons is strongly enhanced in micro and nanoscale optical cavities and waveguides. Such enhanced interaction enabled a range of novel functionalities based on sound-light interaction, such as generating radio-frequency signals, suppressing stimulated light scattering and probing mesoscopic phonon modes. In this talk I will review our recent progress in this field that relies on exploring dielectric nano-waveguides and cavities to enhance or suppress the interaction between light and mechanical waves. These techniques have recently enabled probing in real-time the molecular-scale vibrational modes of carbon nanotubes.

Biography

Gustavo Wiederhecker is an associate professor with the Applied Physics Department in the University of Campinas, which he joined in 2011. His area of research embraces several aspects of nanophotonics, including the interaction between optical and mechanical waves and Kerr-based nonlinearities in nano-waveguides and microcavities. Wiederhecker obtained his PhD in 2008 at the University of Campinas in Brazil followed by a post-doctoral fellowship at Cornell University with Prof. Michal Lipson. He is a member of Optical Society of America and affiliate member of the Brazilian Academy of Sciences.

- 09:30-10:00, August 9 -

Full-stokes polarimeters in silicon photonics

Wei Shi

Laval University, Canada

Abstract

Characterization of the state of polarization (SoP) of light is crucial for many applications in domains such as astronomy, chemical analysis, quantum information, and optical communications. Bulky and costly discrete optical components used in conventional polarimeters limit their broad adoption. This talk reviews our recent progress on chip-scale full-Stokes polarimeters in silicon photonic integrated circuits. We discuss their optimization in presence of Gaussian and Poisson noises. Avoiding the use of free-space optical and mechanical components, this solid-state solution enables significant improvement in system robustness, size and cost.

Biography

Wei Shi is an Associate Professor in the Department of Electrical and Computer Engineering, Université Laval, Québec, QC, Canada. He received the Ph.D. degree in electrical and computer engineering from the University of British Columbia, Vancouver, BC, Canada, in 2012, where he was awarded the BCIC Innovation Scholarship for a collaboration entrepreneurship initiative. Before joining Université Laval in 2013, he was a researcher at McGill University, Montreal, QC, Canada, where he held a Postdoctoral Fellowship from the Natural Sciences and Engineering Research Council of Canada (NSERC). His current research focuses on integrated photonic devices and systems, involving silicon photonics, nanophotonics, CMOS-photonics co-design, high-speed optical communications, chip-scale lasers, and optical sensors. He holds a Canada Research Chair in Silicon Photonics.

- 10:00-10:30, August 9 -

Fabrication technology and foundry models of silicon photonics

Junbo Feng

Chongqing United Micro-Electronics Center, China

Abstract

Silicon photonics is currently at the same early stage of development as microelectronics was in the 1970s. The designers must own some basic understanding of fabrication and packaging at the very beginning of scheme. The most attractive aspects of photonics on silicon are the low primary cost of the material, the mature processing techniques, and the potential for straightforward integration with electrical components in the same substrate. Even silicon photonics is always claimed to be CMOS compatible, every attempt to directly integrate photonic functionality into the advanced CMOS line so far, without making any process changes, has yielded poorly-performing devices or economic

waste. As more and more players entered this field, research and development (R&D) foundries are beginning to play bigger roles in transforming silicon photonics into a mature technology for mass production. R&D foundry services such as multi-project wafer (MPW), customized process developmental runs and small volume manufacturing are discussed. The differences between Silicon Photonics process and CMOS and the development of commercial foundries are presented.

Biography

Junbo Feng received the B.E. and Ph.D. degrees from Huazhong University of Science and Technology, respectively. He studied in the electronic engineering department of Georgia Tech. during 2007.01~2008.06. After that, he continued his research in Peking University and Tsinghua University until 2011. He is now the director of silicon photonics department of Chongqing United Micro-Electronics Center. His research topics focus on silicon photonics and optical integration technologies. He has authored more than 30 journal and conference publications and a book chapter, owned more than 20 patents.

- 11:00-11:30, August 9 -

Design of high-speed drivers for 400 GbE datacenter interconnects

Nan Qi

Institute of Semiconductors, CAS, China

Abstract

With explosive developments of the cloud service and mobile computing, datacenter interconnects demand for higher throughput, evolving from 100 Gb/s to 400 Gb/s. The optical link outperforms copper on low transmission loss and low power consumption, which enables higher density integration for the data-rate at 400 Gb/s and above. Modulated in PAM4, the data-rate in each channel is expected to be 56 Gb/s at the first step, while eventually reaches 100 Gb/s. This talk focuses on the design and demonstration of driver circuits under PAM4 modulation, including a 50 Gb/s direct-modulated VCSEL driver with the proposed asymmetric pulsed pre-emphasis, and a 50 Gb/s Silicon-Photonics MZ modulator driver with optical-domain PAM4 combination.

Biography

Nan Qi received the B.S. from Beijing Institute of Technology in 2005, M.S. and Ph.D. degree from the Institute of Microelectronics, Tsinghua University in 2008 and 2013 respectively. From 2013 to 2015, he worked as a post-doc research scholar in the department of EECS, Oregon State University, Corvallis, OR. From 2015 to 2017, he was with Hewlett-Packard Labs, Palo Alto, CA, as a post-doc and senior circuit-design engineer. In 2017, he joined the Institute of Semiconductors, Chinese Academy of Sciences, as a full professor working on the high-speed Electronic-Photonic Integrated Circuits (EPICs). His research interests include the design of analog/RF circuits and systems, as well as the high-speed electronic/photonic integrated transceivers.

- 11:30-12:00, August 9 -

Universal silicon based multimode photonic devices based on transformation optics

Dingshan Gao
Huazhong University of Science and Technology, China

Abstract

Mode-division multiplexing is a promising and cost-effective way to increase the communication capability of integrated photonic circuits, for both classical and quantum information processing. To construct large-scale on-chip multimode routing systems, the multimode waveguide bending, multimode waveguide crossing and multimode taper are the key components. However, these components can hardly be designed by traditional methods, which severely limits the density and capacity of multimode routing systems. Here we demonstrate the design of the above mentioned multimode functional devices based on transformation optics, which can handle, in principle, any number of waveguide modes and large bandwidth as well. The multimode waveguide bending and multimode taper are coordinately transformed from straight multimode waveguides. And a Maxwell's fisheye is transformed to construct the multimode waveguide star crossing. A gray-scale electron-beam lithography is adopted to fabricate the multimode waveguide star crossing on a commercial silicon-on-insulator wafer. The proposed multimode waveguide star crossing has low loss and low crosstalk throughout an ultra-broad wavelength range of ~400 nm. Our study paves the way for realizing highly integrated and large capacity on-chip multimode routing and communication systems.

Biography

Dr. Dingshan Gao received his doctorate from Institute of Semiconductors, Chinese Academy of Sciences in 2004. After that, he worked as a postdoctoral researcher in Huazhong University of Science and Technology. Now he is an associate professor at Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology. He is currently the Chinese chairman of the Sino-French "PHOTONET" joint research network. His research interests include silicon photonics, nano-optics and quantum optics. He has published more than 50 papers in Optica, Scientific Reports, Optics Letters, Optics Express and other international journals. He is an associate editor of the international journal IET Optoelectronics.

Oral Talks

CIOP2019-2019-000036 (15:15-15:30, August 7)

64 Gb/s PAM-4 modulation using a single-drive silicon Mach-Zehnder modulator with 2 V drive voltage

Gangqiang Zhou[1], Yuyao Guo[1], Shuhuang Chen[1], Linjie Zhou[1*], Liangjun Lu[1], Lei Liu[2], Jianping Chen[1]
1. Shanghai Jiao Tong University, China
2. Huawei Technologies Co.Ltd, China

Abstract: We demonstrate a single-drive silicon Mach-Zehnder modulator (MZM) for four-level pulse amplitude modulation (PAM-4). PAM-4 Modulation at the 64 Gb/s data rate is successfully achieved with 2 V drive voltage.

CIOP2019-2019-000173 (17:00-17:15, August 7)

Reconfigurable optical directed logic device based on cascaded micro ring resonators

Yonghui Tian
Lanzhou University, China

Abstract: We propose and demonstrate a reconfigurable optical directed logic circuit which can perform any combination logical operations using cascaded microring resonators (MRRs).

CIOP2019-2019-000397 (17:15-17:30, August 7)

Closed-loop thermal-electronic-photonic co-simulation for a novel mach-zehnder modulator bias control scheme

Yuhang Wang, Min Tan, Da Ming, Zhicheng Wang
Huazhong University of Science and Technology, Wuhan 430074, China

Abstract: A novel bias control scheme for Mach-Zehnder modulator is presented. To verify the proposed design, compact Verilog-A optical models are constructed and a fast simulation method is used to achieve closed-loop thermal-electronic-photonic co-simulation.

CIOP2019-2019-000353 (10:15-10:30, August 8)

Theoretical study of microring resonator based refractive index sensor

Rahul Kumar Gangwar, Xingjun Wang
1. State Key laboratory of Advanced Optical Systems and Networks, Department of Electronics, School of Electronics Engineering and Computer Science, Peking University, Beijing 100871, China
2. Nano-optoelectronics Frontier Center of Ministry of Education, Peking University, Beijing 100871, China

Abstract: We report a refractive index sensor based on microring resonator. Silicon nitride on insulator platform is used for the microring resonator. The sensitivity of the sensor is found to be 1000 nm/RIU

CIOP2019-2019-000551 (15:00-15:15, August 8)

High extinction ratio subwavelength grating ring resonator

Lijun Huang, Xianwu Mi, Dajiang He, Shenghai Chen, La Xiang, Ni Zhou
Key Laboratory of Intelligent Control Technology for Wuling-Mountain Ecological Agriculture in Hunan Province, School of Electrical and Information Engineering, Huaihua University, China

Abstract: We experimentally demonstrate a subwavelength grating ring resonator around 1310 nm, the extinction ratio of 18.8 dB has an enhancement of 28.7% larger than that around 1550 nm, thus showing a potential in bio-sensing applications.

CIOP2019-2019-000524 (15:15-15:30, August 8)

Near-infrared optical amplifier and lasers based on erbium silicate nanostructures

Xiujuan Zhuang, Hepeng Zhao, Xiaoxia Wang, Anlian Pan
Hunan University, China

Abstract: We have achieved an optical amplification and a laser in the near-infrared communication band based on unique silicon/erbium silicate core-shell nanowires and erbium silicate microplates covered by DBR cavities, respectively.

SC6 Microwave Photonics

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Microwave photonics (Tutorial)

Thas Nirmalathas
University of Melbourne, Australia

Abstract

Microwave photonics is a fast-developing field that seeks to exploit the interaction between lightwaves and microwaves. This interaction offers opportunities for innovative devices, subsystems, systems and networks that can seamlessly interconnect microwave and optical domains. In this pursuit, microwave photonics often provides a new platform to realize new functionalities and also seeks to perform existing functionalities of microwave systems by exploiting recent developments in photonics domain to achieve improved performance. Applications of microwave photonics can be found in broadband wireless systems, radars, astronomy, space and electronic warfare. The tutorial will provide an exposure to the basics of lightwave-microwave interfaces, followed by an in-depth discussion of key unique performance metrics needed to describe and understand microwave photonics applications. It will then outline the latest developments in applications such as antenna remoting (in the context of 5G), filtering, photonic mixing and photonic beam forming for radars.

Biography

Thas Nirmalathas is a Professor of Electrical and Electronic Engineering at The University of Melbourne, Australia. He is also the research group leader for the Electronic and Photonic Systems Group at the same university.

Prof Nirmalathas obtained his BEng and PhD in Electrical and Electronic Engineering from the University of Melbourne in 1993 and 1998 respectively. Between 2000 and 2004, he was the Director of Photonics Research Laboratory (Melbourne Node of Australian Photonics CRC) and also the Program Leader of Telecommunications Technologies Program. From 2004 to 2006, he was the Program Leader for the Network Technologies Research Program in NICTA. He was also the acting Lab Director of VRL in 2007. Between 2006 and 2008, He was the Research Group Manager of the Networked Systems Group of Victoria Research Laboratory (VRL) at the National ICT Australia (NICTA), a premier Australian research centre of excellence in ICT. Between 2010 and 2013, he was the Head of Department of Electrical and Electronic Engineering. Between 2013 and 2014, He was the associate Director for the Institute for Broadband-Enabled Society. In 2012, he co-founded the Melbourne Accelerator Program (Australia's first university-based startup accelerator). He was its Director between 2012-2015 and provided the academic leadership between 2015 and 2017. Between 2014 and 2019, He is also the Director of Networked Society Institute – an interdisciplinary research institute focusing on challenges and opportunities arising from the society's transition towards a networked society.

He has written more than 400 technical articles and currently hold 3 active international patents. His current research interests include energy efficient telecommunications, access networks, optical-wireless network integration and broadband systems and devices. He has held many editorial roles with the IEICE Transactions in Communications, IEEE/OSA Journal of Lightwave Technology and Photonics and Networks SPIE Journal. He is a Senior Member of IEEE, a member of Optical Society of America and a Fellow of the Institution of Engineers Australia.

- 14:15-14:45, August 7 -

Recent advances in optoelectronic oscillators

Ming Li
Institute of Semiconductors, CAS, China

Abstract

Optoelectronic oscillators (OEOs) have been widely studied in recent years as a microwave photonics system to generate microwave signals with ultra-low phase noise, thanks to the high-quality-factor of the optoelectronic feedback loop. However, there are still some limitations in a traditional OEO, including large mode building time, stringent requirements for the loop filter to achieve single mode operation, as well as large size and weight. Here we report three OEOs based on Fourier domain mode locking (FDML), parity-time (PT) symmetry and photonic integrated circuits to overcome the above three limitations, respectively. Frequency scanning microwave waveforms are generated directly from a FDML OEO cavity, which breaks the limitation of mode building time. Single mode oscillation is achieved in a PT symmetric OEO without the need of filters with narrow bandwidth, which opens a new avenue for mode selection in a microwave photonics system. All of the optical devices needed in the OEO loop are monolithically integrated on chip in the integrated OEO, which has a very compact size and weight.

Biography

Prof. Ming Li received the Ph.D. degree in electrical and electronics engineering from the University of Shizuoka, Hamamatsu, Japan, in 2009. In 2009, he was with the Microwave Photonics Research Laboratory, School of Electrical Engineering and Computer Science, University of Ottawa, Ottawa, ON, Canada, as a Postdoctoral Research Fellow. In 2011, he was with the Ultrafast Optical Processing Group, INRS-EMT, Montreal, QC, Canada, as a Postdoctoral Research Fellow. In 2013, he was with the Institute of Semiconductors, Chinese Academy of Sciences, as a Full Professor under the support of Thousand Youth Talents Program. He has authored more than 120 high-impact journal papers. His research interests include integrated microwave photonics and its applications, ultrafast optical signal processing, and high-speed real-time optical measurement and sensing.

- 14:45-15:15, August 7 -

The six-port in microwave photonics

Zhenzhou Tang
Nanjing University of Aeronautics and Astronautics, China & Ghent University, Belgium

Abstract

Six-port receiver is widely used in microwave society. In this talk, an introduction of optical six-port receiver in microwave photonics will be introduced. Microwave photonic applications based on optical six-port receiver, such as image-reject mixer, RF channelizer, photonics-based radar, will also be presented.

Biography

Zhengzhou Tang received the M.S. degree in Information Engineering from Nanjing University of Aeronautics and Astronautics, Nanjing, China, in 2015. He is currently a joint PhD student in the Key Laboratory of Radar Imaging and Microwave Photonics (Nanjing Univ. Aeronaut. Astronaut.), Ministry of Education, and the Photonics Research Group, Ghent University. His research interests are microwave photonic mixing and silicon optomechanics. He received the 2017 Graduate Student Fellowship of IEEE Photonics Society.

- 16:00-16:30, August 7 -

Frequency-time coherence and dispersion engineering for microwave photonic applications

Thomas Schneider
Technical University-Braunschweig, Germany

Abstract

Microwave Photonics has the unique potential to enable ultra-high bandwidth microwave signal processing, to transport the microwave signal via waveguides over kilometres of lengths with almost no losses and to be immune against electromagnetic interference. Integrated electronics is a mature technology with libraries for almost everything in signal processing. Therefore, the connection between both might enable new, integrated devices for microwave, ultra-high bandwidth signal processing demands.

For the processing of ultra-high bandwidth, microwave signals we exploit the frequency time coherence and the dispersion engineering. The frequency and time domain are equivalent to each other, i.e. each signal in the time domain has a corresponding frequency domain representation. Both are connected via the well-known Fourier transform equations. This inherent connection might enable the processing and measurement of very short, ultra-broadband microwave signals, directly in the frequency domain with integrated photonic-electronic devices. By the engineering of the dispersion of an optical element, new degrees of freedom for the design of microwave photonic filters are enabled. In the talk, after an introduction into time-frequency coherence and dispersion engineering, special signal processing demands like microwave filtering, time-lenses, analogue-to-digital (ADC) and digital-to-analogue conversion DAC will be discussed. First preliminary, experimental results will be presented and the roadmap to integrate these devices into electronic-photonic silicon chips will be introduced.

Biography

Thomas Schneider received the diploma degree in electrical engineering from the Humboldt Universität zu Berlin, Germany, in 1995, and the Ph.D. degree in physics from the Brandenburgische Technische Universität Cottbus, Germany in 2000.

From 2000 to 2014 he was with the Hochschule für Telekommunikation (HfT) in Leipzig, Germany. From 2006 to 2014 he was the head of the Institut für Hochfrequenztechnik at the HfT. Since 2014 he has been the head of the THz-photonics group at the Technische Universität Braunschweig.

Dr. Schneider was a guest professor at the Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland, a guest scientist at the Deutsche Telekom Innovation Laboratories and the Fraunhofer Heinrich Hertz Institute Berlin.

His current research interests include integrated and microwave photonics the photon-phonon coupling in nano-waveguides and the exploitation of frequency-time coherence for signal processing.

Dr. Schneider is the author and co-author of 4 books, more than 160 publications and more than 30 patents or patent applications.

SC6

- 16:30-17:00, August 7 -

Microwave photonic radar

Wangzhe Li
Institute of Electronics, CAS, China

Abstract

In the past few decades, photonic techniques have been intensively studied to improve the capabilities of modern radar systems, such as large bandwidth, low loss transmission and electromagnetic immunity. In our previous works, a microwave photonic synthetic aperture radar (SAR) is developed and experimentally demonstrated. In the transmitter, microwave photonic frequency multiplication is used to generate a linearly-frequency-modulated

(LFM) radar signal; while in the receiver, photonic stretch processing is employed to receive the reflection signal. The presented system operates in Ku band with an instantaneous bandwidth up to 5 GHz, and is vehicle-mounted for a series of SAR and inverse SAR imaging tests in the field trial. A SAR image of the ground surface is obtained through motion compensation and imaging algorithms, achieving a high two-dimensional resolution of 3 cm (range) × 4 cm (cross-range). Furthermore, a microwave photonic dual-band radar operating in C-band and Ku-band is proposed with photonic-assisted stretch receiving. In the receiver, the echoes and reference signals of C-band and Ku-band are applied to two parallel pairs of sub-modulators, which are biased at the peak points and null points respectively, resulting in two stretched signals with different frequencies. Thus operation in dual-band based on a unified system is achieved. An experimental demonstration in C-band and Ku-band with a bandwidth of 850 MHz and 3600 MHz is conducted. The above works show the potential of photonic technique to overcome the conventional radar bandwidth bottleneck and promote the performance of modern radar systems, which can be further applied in target recognition and earth observation.

Biography

Dr. Wangzhe Li is currently the head of the National Key Lab of Microwave Imaging Technology, Institute of Chinese Academy of Sciences (IECAS). He graduated from University of Ottawa as a PhD in 2013. Dr. Li did his postdoctoral research in Prof. Jianping Yao's group in University of Ottawa and in Prof. Larry Coldren's group in UCSB until the end of 2015. Then Dr. Li joined IECAS with the support of the "100 Talent Project of Chinese Academy of Sciences" and was entitled to "1000 Plan Program for Young Talents" (2017). Dr. Li's major research interests include microwave photonics, photonic integrated circuits, photonic-assisted radar and its applications. Dr. Li has published over 60 papers in peer-reviewed journals. In 2017, Dr. Li's group develop the first prototype of a microwave photonic radar and successfully obtained the ISAR and SAR imaging through a series of field trials.

- 09:00-09:30, August 8 -

Integrated microwave photonics: from photons to radio waves on a chip

Guillermo Carpintero

Universidad Carlos III de Madrid, Spain

Abstract

Integrated microwave photonics (IMWP) starts being commonly used to refer to the development of microwave photonic techniques using photonic integration technology. The key advantage is that enables placing the crucial components of the microwave photonic function on a photonic integrated circuit (PICs), avoiding optical path length differences among components, improving the performance of the implemented functions.

These improvements are required as different fields of application for microwave photonic technology, like 5G wireless communication, radar and aerospace ecosystems and automotive are demanding increasing levels of performance to meet the challenges in terms of higher data rates (100 Mb/s per user with peaks up to 20 Gb/s), ultra-low latency (1ms) and high reliability with lower costs and higher volumes. The approach is aided by the efforts across Europe and United States to establish photonic integration technology platforms with generic foundry approach.

Biography

Guillermo Carpintero is Full Professor at the Electronics Technology Department of Carlos III University of Madrid (UC3M), co-director of the Optoelectronics and Laser Technology Group (GOTL) and Director of the Graduate School of Engineering and Basic Sciences of UC3M. Received the Telecommunication Engineering degree from Polytechnic University of Madrid (UPM) in 1993 and the PhD from UC3M in 1999, awarded with the Extraordinary Doctoral Distinction. Has over 25 years of research experience, having coordinated European projects and over 10-year experience in academic positions at UC3M School of Engineering. I am IEEE Senior Member, member of the editorial board of IET Optoelectronics journal and member of the Board of Stakeholders of the Photonics21 European Technology Platform. I have published over 200 contributions in journals and international conferences, delivering above 15 invited talks.

- 09:30-10:00, August 8 -

Non-Hermitian microwave photonic systems

Jiejun Zhang
Jinan University, China

Abstract

The integration of non-Hermitian mechanism and microwave photonic technique is an emerging field of research that can be used to implement novel functionalities that are difficult to achieve with traditional techniques. In this talk, I will first present our recent work using a special non-Hermitian system, i.e., a parity-time (PT) symmetric system, in an opto-electronic oscillator (OEO) for the generation of single-tone microwave photonics with ultra-low phase noise. Our experimental results show that PT symmetry provides an easy solution to the long-lasting model selection challenge in a long-cavity OEO. Then, I will introduce how multiplexing techniques in optical communications can be used to further improve the overall performance of a PT-symmetric microwave photonic system. Lastly, I will discuss how the high-speed microwave photonic technique, including waveform generation, signal sampling and real-time spectrum analyzing, can be used to study the dynamics in a PT-symmetric system.

Biography

Prof. Jiejun Zhang joined the Institute of Photonic Technology at Jinan University, Guangzhou, China in 2018. From 2017 to 2018, he was a photonic engineer at Ciena Corporation, Canada. He received his PhD degree in Electrical Engineering and Computer Science from the University of Ottawa, Canada in 2017, after which he continued his post-doc research in the Microwave Photonics Research Laboratory. He received the M.Sc. degree in Optical Engineering from the Huazhong University of Science and Technology, Wuhan, China, in 2013, and the B.Eng. degree in Electronic Science and Technology from the Harbin Institute of Technology, Harbin, China, in 2010.

- 10:00-10:30, August 8 -

High performance microwave photonic coherent receiver

Yunxin Wang
Beijing University of Technology, China

Abstract

With the rapid development of wireless communications, the demand for microwave technology is growing towards large bandwidth and high-frequency band. Due to the advantages of broad bandwidth, low loss and immunity to electromagnetic interference (EMI), microwave photonic coherent receiver has become more attractive and has been a promising technique for wideband wireless access networks, antenna remoting, radar and other applications. In this presentation, the microwave photonic coherent receivers with high bandwidth, high dynamic range or functional integration would be introduced. The proposed microwave photonic frequency downconverter supplies an ultra-wideband and high-purity alternative for the signal processing in microwave photonic applications. The proposed link with high dynamic range has great flexibility, simple structure and convenient operation, and it can be applied in both the single-octave and multi-octave communication systems. The functional integration of coherent receivers consists of LO doubling, quadrupling, phase shift or frequency conversion. Due to the LO frequency doubling and quadrupling, the frequency requirement of the LO signal can be greatly decreased for the high-frequency receiver and transmitter. The integrated phase-tunable mixer provides a compact alternative with low cost and high purity for the transceiver in the phase-coded radar systems and phased-array beam forming networks. The proposed microwave photonic coherent receivers can be applied in various communication systems such as radar and 5G wireless communications.

Biography

Yunxin Wang received Ph.D. degree from the Tianjin University in 2009. She is currently an associate professor in Beijing University of Technology. Her research interests include microwave photonic technology, optical information processing, and integrated device design. She was selected by Beijing Municipal Education Commission's Young Top Talents Training Program and Beijing University of Technology Youth Hundred Program.

- 11:00-11:30, August 8 -

High speed PON and RoF based optical access technologies for 5G and beyond

Hwan Seok Chung

Electronics and Telecommunications Research Institute (ETRI), South Korea

Abstract

Increasing mobile traffics induced by smart mobile devices, virtual reality service(VR), and augmented reality(AR) services require a continuous capacity expansion of wireless networks, and 5G network would provide 20 Gb/s data rate and 1 ms latency. There are multiple new technologies to deliver 5G capabilities such as new radio specifications, millimeter wave transmission, massive MIMO, beamforming, small cells, and so on. The carrier frequencies for 5G is divided into two frequency bands, below 6 GHz and above 6 GHz (mmWave), which is much higher than carrier frequency of 4G. Thus, the distance of wireless path become shorter and the penetration of optical fiber become deeper into end users.

A cost-effective fiber connection or optical access network to remove service shadowing area is very important issues for both outdoor and indoor network for 5G and beyond. To avoid loss of the connectivity for 5G and beyond, we could make a small scale cell around a distance of about 250-300 m. Recently, there have been extensive researches to implement cost-effective solution of fiber connection for mobile networks including high-speed/low-latency PON and analog radio-over fiber (RoF). The hybrid PON combined with WDM and TDM could be used to mobile data transmission for small cell backhaul since it provides low latency and easy capacity expansion. The RoF technology maintains the advantages of CPRI while reducing optical transmission speed significantly, which will well suited for indoor network. In this paper, we review optical access technologies for 5G and beyond, and introduce some recent feasibility demonstrations.

Biography

Hwan Seok Chung received the Ph.D. degree in electronics engineering from the Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea, in 2003. In 2003, he was a Postdoctoral Research Associate with KAIST, where he worked on hybrid CWDM/DWDM system for metro-area network. From 2004 to 2005, he was with KDDI R&D Laboratories, Inc., Saitama, Japan, and had involved in research on wavelength converter and regenerator. Since 2005, he has been with the Electronics and Telecommunication Research Institute, Daejeon. His current research interests include fronthaul and backhaul for 5G and beyond, high-speed PON, and indoor network. Dr. Chung served as a Technical Committee Member of the OFC, Optoelectronics and Communications Conference (OECC), CLEO-PR, MWP, CLEO-PR, and Photonic West. He received the Best Paper Awards from the OECC in 2000 and 2003, as well as from the ETRI in 2011 and 2012.

- 11:30-12:00, August 8 -

Microwave signal processing with optoelectronic oscillator

Xiuyou Han
Dalian University of Technology, China

Abstract

Microwave photonic techniques offer a promising solution to implement RF signal processing with unique advantages of wide frequency range, large bandwidth and immunity to electromagnetic interference. They have potential applications in radar systems, satellite communications, electronic warfare, and the radio astronomy. Detection and characterization of low-power RF signals over a broad frequency range in the complex electromagnetic environment are a real challenge due to high power interference signals. In this report we will present our recent work about the microwave signal processing with optoelectronic oscillator (OEO). The low-power RF signal detection by using a tunable OEO is analyzed and experimentally demonstrated. The frequency down-conversion without external local oscillators is realized by the developed OEO system. The optimization scheme for improving the OEO based detection system is also investigated.

Biography

Xiuyou Han received the Ph.D. degree in Optical Engineering from the Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences (CAS), China, in 2006. In July 2006, he joined the School of Physics and Optoelectronic Engineering, Dalian University of Technology (DUT), China, as a as an Assistant Professor, where he became an Associate Professor in 2009, and a Full Professor in 2016. From 2014 to 2015 he was a Visiting Scholar in the Microwave Photonics Research Laboratory, University of Ottawa, Canada. Since 2017, he has been a Full Professor in the School of Optoelectronic Engineering and Instrumentation Science (OEIS), DUT. Now, he is Associate Dean of OEIS, DUT.

His current research interests include microwave photonics and integrated photonics. He has authored or coauthored more than 100 research papers in peer-reviewed journals and conference proceedings. He has 17 patents authorized by National Intellectual Property Administration, PRC.

- 13:30-14:00, August 8 -

RF signal generation, hoping and switching based on negative wavelength detuning in SMFP-LDs

Bikash Nakarmi
Nanjing University of Aeronautics and Astronautics, China

Abstract

Single Mode Fabry-Perot laser diode (SMFP-LD) has shown significant effects on digital photonics and optical signal processing due to the prominent advantages such as low power consumption, simple and easy configuration, and low cost. Recently, the use of SMFP-LDs on demonstrating RF signal generation has shown its potential in microwave photonics (MWP) domain too. In this paper, we discuss the use of SMFP-LDs in MWP for signal generation, hoping and the switching of RF signal. Injection locking with negative wavelength detuning is discussed, illustrating its benefits over positive injection locking for RF signal generation and output signal quality. Also, multi-injection locking in a single SMFP-LD is demonstrated to generate multiple RF signals which are of the same of different RADAR bands. Then after, the hoping between the generation of microwave, millimeter wave and, simultaneous microwave and millimeter wave using a single SMFP-LD is demonstrated. As a proof of concept for the switching of RF signal, 2 Gbps 16-bit NRZ signal is used as a control signal to switch the generation of RF signals using SMFP-LDs. The switching speed of less than 40 ps is observed. With the modification in the control unit, switching of multiple RF signal generation can be easily obtained

using SMFP-LDs which can be used for other techniques of RF generation providing flexibility and reconfigurability of the proposed scheme. With the modification on the control signal as a random bit sequence generator, the proposed scheme can be used for the secure military communication besides other conventional application such as radars, 5G communications, sensing and detection, and others.

Biography

Bikash Nakarmi received Ph.D. degree in Information and Communication Engineering from Korea Advanced Institute of Science and Technology (KAIST) , Daejeon, Rep. of Korea in 2012. Prof. Nakarmi joined College of Electronic and Information Engineering, Nanjing University of Aeronautics and Astronautics (NUAA), China, in 2016, where he is currently a professor in t Key Laboratory of Radar Imaging and Microwave Photonics (Nanjing Univ. Aeronaut. Astronaut.), Ministry of Education.

His research is focused on the development of optical blocks used in optical communication and networks using Fabry-Pérot laser diode, bio-sensors based on nano-structures and microwave photonics. From 2012 to 2013, he worked as a Research and Development Manager in InLC technology, Korea and as a Post-doctoral Researcher at Nanjing University (2012-2014), China. From 2014 to 2016, he was a Research Professor at KAIST. Prof. Nakarmi has authored and co-authored over 60 research papers, including 30 peer-reviewed journals and 30 papers in conference proceedings and several invited talks and workshop. Prof. Nakarmi is a member of the Optical Society of America, IEEE Photonics Society, and SPIE. Prof. Nakarmi had served as a committee member in SPIE photonics ASIA 2012 and a reviewer of several peer-reviewed IEEE and OSA journals.

- 14:00-14:30, August 8 -

Microwave photonic system with bandwidth scaling

Feifei Yin

Beijing University of Posts and Telecommunications, China

Abstract

In conventional microwave (MWP) systems, the bandwidth keeps unchanged during the electronic-to-optical (E-O) conversion and the optical-to-electronic (O-E) conversion. Here we propose and demonstrate a novel MWP system where the bandwidth is stretched during the E-O conversion and compressed during the O-E conversion. The proposed bandwidth scaled MWP system provides some new and valuable features. Firstly, the bandwidth of the input signal is greatly magnified after the E-O conversion so that the requirement of the frequency resolution of the optical devices is effectively reduced. One of the examples is a novel high resolution reconfigurable microwave wave-shaper. Using this bandwidth scaling technology, we manage to map a reconfigurable optical wave-shaper with lower frequency resolution of tens of GHz into a microwave one with resolution of tens of MHz. Secondly, the bandwidth is compressed but the phase keeps preserved during the O-E conversion. As a result, the phase response is remarkably magnified from the optics to the microwave. With this feature, we can greatly magnify the group delay variation by around 200 times from optics to microwave and a dispersion enlargement of about 40000 times is also obtained. We believe that this novel concept of “bandwidth scaling” can provide a potential routine in many MWP applications.

Biography

Feifei Yin received his B.Sc. and Ph.D. degrees in electronic science and technology from Tsinghua University, Beijing, China, in 2007 and 2012, respectively.

Since June 2012 he has been a Postdoctoral Research Fellow with the State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications (BUPT), Beijing, China. He is now an Associate Professor in BUPT.

Feifei Yin has published over 50 papers on journals and international conferences, including more than 20 papers published by IEEE (Institute of Electrical and Electronics Engineers) and OSA (optical society of America). His current research interests include microwave photonics, optical fiber communications, and integrated photonics.

Oral Talks

CIOP2019-2019-000136 (15:15-15:30, August 7)

Hybrid integration of high-speed MUTC-PD on SOI

Enfei Chao, Bing Xiong*

Department of Electronic Engineering, Tsinghua University, Beijing 100084, China

Abstract: A hybrid integrated of fabricated high-speed back-illuminated MUTC-PD with 30 GHz bandwidth is presented, which is implemented by a flip-chip bonding machine, providing a way to utilize the high-speed PD in integrated microwave photonics on SOI.

CIOP2019-2019-000361 (17:00-17:15, August 7)

Stable OFC generator based on cascaded phase modulators

Xiangchuan Wang, Wei Wang, Angran Zhao, Dan Zhu, Shilong Pan*

Key Laboratory of Radar Imaging and Microwave Photonics, Ministry of Education, Nanjing University of Aeronautics and Astronautics, China

Abstract: A simple and stable OFC generating system based on cascaded phase modulators is proposed. Up to 11 lines OFC has been demonstrated in the numerical simulation while 9 lines OFC have been generated experimentally.

CIOP2019-2019-000532 (17:10-17:30, August 7)

Low-noise Dual-frequency VECSELs realized with correlated pumping

Hui Liu[1*], Grégory Gredat[1], Ghaya Baili[2], François Gutty[2], Isabelle Sagnes[3], Fabienne Goldfarb[1], Fabien Bretenaker[1,4]

1. Laboratoire Aimé Cotton, CNRS, Université Paris–Sud, ENS Paris–Saclay, Université Paris–Saclay, Orsay, France

2. Thales Research & Technology, 1 avenue Augustin Fresnel, 91767 Palaiseau, France

3. Centre de Nanosciences et de Nanotechnologies (C2N), CNRS, Université Paris–Sud, Université Paris–Saclay, Marcoussis, France

4. Light and Matter Physics Group, Raman Research Institute, Bangalore 560080, India Light and Matter Physics Group, Raman Research Institute, Bangalore 560080, India

Abstract: Dual-frequency vertical-external-cavity surface-emitting-lasers (DF-VECSELs) are attractive in applications such as, for instance, transmission of radio over fiber, coherent population trapping detection. We report our study of the noises of DF-VECSEL, emphasizing on the low noise performance realized with correlated pumping.

CIOP2019-2019-000123 (14:30-14:45, August 8)

Parity-time-symmetry based optoelectronic oscillator

Haitao Tang, Yuan Yu*, Xinliang Zhang*

Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China

Abstract: We propose and demonstrate a widely tunable optoelectronic oscillator by using selective parity-time symmetry breaking. The side mode suppression ratio reaches up to 71.4 dB, and the phase noise at 17.74 GHz is -129 dBc/Hz@10kHz.

CIOP2019-2019-000335 (14:45-15:00, August 8)

Optical sensor network interrogation based on nonuniformly spaced microwave photonic delay-line filter

Dongrui Xiao[1], Liyang Shao[1], Chao Wang[2*]

1. Southern University of Science and Technology, China

2. University of Kent, UK

Abstract: We propose and demonstrate a generic optical fiber sensors interrogation platform based on novel microwave photonic delay-line filter. A large sensor network with various types of fiber sensors can be interrogated simultaneously with high resolution.

SC7 Micro and Nanophotonics

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Whispering-gallery-mode microresonators: fundamentals and applications (Tutorial)

Lan Yang
Washington University, St. Louis, USA

Abstract
Light-matter interactions are the fundamental basis for many phenomena and processes in optical devices. Ultra-high-quality Whispering-gallery-mode (WGM) optical micro-resonators provide unprecedented capability to trap light in a highly confined volume smaller than a strand of human hair; a light beam can travel around the boundary of a WGM resonator over 10^6 times, significantly enhancing light-matter interactions, creating the potential for a wealth of new scientific discoveries and technological breakthroughs for a variety of fields of science, spanning from communication to non-Hermitian physics, sensing and metrology. In this talk, I will present a few cases demonstrating the great potentials of high-Q WGM microresonators and microlasers for both fundamental science and engineering applications. I will start with the discussion of ultra-high-Q microresonators and microlasers for ultra-sensitive detection of nanoscale objects. Afterwards, I will discuss our recent exploration of fundamental physics, such as parity-time symmetry (PT-symmetry) and light-matter interactions around exceptional points (EPs) in high-quality WGM resonators, which can be used to achieve a new generation of optical system enabling unconventional control of light flow. Examples including nonreciprocal light transmission, loss engineering in a lasing system, directional lasing emission, and EPs enhanced sensing, will be introduced. A non-Hermtian phonon laser tuned in the vicinity of EPs will be discussed briefly. In the end I will present a new generic and hand-held microresonator platform transformed from a table-top setup, which will help release the power of high-Q WGM resonator technologies.

Biography
Professor Lan Yang is the Edwin H. and Florence G. Skinner professor in the Preston M. Green Department of Electrical and Systems Engineering at Washington University, St. Louis, MO, USA. She received B.S. from the University of Science and Technology of China and received her Ph.D. in applied physics from Caltech in 2005. Her research interests have been focusing on the fundamental understanding of high-quality photonic whispering-gallery-mode (WGM) resonators and their applications for sensing, lasing, light harvesting, and communications. Recently, her research interests expanded to parity-time-symmetry and non-Hermitian physics in high-quality WGM resonators, which have led to a series of new discoveries for unconventional control of light transport in photonic structures. She is the recipient of the 2010 Presidential Early Career Award for Scientists and Engineers (PECASE) for her work on chip-scale microlasers and her pioneering studies of nanoparticle detection using high-quality optical resonators. She has published 100 papers in peer-reviewed journals, including Science, Nature, Nature Photonics, Nature Nanotechnology, Nature Physics, and PNAS, etc. She is a fellow of the Optical Society of America (OSA). Currently, she serves as the editor-in-chief of Photonics Research.

- 14:15-14:45, August 7 -

Quantum signatures in plasmonics systems

Dangyuan Lei
City University of Hong Kong, Hong Kong, China

Abstract

In this talk, I will present our recent far-field and near-field investigations of quantum signatures in plasmonic systems, including the fundamental limit of electric near-field enhancement factor in one of the most common surface-enhanced Raman scattering substrates – rough metal films [1], the effects of spatial nonlocality and quantum tunneling in metallic nanoparticle dimers [2] and particle-on-film nanocavities [3], and the quantum electron transport phenomenon in plasmonic molecule junctions [4].

References:

[1] Y.D. Zhao, X. Liu et al., Nanoscale 6, 1311-1317 (2014).
[2] Q. Zhang et al., Advanced Quantum Technologies 1, 1800016 (2018).
[3] L. Lin, Q. Zhang et al., ACS Nano 12, 6492-6503 (2018).
[4] D.J. Liu, Q. Zhang et al., under revision with ACS Nano (2019).

Biography

Dangyuan Lei received his BSc, MPhil and PhD degrees all in Physics from Northwestern University, Chinese University of Hong Kong, and Imperial College London in 2005, 2007 and 2011, respectively. He is currently an associate professor with the Department of Materials Science and Engineering at City University of Hong Kong. His research interest centers on nonlinear and quantum nanophotonics and optical spectroscopy, with particular interest in surface plasmon photonics interfaced with low-dimensional materials systems. Two of his publications have been respectively selected into the RSC "Emerging Investigators" themed issue of Journal of Materials Chemistry C (2016) and the IOP "Emerging Leaders" edition of Journal of Optics (2017). Since 2007, he has published 108 journal papers, with 37 papers appeared in index>10 journals, receiving in total 3660 citations and an H-index of 38 (Google Scholar as of April 2019).

- 14:45-15:15, August 7 -

Enhanced performance of plasmonic nanolasers on graphene-insulator-metal platform

Tien-chang Lu
National Chiao Tung University, Taiwan, China

Abstract

It's an endless quest in searching for the development of laser miniaturization for different kinds of methods such as photonic crystal lasers, microdisk lasers and nanowire lasers. Utilizing the surface plasmons in replacement of photonic resonance in the laser cavity has been shown effective to down-size the cavity beyond the diffraction limit. Graphene is a membrane with thickness of only one atom and the carrier mobility can be as high as about 15000 $cm^2/V \cdot s$. Until now graphene has been widely used for many optoelectronics applications, for example, ultrafast photodetector, modulator, biosensor, transparent electrode and so on. As far as plasmonic laser is concerned, since the insulator layer on the metal structure is required to be very thin, it seems to be feasible to add a single-layered graphene in between the nanowire and metal while preserving the capability of forming surface plasmon polariton (SPP). Besides, we would like to take advantage of good electrical property of graphene to make a plasmonic nanolaser which can be modulated by externally applied current. By adding graphene on the insulator can form a versatile platform, called graphene-insulator-metal (GIM) structure, that can modulate the plasmonic wave characteristics. In this study, we successfully

fabricated and demonstrated the SPP nanolaser on GIM structure. The improvement on the lasing threshold of ZnO nanowire on aluminum with graphene was realized.

Biography

Professor Tien-chang Lu received the B.S. degree in Electrical Engineering from National Taiwan University, Taiwan, in 1995, the M.S. degree in Electrical Engineering from University of Southern California, USA, in 1998, and the Ph.D. in Electrical Engineering and Computer Science from National Chiao Tung University, Taiwan, in 2004. He was with the Union Optronics Corporation as a Manager of Epitaxy Department in 2004. Since August 2005, he has been with National Chiao Tung University as a full-time professor in Department of Photonics. In 2007, he went to Ginzton lab, Department of Applied Physics at Stanford University as a visiting scholar. He served as the director of the Institute of Lighting and Energy Photonics, National Chiao Tung University from 2009 to 2011. From 2017, his serves as the director of Tin Ka Ping Opto-Electronics Research Center. And from 2018, he has been elected as the chairman of Department of Photonics, National Chiao Tung University. Prof. Lu's research works includes the design, epitaxial growth, process, and characterization of optoelectronic devices. He has been engaged in the low-pressure MOCVD epitaxial technique associated with various material systems as well as the corresponding process skills. He is also interested in tailoring the light-matter interaction in micro or even nano-scale architectures, such as the microcavity, photonic crystal and plasmonic structures. Especially, Prof. Lu has been devoting to wide-gap materials and device research and has several breakthroughs, such as the first current injection blue VCSEL, photonic crystal surface emitting lasers and microcavity exciton-polariton lasers and world's smallest plasmonic nanolasers. Prof. Lu has authored and co-authored more than 200 international journal papers. He is a recipient of The Exploration Research Award of Pan Wen Yuan Foundation 2007, Excellent Young Electronic Engineer Award 2008, Young Optical Engineering Award 2010, International Micro-Optics Conference Contribution Award 2011, Dr Ta-Yu Wu's Memorial Award 2012, Y. Z. Hsu Scientific Paper Award 2016 and Distinguished Professor of NCTU. He is an OSA Fellow since 2017, senior members of IEEE and SPIE. He also severed as deputy editor of IEEE J. Lightwave Technology and associate editors of IEEE J. Quantum Electronics.

- 16:00-16:30, August 7 -

Extended Drude model for intraband transition induced optical nonlinearity: the physical origin

Ting Mei

Northwestern Polytechincal University, China

Abstract

Transparent conductive oxides are excellent plasmonic materials with their large optical nonlinearity at epsilon-near-zero (ENZ) wavelengths, which have recently emerged as candidates for design and fabrication of active nanophotonic devices. However, the physical origin of the optical nonlinearity is unclear and there is no effective physical model. We have proposed to extend the Drude model by adopting a weighted electron effective mass which takes into account the electron distribution in the nonparabolic conduction band. The relations between electron effective mass, mobility and the electron temperature are characterized by a femtosecond-pump-continuum-probe system. The extended Drude model is able to interpret the cause of the nonlinearity and provide a functional relationship between refractive index and wavelength. Both the band nonparabolicity and the temperature-dependent mobility are responsible for the intraband transition induced optical nonlinearity. The spectrally-resolved nonlinear refractive index and nonlinear susceptibilities are obtained for the first time from this model. The results can be applied to help in the design and modeling of spectral responses of nonlinear plasmonic devices.

Biography

Ting Mei is a distinguished professor of School of Science, Northwestern Polytechnical University. He received his Bachelor's and Master's Degrees in Optical Engineering from Zhejiang University and Ph.D. Degree in Electrical Engineering from the National University of Singapore. He was the Director of the Institute of Optoelectronic Materials and Technology, South China Normal University and an Associate Professor with tenure in Nanyang Technological University, Singapore. His research is in the fields of surface plasmonics and semiconductor optoelectronics. He is a senior member of IEEE and served as Vice President of IEEE-LEOS/Photonics Society Singapore Chapter for 2004 and 2005 and a member of IEEE EDS Optoelectronic Devices Committee since 2014. He is a board member of council, China Optical Engineering Society. He chaired/cochaired the 2nd and the 4th OSA topical conferences of Advances in Optoelectronics and Micro/nano-optics (AOM). He is a member of the editorial board of Advanced Photonics.

- 16:30-17:00, August 7 -

Closely packed quantum well stacks individually resolved near to physical resolution limit

Frank Bertram
University of Magdeburg, Germany

Abstract

For a comprehensive understanding of complex semiconductor heterostructures and the physics of devices based on them, a systematic determination and correlation of the structural, chemical, electronic, and optical properties on a nanometer scale is essential. Luminescence techniques belong to the most sensitive, non-destructive methods of semiconductor research. The combination of luminescence spectroscopy – in particular at liquid He temperatures - with the high spatial resolution of a scanning transmission electron microscope (STEM) as realized by the technique of low temperature cathodoluminescence microscopy in a STEM (STEM-CL), provides a unique, extremely powerful tool for the optical nano-characterization of quantum structures. Testing the spatial resolution limit in cathodoluminescence, we concentrate on highly spatially resolved luminescence characterization of a deep-UV emitting quantum well stack. 100 periods of GaN/AlN multiple quantum wells have been grown by MOCVD. The monolayer-thick GaN films are separated by 10 nm AlN barriers. STEM analysis evidences the high structural quality with abrupt interfaces and monolayer thickness of the GaN QWs. The thick QW stack shows intense emission at 228 nm at 17 K. In cross section, the CL intensity clearly correlates with the position of each individual QWs. The exceptionally small CL profile width of 2.8 nm indicates an efficient confinement of the wells. As a result, STEM as well as CL images clearly resolve the separation of QW with a distance of 10.8 nm.

Biography

TBA

- 17:00-17:30, August 7 -

Laser printing crypto-display nano-imprints and metasurfaces

Xiangping Li
Jinan University, China

Abstract

The facile laser writing approach offers a facile and powerful platform to print flat optics composed of digitalized pixels with high spatial resolution and high fidelity in a lithography-free fashion. In this paper, we report on that nano-imprints with varying geometric sizes and morphologies can be reproducibly printed by irradiation of tightly

focused femtosecond pulsed beams. These nano-imprints resonantly interact with impinging light and offer tremendous flexibility in manipulating light field in amplitude and phase to realize various functionalities of interests. We demonstrate that laser splashed 3D nanostructures exhibit spectral and color tunability by illumination angle allowing the demonstration of encrypting images in angular anisotropy. Such angular anisotropy enables encrypting color images among different illumination angles when while light is employed as the source. In addition, the thermoplasmonic effect can be precisely utilized to tailor the optical properties in pre-textured Al nanostructures including their resonances and phase manipulations. Therefore, multifunctional Janus optical metasurfaces supporting color images when illuminating by white light sources and holographic images when illuminating by coherent laser beams can be realized.

Biography

Dr. Xiangping Li completed his PhD at Swinburne University of Technology in 2009. His research is focused on nanophotonic techniques for high capacity optical information technologies including optical multiplexing, plasmonics and superresolution microscopy. Dr. Li has published over 60 internationally referred journal publications including Science, Nature Photonics, and Nature Communications. He joined the Institute of Photonics Technology in Jinan University as a full professor and research leader in nanophotonic devices group in 2015.

- 08:45-09:30, August 8 -

Subwavelength grating metamaterial for integrated photonics (Tutorial)

Ray Chen

The University of Texas at Austin, USA

Abstract

Subwavelength grating metamaterial (SGM) is formed by interleaving two or more types of materials with a period far less than the operating wavelength. It offers an additional degree of freedom to customize the optical properties of naturally existing materials and develop integrated photonic components with unprecedented applications. In this paper, we introduce the design and implementation of SGM based silicon photonics devices. Silicon provides high index contrast and thus the footprints of silicon photonic devices can be made very small. However, high index contrast is a double-edged sword as it also leads to a few limitations such as limited photon-matter interaction and high dispersion. SGM waveguide can potentially resolve these issues. For instance, leveraging the enhanced photon-matter interaction within SGM, silicon-organic hybrid SGM modulator demonstrates 44 GHz 6 dB bandwidth and estimated energy consumption of 2.55 fJ/bit. SGM waveguide based refractive index sensors exhibit eminent improvement on the sensitivity compared to conventional strip waveguide based sensors. In the meantime, unlike evanescent wave based sensors, the surface sensitivity of SGM sensors does not decrease as analytes accumulate on the waveguide surface. SGM waveguide based passive components show improved bandwidth due to the decrease of waveguide dispersion. Other potential applications of SGM will also be discussed.

Keywords: Subwavelength Grating Metamaterial, Silicon Photonics, Sensor, Silicon-Organic Hybrid Modulator, Ring Resonator

Biography

Ray Chen is the Keys and Joan Curry/Cullen Trust Endowed Chair at The University of Texas Austin. Chen is the director of the Nanophotonics and Optical Interconnects Research Lab, at the Microelectronics Research Center. He is also the director of the AFOSR MURI-Center for Silicon Nanomembrane involving faculty from Stanford, UIUC, Rutgers, and UT Austin. He received his BS degree in Physics in 1980 from the National Tsing Hua University in Taiwan, China, his MS degree in physics in 1983, and his PhD degree in Electrical Engineering in 1988, both from the University of California. He joined UT Austin in 1992 to start the optical interconnect research program. From 1988 to 1992 Chen worked as a research scientist, manager, and director of the Department of Electro-Optic Engineering at the Physical Optics Corporation in Torrance, California.

- 09:30-10:00, August 8 -

Strong optical nonlinearity in Si-based nanoplasmonic guides

Abdulhakem Elezzabi

University of Alberta, Canada

Abstract

We investigate silicon-based plasmonic devices as a platform for high-non-linear field effects at telecommunication wavelengths of 1550 nm. The Silicon-based nanoplasmonic devices are fabricated on silicon-on-insulator (SOI) substrates using processing techniques that are largely CMOS compatible, thus, allowing an ease of integration with electronic and silicon photonic devices. The strong nonlinear filed confinement at the metal-Si interface allows for the generation of third harmonic (TH) 516 nm radiation at unprecedented conversion efficiency that is two orders of magnitude higher than any observed to date in Silicon. This demonstrates the potential for compact visible light sources for integrated photonics or hybrid photonic-electronic nanocircuitry. We show also that electrons excited, via two photon absorption, are accelerated to energies up to several eVs by the ponderomotive potential that exists in the highly confined nanoplasmonic field. Subsequent collisions with valence electrons enable the observation of new phenomena, such as field-driven electron impact ionization, strong white light emission, and ultrafast electron-hole sweeping. These findings uncover a new strong-field interaction that can be used in sensitive nanoplasmonic modulators and hybrid plasmonic-electronic transducers.

Biography

Prof. Abdulhakem Y. Elezzabi received his B.Sc. in Physics from Brock University, St. Catharines, Canada in 1987. He received his M.Sc. and Ph.D. in Physics at the University of British Columbia, Vancouver, Canada in 1989 and 1995, respectively in Femtosecond Laser Physics. Between 1996-1997, he was IBM, Natural Sciences and Engineering Research Council of Canada & Issak Walton Killam Postdoctoral Fellow. Since 1997 he has been with the Department of Electrical and Computer Engineering at the University of Alberta. In 2003 he was appointed as a Canada Research Chair in Ultrafast Photonics and Nano-Optics at the University of Alberta. Prof. Elezzabi current research interests are in ultrafast phenomena, ultrafast physics, nanoplasmonics, high-speed photonic devices, femtosecond electron pulse generation, terahertz radiation, non-linear optics, nano-optics, laser-matter interactions, and biophotonics.

- 10:00-10:30, August 8 -

III-V optoelectronic devices directly on Si substrate

Jiang Wu
University of Electronic Science and Technology of China, China

Abstract
The ability to fabricate high-performance photonic devices, e.g. lasers, directly on silicon substrates would enable the long-pursuit efficient light sources for the silicon photonics. However, large material dissimilarity between III-V materials and silicon, especially polar versus nonpolar surfaces and lattice mismatch, makes the monolithic growth of III-Vs directly on silicon substrates highly challenging by introducing high-density antiphase boundaries and threading dislocations. Recently, III-V quantum dot devices have received much attention for integrated III-V/Si photonics due to their unique properties, in particular reduced sensitivity to defects and delta-function density of states. Here, recent advances in fabricating optoelectronic devices based on high-quality III-V heterostructures directly on silicon substrates are introduced.

Biography
Dr. Jiang Wu is a Professor of the Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China (UESTC). Dr. Wu received his PhD degree in Electrical Engineering from the University of Arkansas-Fayetteville in 2011. After his PhD, he joined UESTC as an Associate Professor and then Professor. He joined the Photonics group at University College London (UCL) as a Research Associate in 2012. From 2015, he was a Lecturer at UCL and a Key Principle Investigator of the UK EPSRC Future Compound Semiconductor Manufacturing Hub. In 2018, he returned to UESTC as a professor and currently his research interests include Molecular Beam Epitaxy of III-V semiconductors and optoelectronic devices, especially infrared photodetectors and light-emitters. He has co-authored over 100 technical papers in Nat. Photonics, Sci. Adv., Nano Lett., Adv. Mater., etc. He has delivered over ten invited seminars and invited talks at international conferences, including PIERS, SPIE, etc. He is a Fellow of Higher Education Academy and Senior Member of IEEE. He serves as the Editor-in-Chief of Nanoscale Research Letters, Associate Editor of IEEE Access, and Editorial Board Member of Scientific Reports, Nano-Micro Lett., and Experiment Science and Technology.

- 11:00-11:30, August 8 -

Quantum state control in single quantum dots and the coupling with photonic crystal cavities

Xiulai Xu
Institute of Physics, CAS, China

Abstract
We report on high-resolution photocurrent (PC) spectroscopies of a single self-assembled InAs/GaAs quantum dot (QD) embedded in an n-i-Schottky device with an applied magnetic field. When the magnetic field is applied in Voigt geometry, the mixture of bright and dark states results in an observation of dark exciton states. For a positive charged trions (X+) in a single quantum dot, giant enhancement of photocurrent has been achieved because of the Coulomb repulsion between the two holes. In addition, photonic crystal cavities with high quality factors around 10000 are fabricated with single quantum dots located in antinode position of the cavity. Strong coupling for cavity QED between different excitonic states in a single quantum dot and the cavity will be presented, two-photon Rabi splitting in a strongly coupled cavity-dot system is demonstrated. Both exciton and biexciton transitions couple to a high quality factor photonic crystal cavity with large coupling strengths over 130 μeV. When the cavity to simultaneously couple

with two exciton states, two-photon Rabi splitting between biexciton and cavity is achieved, which can be well reproduced by theoretical calculations with quantum master equations. Finally, strong interactions between cavities and p-shell excitons with a great enhancement by the in situ wave-function control will be demonstrated because of the large wave-function extents and nonlocal interactions beyond the dipole approximation. A large coupling strength of 210 μeV has been achieved, indicating the great potential of p-shell excitons for coherent information exchange.

Biography

Dr Xiulai Xu received BA degree in Electronic Engineering from the Jilin University in 1996, and Ph.D. degree from Cavendish Laboratory, University of Cambridge in 2005. He has been working as research scientist, senior research scientist in Hitachi Cambridge Laboratory from 2005-2011, and was also a research fellow in Clare Hall, University of Cambridge during 2009-2011. He is currently a professor with Institute of Physics, Chinese Academy of Sciences on quantum optoelectronics and nano-photonics.

- 11:30-12:00, August 8 -

Femtosecond polarization pulse shaping by dielectric metasurfaces

Lu Chen

National Institute of Standards and Technology & University of Maryland, USA

Abstract

The ability to arbitrarily shape femtosecond pulses with large bandwidth and high spectral resolution holds great potential for both studying fundamental light-matter interactions and developing real-world applications. A femtosecond pulse is defined by its phase, amplitude, and polarization. It has recently been demonstrated that dielectric metasurfaces can simultaneously and independently manipulate the phase and amplitude of a near-infrared femtosecond pulse having over 200 nm ultra-wide bandwidth while maintaining high spectral resolution of 0.3 nm [1]. Here, we further extend this work to offer the first experimental demonstration of femtosecond polarization pulse shaping using dielectric metasurfaces by controlling the temporal polarization state within a single pulse. The pulse shaper consists of a Fourier-transform setup with a dielectric metasurface positioned in the focal plane. The metasurface is formed of arrays of rectangular silicon nanopillars whose dimensions are carefully designed to deliver the targeted spectral phase for two orthogonal polarizations. A pulse of linearly polarized input light is orientated 45° with respect to the nanopillars, providing two equal polarization components. After passage through the metasurface, the shaped output pulse is characterized by direct electric-field reconstruction using spectral phase interferometry. The output pulse contains both polarization components. As a result, after the metasurface, the polarization state evolves between different linear and elliptical polarizations with varying degrees of ellipticity as a function of time. Such an approach further expands the versatility of metasurfaces and opens up new possibilities in the field of ultrafast science and technology.

[1] S. Divitt, W. Zhu, C. Zhang, H. J. Lezec, and A. Agrawal. Science 364, 890-894 (2019).

SC7

Biography

Lu Chen is a Postdoctoral Associate at the National Institute of Standards and Technology and the University of Maryland. She received a B.S. in Optical Information Science and Technology from Nankai University in 2012, and a Ph.D. in Physics from University of Pittsburgh in 2018. Her doctoral research focused on ultrafast optical response and transport properties of strontium titanate-based complex oxide nanostructures. She is currently working on ultrafast optical spectroscopy of novel nanophotonic devices including metasurfaces, metamaterials and nanoplasmonic devices.

- 13:30-14:00, August 8 -

Influence of dopants induced electric fields on the band-edge absorption of GaN

Shijie Xu
University of Hong Kong, Hong Kong, China

Abstract
Dopants induced electric fields and their influence on the band-edge absorption coefficient of GaN are theoretically examined. For dopants induced electric field distribution, it is derived with Bayes' rule. For the average electric field strength, it is revealed to be quite strong, e.g., in an order of 106 V/m in GaN with a fairly low dopant density. On the basis of Franz-Keldysh mechanism, influence of the dopants induced electric fields on the band-edge absorption coefficient of GaN is then investigated. Without any adjustable parameters, absorption coefficients of GaN are computed and are in good agreement with available experimental values.

Biography
S. J. Xu is currently a professor with tenure in Department of Physics, The University of Hong Kong, China. He received his PhD degree in Electronic Engineering from Xi'an Jiaotong University in 1993. He has authored >170 peer-reviewed articles and letters with >4600 SCI citations.

- 14:00-14:30, August 8 -

High-throughput optical modeling guided design of polymer solar cells

Hin-Lap Yip
South China University of Technology, China

Abstract
Owing to the advancement in new material design over the past few years, the power conversion efficiencies (PCE) of polymer solar cells have now reached over 15% and 17% for single-junction and multi-junction devices, respectively. However, in order the meet the commercialization requirement, further improvement in device stability and the exploration of niche applications of polymer solar cells are urgently needed. In this talk, I will discuss how to utilize an integrated strategy combining material design, interface engineering and optical management to tackle the efficiency, stability and application issues of polymer solar cells. I will particularly highlight our work on using optical management as a powerful means to enhance the performance of polymer solar cells by maximizing the light harvesting property of the devices. The capability to use optical model to precisely predict the light propagation property and charge generation rate within the devices allows us to design optimal device architectures with improved performance and stability. I will also discuss how to apply high throughput optical model to rapidly screen more than 10 million device structures in order to identify the very best device design for extremely high performance tandem and semitransparent polymer solar cells (ST-PSCs). In addition, I will also discuss how to engineer the optical property of ST-PSC for greenhouse applications. Finally, a multiple-function semitransparent polymer solar cell with both heat insulation and power generation properties will also be presented.

Biography

Hin-Lap (Angus) Yip is a Professor in the State Key Laboratory of Luminescent Materials and Devices and the Materials Science and Engineering (MSE) Department in South China University of Technology (SCUT). He got his BSc and MPhil degrees in Materials Science from the Chinese University of Hong Kong, and completed his PhD degree in MSE in 2008 under the guidance of Prof. Alex Jen at the University of Washington, Seattle. He joined SCUT in 2013 as full Professor. His current research focuses on the use of an integrated approach combining materials, interface, and device engineering to improve both polymer and perovskite optoelectronic devices. He had published more than 160 scientific papers with citations ~ 16000 and H-index of 69. He was also honored as “Highly Cited Researcher” in Materials Science by Thomson Reuters from 2014-2018.

- 14:30-15:00, August 8 -

Non-volatile integrated photonic devices based on Si-GST hybrid waveguides

Linjie Zhou

Shanghai Jiao Tong University, China

Abstract

Chalcogenide phase change materials based on germanium-antimony-tellurides (GST) have shown outstanding properties in resistive random-access memory (PRAM). They could provide reversible phase transition, a high degree of scalability, low power consumption, and multi-level storage capability. The reversible phase change between the amorphous and crystalline states could be triggered by thermal, optical or electrical pulses as long as the generated heat raises the temperature of GST above the crystallization or melting point. The process is non-volatile and thus no power is required to maintain the state. Besides the electrical resistance change, a pronounced change also occurs in optical property, namely the complex refractive index of GST, during the phase transition. In this talk, we will review our recent progress on silicon-GST hybrid photonic devices for non-volatile optical signal manipulation. In particular, we demonstrate a photonic memristive switch element composed of a silicon MMI structure with a nanoscale GST patch on top. The phase change is triggered by applying an electrical pulse to the silicon resistive heater. The maximum transmission contrast can exceed 20 dB and multiple intermediate transmission levels can be obtained by partial crystallization of GST. GST can also be integrated into a ring resonator to control the resonance extinction ratio. Transmission contrast of larger than 20 dB is obtained when the GST phase transition is triggered by using a sequence of optical pulses launched from the input waveguide.

Biography

Dr. Linjie Zhou received his B.S. degree in microelectronics from Peking University in 2003. He received his Ph.D. degree in electronic and computer engineering from the Hong Kong University of Science and Technology in 2007. From 2007 to 2009, he worked as a postdoctoral researcher at University of California, Davis. Currently, he is a professor in the State Key Lab of Advanced Optical Communication Systems and Networks of Shanghai Jiao Tong University. His research interests include silicon photonics, plasmonic devices, and optical integration. He has published more than 200 peer-reviewed journal and conference papers with over 2000 citations and has given more than 50 invited talks in international and domestic conferences. He has organized many sessions at multiple international and domestic conferences. He was elected as the “Yangtse Rive Young Scholar” by the Minister of Education of China in 2016. He was granted the “Newton Advanced Fellowship” in 2016 and “National Science Fund of China for Excellent Young Scholars” in 2014 and entered the “Shanghai Rising-Star Program” in 2014. He also got the SMC Excellent Young Faculty Award of Shanghai Jiao Tong University in 2014 and 2010.

- 15:00-15:30, August 8 -

$CsPbBr_3$ nanocrystals—the origin of the strong green emission from the edge of two-dimensional pervoskite $CsPb_2Br_5$

Chong Wang
Yunnan University, China

Abstract

Two-dimensional highly luminescent $CsPb_2Br_5$ has been reported for optoelectronic applications in recent years. However, the band gap and the origin of green photoluminescence (PL) are still in intense debate. To reveal the completed optical properties of the $CsPb_2X_5$ (X=Br, Cl, or I) proveskites and end these controversies, both PL-inactive and green emission $CsPb_2Br_5$ are synthesized by using different solution methods. Same-spot Raman-PL spectra, which is a kind of effective probe technique characterized by the strong correlation between structure property, reveal that $CsPbBr_3$ nanocrystals are the origin of the green emission. The Raman-PL spectra under applied hydrostatic pressure with a diamond anvil cell rule out the alternative luminescence theory of defect states such as Br vacancies. Pressure-dependent absorption indicates that the bandgap of $CsPb_2Br_5$ is 3.45 eV, which is 0.3-0.4 eV higher than that of those pervious reports and agrees well with our density functional theory (DFT) calculation, and this bandgap value remains nearly constant with pressure up to 2 GPa. We further prove that the luminescence of the $CsPbBr_3$-xXx (X = Cl or I) nanocrystals is responsible for the light emission of their corresponding $CsPb_2Br_5$-xXx. Our findings open up new opportunities to understand and develop highly efficient inorganic lead halide optoelectronic devices.

Biography

Wang Chong, obtained his Ph.D. in solid electronics and microelectronics in 2007 from Shanghai Institute of Technical Physics, Chinese Academy of Science (CAS), then joined Yunnan University as an associated professor. He did one-year research at University of Houston in USA as a visiting scholar (in 2017), and built a solid partnership with Prof. Jiming Bao. Now, he is a professor and Master's supervisor of Materials Science at Yunnan University, and have been elected a Member of Youth Committee of Chinese Materials Research Society (CMRS) for his contribution on the low dimensional semiconductors and their application on the photodetectors and light emitting diodes (LEDs). In recent years, his research work is financially supported by the National Science foundation of China, the Reserve Talents of Academic and Technical Leader Project, and Ten Thousand Talents Plan of Yunnan Province, China. He had published over 100 paper, his representative paper was published on Advanced Materials, Chemical Communications, Optics Express, Applied Surface Science, and Nanotechnology, and has been cited over 900 times.

- 09:00-09:30, August 9 -

Nanowire plasmons: waveguiding and coupling with quantum emitters

Hong Wei
Institute of Physics, CAS, China

Abstract

Metal nanostructures can concentrate electromagnetic energy into nanoscale volumes due to the excitation of surface plasmons, enabling the manipulation of light beyond the diffraction limit. Nanowires supporting propagating surface plasmons can function as nanowaveguides to realize light guiding with subwavelength field confinement, providing a fundamental building block for nanophotonic integrated circuits. In this talk, I will present our studies on the propagating surface plasmons on metal nanowires and their interaction with excitons in quantum emitters.

Biography

Hong Wei is a professor in Institute of Physics, Chinese Academy of Sciences. She received her B.S. in physics from Shandong University, China, in 2004, and her Ph.D. from Institute of Physics, Chinese Academy of Sciences, in 2009. Her research is focused on plasmonics and nanophotonics. She did innovative work on surface plasmon propagation in metal nanowires, nanowire-based plasmonic devices, and interconversion of nanowire plasmons with excitons at single quanta level. She is author of more than 50 papers, has been cited more than 2500 times, and has presented more than 50 invited talks. She is a member of the editorial board of Journal of Optics, and a topical editor of Journal of the Optical Society of America B.

- 09:30-10:00, August 9 -

Semiconductor nanowire lasers: possible routes towards practical applications

Xin Guo
Zhejiang University, China

Abstract

Owing to their possibilities to work as nanoscale waveguide lasers with miniaturized footprints, great material diversity and tunability, semiconductor nanowire lasers have been attracting intense attention in recent years, however, practical applications of these tiny lasers remains challenging. In this talk, I introduce our recent progress in possible routes for pushing single semiconductor nanowire lasers toward practical applications. Firstly, I introduce a wavelength-tunable single-nanowire laser with high tuning rates and excellent reversibility by incorporating temperature-dependent Varshni shift of the bandgap with ultra-low thermal inertia of a free-standing CdS nanowire. Secondly, by assembling a CdS nanowire onto the silicon nitride planar waveguide to form a Mach-Zehnder structure for mode selection, I show on-chip single-mode CdS nanowire lasers. Thirdly, I introduce a proposal to cool nanowire lasers in liquids to bestow the nanowire laser with greater versatilities.

Biography

Xin Guo received the B. S. degree in Optical Information Science and Technology from Sichuan University in 2005 and the Ph. D. degree in Optical Engineering from Zhejiang University in 2010. During 2014 and 2015, she worked as a visiting scholar in the Department of Electrical Engineering at The Hong Kong Polytechnic University. She is currently an associate professor in the College of Optical Science and Engineering at Zhejiang University. Her research interests mainly include nanophotonics and plasmonics. She has published more than 30 papers in peer-reviewed journals including Nano Letters, Accounts of Chemical Research, Laser & Photonics Reviews, Advanced Optical Materials, Optics Express.

- 10:00-10:30, August 9 -

Nanocavities for strong light-matter interaction

Shunping Zhang
Wuhan University, China

Abstract

The integration of monolayer transition metal dichalcogenides (TMDs) and plasmonic nanocavities merges the advantage of the two continents, i.e., the excellent optoelectronic properties of TMDs and the extreme light concentration of the plasmonic nanostructures. In this talk, I will talk about how to integrate monolayer TMDs with deep subwavelength nanocavities, to realize the strong, intermediate or weak coupling of plasmons and excitons. In the strong coupling region, we observed Rabi splitting from the nanorod plasmon and excitons in 1L WSe_2. In the

intermediate coupling region, we observed a 1700-times photoluminescence enhancement inside the hot spot, which is the direct consequence of the energy transfer from plasmon to excitons. In the weak coupling region, we used 1L MoS_2 as atomic lattice probe to measure the plasmonic field enhancement by surface enhanced Raman scattering, revealing the onset of quantum tunneling process at sub-nanometer gap.

Biography

Shunping Zhang received his Bachelor's degree from Sun Yat-Sen University in 2008 and obtained his Pd. D. degree from Institute of Physics, Chinese Academy of Sciences in January, 2013. He joined Wuhan University first as an outstanding postdoc and then got promoted as an associate professor in April, 2015. He has published more than 30 peer reviewed papers (> 2000 citations in Web of Science), including PRL, Nature Commun., Nano Lett. Light: Sci. & Appl. etc. His major achievements include the discovery of chiral surface plasmon polaritons, ultrasensitive plasmonic sensing based on Fano resonances or cavity plasmons, and strong coupling of plasmon and 2D excitons.

- 11:00-11:30, August 9 -

Computational simulations of optical properties in novel two-dimensional materials using many-body perturbation theory

Liujiang Zhou

University of Electronic Science and Technology of China, China

Abstract

One-electron approximation and hybrid functionals based density functional theory wrongly describe the reduced charge screening and the enhanced electron–electron correlation in the low-dimensional (2D) systems. Thus many-Body perturbation theory calculations (GW + Bethe-Salpeter equation) are utilized to describe such couplings and to correct electronic and optical properties in nano-systems. I will present the theory of this method and apply it to novel two-dimensional materials, including siligraphene, halogenated TiN and Sc-based Mxene. These modeling results can guide future development of 2D materials for optoelectronic applications.

Biography

Dr. Liujiang Zhou received his Ph.D. in 2014 from University of Chinese Academy of Sciences and performed postdoctoral researches at University of Bremen, Germany (2014.10-2016.12) and at Los Alamos National Laboratory, USA (2017.1-2019.5). He started his own independent academic career as a full professor at University of Electronic Science and Technology of China. His research efforts are focused on information functional materials, optoelectronic devices and computational materials, etc. He utilizes methods of first principle calculations (such as DFT, TD-DFT, GW), semi-empirical (phase-field, etc.) and molecular dynamics, etc., to conduct the computational designs on novel optoelectronic, energy, topological materials, and to carry out static and dynamic simulations on electronic, magnetic, phonon, optical and intersecting properties.

Oral Talks

CIOP2019-2019-000042 (15:15-15:30, August 7)

Fiber-based tunable microcavity with high coupling efficiency

Wei Fang
Zhejiang University, China

Abstract: We demonstrate a simple method to fabricate high-quality fiber-tip micromirror which is automatically aligned with fiber core. Fabry-Pérot cavity based on a micromirror with optimal radius of curvature shows near unity cavity-to-fiber coupling efficiency.

CIOP2019-2019-000088 (17:30-17:45, August 7)

Optical tuning of surface plasmons and their enhanced photoluminescence

Tao Ding
Wuhan University, China

Abstract: By using optical heating, the nanogaps of gold nanoparticle on mirror can be modified, which tunes their plasmonic resonances and the photoluminescence of the dielectrics in the nanogaps can be tuned correspondingly.

CIOP2019-2019-000508 (11:30-11:45, August 9)

Selective trimming of optical resonances in three-dimensional tubular optical microcavities

Jiawei Wang[1*], Yue-de Yang[2], Libo Ma[1], Yong-Zhen Huang[2], Oliver Schmidt[1]
1. IFW Dresden, Germany
2. Institute of Semiconductors, CAS, China

Abstract: We demonstrate an efficient trimming scheme utilizing in-situ electron-beam-induced depositions for the optical resonances and emission directionalities in self-rolled-up nanomembrane-based cavities. The deposited nanocap selectively coupled with axial modes leads to a flexible tuning effect.

CIOP2019-2019-000182 (11:45-12:00, August 9)

Symmetry breaking due to misaligned structural and material axes for the stimulated brillouin scattering in a sub-wavelength anisotropic waveguide

Xiaoxing Su
Department of Mechanics, Beijing Jiaotong University, China

Abstract: The stimulated Brillouin scatterings in a circular nanowire made of the strongly birefringent material rutile are simulated. Observable effects of the symmetry breaking due to misaligned structural and material axes are found in the results.

SC8 Optical Materials

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Fluorooxoborates: novel candidates for DUV nonlinear optical materials (Tutorial)

Shilie Pan
Xinjiang Technical Institute of Physics & Chemistry, CAS, China

Abstract

The ever-growing application of deep-ultraviolet (deep-UV, λ 200 nm) nonlinear optical (NLO) materials in various fields requires searching for candidates to generate the deep-UV lasers through direct second-harmonic generation (SHG) method. Among them, fluorooxoborates, benefiting from the large optical band gap, high anisotropy and ever-greater possibility to form non-centrosymmetric structures activated by the large polarization of the functionalized $[BO_xF_{4-x}]^{(x+1)-}$ (x =1, 2 and 3) building blocks, have been considered as the new fertile fields for searching the deep-UV NLO materials. Two series of fluorooxoborates AB_4O_6F (A = NH_4, Na, Rb, Cs, K/Cs and Rb/Cs) and $MB_5O_7F_3$ (M = Ca and Sr) were rationally designed and synthesized, which not only inherit the favorable structural characteristics of KBBF, but also possess superior optical properties. Property characterizations reveal that these two series possess the optical properties (deep-UV cutoff edges, large SHG responses, improved growth habit and also large birefringence to ensure the phase matching behavior in the deep-UV spectral region, etc.) required for the deep-UV NLO applications, which make them potential candidates to produce the deep-UV coherent light by the direct SHG process.

Biography

Prof. Shilie Pan has been Professor of XJIPC, CAS since 2007 as the "One-hundred talent" scholar. He received his Ph.D. degree from the University of Science & Technology of China in 2002. Before 2007, he worked as a postdoctor in Technical Institute of Physics & Chemistry, CAS, and later at Northwestern University in USA. Prof. Pan is now the director of New Opto-electronic Functional Materials Laboratory. His current research interests focus on synthesis, crystal growth, properties characterization, structure-property relationships and devices in new optical-electronic functional materials. As the first author or the corresponding author, Prof. Pan has published more than 390 papers in peer-reviewed international journals such as *J. Am. Chem. Soc., Angew. Chem. Int. Edit*, etc. And he has 9 authorized US patents, 68 authorized Chinese patents. He was also awarded National Ten Thousand Talents Project, National Science Fund for Distinguished Young Scholars, National Youth Science and Technology Innovation Leading Talent, China Youth Science and Technology Award, New Century National Hundred, Thousand and Ten Thousand Talent Project.

- 14:15-14:45, August 7 -

Quantum dots for optoelectronic and photonic applications

Kwang-Sup Lee
Hannam Univerity, South Korea

Abstract

Semiconducting quantum dot nanocrystalshave unique optical properties such as high quantum yields and broad emission spectral wavelengths that are tunable by the quantum confinement effect. Considerable effort directed at modifying the surface of quantum dots using capping agents have led to a simple solution-based process, the stabilization of quantum dots, and their uniform dispersion in solvent. Due to these unique properties, quantum

dots are of increasing importance in the fundamental studies and in a wide range of technological applications such as optical power limiters, light emitting devices, photovoltaics, lasers, and fluorescent labels for bioimaging. Tacking the full potential of quantum dots in optoelectronic devices require efficient mechanisms for transfer of energy or electrons produced in the optically excited quantum dots. We have investigated various organic-inorganic hybrids based on quantum dot-decorated and quantum dot-coupled systems on semiconducting substrates or molecules to achieve energy or charge transfer. The hybridization of p-type π-conjugated molecules to the surface of n-type quantum dots can induce distinct luminescence and charge transport characteristics due to energy and/or charge transfer effects. These kinds of energy/charge transporting properties are also observable in the perovskite quantum dots. The novel properties of hybrids consisting of quantum dots decorated or attached to conducting materials could find applications in molecular electronics and optoelectronics, including luminescent displays and energy harvesting cells.

Biography

Kwang-Sup Lee is a Professor of the Department of Advanced Materials at the Hannam University, Korea. He also holds a position as the Research Professor at the Institute for Lasers, Photonics and Biophotonics in the University at Buffalo, State University of New York, USA. He received his Ph.D degree in polymer science from the Freiburg University, Germany in 1984. He was a postdoctoral fellow at the Max-Planck-Institute for Polymer Research, Germany from 1985 to 1986 and a visiting professor at the Naval Research Laboratory, USA in 1998. Prof. Lee's research interests lie in the field of photofunctional materials including the synthesis of conjugated organics and polymers, quantum dots, carbon nanotubes, and organic-inorganic hybrid materials and fabrication of device involving them. He has authored and coauthored more than 250 journal articles and book chapters, and also 40 patents. He has chaired and co-chaired more than 20 conferences and symposia, and has given about 250 plenary, keynote, and invited talks. Prof. Lee is a Fellow of SPIE (USA) and EM Academy (USA) and he is currently serving as editorial board members for several international scientific journals including Advances in Polymer Science (Springer, Germany), NPG Asia Materials (Nature, UK), OSA Continuum, (OSA, USA), Nonlinear Opt. Quantum Opt. (OCP, USA).

- 14:45-15:15, August 7 -

Tailoring refractive index dispersion of chalcogenide glasses for use in thermal imaging applications

Yong Gyu Choi

Korea Aerospace University, South Korea

Abstract

As for imaging applications of lens materials over the visible-wavelengths range, which are either inorganic or polymeric, a multitude of compositions spreading in a wide area of the visible-range Abbe diagram are enabling design of lens assemblies with optical aberrations minimized down to (almost) any desired level. Compared with this situation, taking a look at thermal imaging applications over the long-wavelength infrared (LWIR) range, i.e., 8 ~ 12 m, only a few optical materials have been commercialized; single-crystalline Ge, poly-crystalline ZnSe and chalcogenide glass. Since these crystalline materials should not only feature fixed optical constants such as refractive index and its dispersion but also be processed via direct machining, only chalcogenide glass is able to broaden the LWIR-range Abbe diagram. Moreover, the inherent moldability bestowed to chalcogenide glass enhances its cost effectiveness in various sectors of the thermal imaging market. In this talk, a recent progress achieved in compositional optimization of chalcogenide glass for use as (molded) lenses in the LWIR domain is to be delivered with an emphasis paid to possibility of all-glass-based LWIR lens assembly.

SC8

Biography

Yong Gyu Choi received a B.S. degree from KAIST in 1991. Then, he moved to POSTECH where he earned his M.S. and Ph.D. degrees in 1994 and in 1998, respectively. During the period of 1994 to 1998, his works were focused on processing and characterizing amorphous materials doped with rare-earth elements. He became a senior research staff of ETRI in early 1998, where he was mainly involved in development of fiber amplifiers and fiber lasers for use in optical telecommunications. After 6 years of experience at ETRI, he joined Korea Aerospace University as a faculty member. During the ETRI period, he visited University of Southampton and University of Sydney as a visiting research fellow. He enjoyed his first sabbatical leave at IMI-NFG, Lehigh University in 2010-2011. For his second sabbatical leave in 2017-2018, he stayed at Zhejiang University.

His current research interests cover from optical functionalities of doped or undoped glasses to structural analysis of optical materials especially with X-ray absorption spectroscopy using synchrotron radiation.

- 16:00-16:30, August 7 -

Materials and devices for bendable and stretchable integrated photonics

Lan Li

Westlake University, China

Abstract

Integrated photonics that can be both bendable and stretchable open up emerging applications ranging from flexible optical interconnects, broadband photonic tuning to conformal sensors on biological tissues. In this talk, we will discuss a new technology to realize monolithic photonic integration on plastic substrates. Our technology capitalizes on the exceptional properties of amorphous chalcogenide glass materials including broadband infrared (IR) transparency, wide accessible range of refractive indices, as well as low deposition temperature. High-index-contrast multi-layer 2.5-D photonic devices with record optical performance were fabricated using simple, low-cost contact lithography. A novel multi-neutral-axis design is implemented to render the structure highly mechanically flexible, allowing repeated bending and stretching of devices without measurable optical performance degradation. We further demonstrated hybrid integration of active optoelectronic components onto the flexible photonic platform, which potentially enables complete system-on-a-flexible-chip solutions for a wide cross-section of applications.

Biography

Dr. Lan Li received her B. S. degree from University of Science and Technology of China (2010) and Ph.D. degree from University of Delaware (2016), both in Materials Science and Engineering. Since then she has been the postdoctoral associate at the Massachusetts Institute of Technology until Feb., 2019. She is currently the assistant professor at the School of Engineering in Westlake University. Her research interest focuses on nanophotonic materials and devices, infrared optical glass materials, integrated flexible photonic device fabrication, characterization and application.

- 16:30-17:00, August 7 -

Two-dimensional and other nanoparticles as low-concentration dopants for stimulated Brillouin scattering suppression

Ivan Kislyakov

Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

The suppression of Stimulated Brillouin scattering (SBS) in optical fibers is one of the current issues of the fiber laser technique development. Many different means are proposed for the suppression including refractive index

and fiber profile modulations. However, the material modification being technically the simplest way seems to be very promising to reach the goal. Two dimensional materials like monolayer graphene, black phosphorus, transient atoms chalcogenides, etc. are newsworthy due to their nonlinear optical properties like two-photon absorption (2PA) and saturable absorption saturation providing good perspectives of their application in laser techniques, optical informatics and telecommunications. Recently we observed a strong quenching of SBS in liquids when added vanishing concentrations of the nanoparticles both absorptive (graphene) and non-absorptive (hexagonal boron nitride, hBN). It has been shown that 2PA of hBN nanoflakes is strong even for nanosecond laser radiation and enough to produce local heating centers in suspensions creating interfaces in liquids which scatter light almost as effectively as graphene nanoparticles. Since hBN has strong 2PA and has no linear absorption in the wide range it seems to be a perfect dopant into polymers and maybe glass to suppress SBS in fibers in high-power laser systems of visible and telecommunication wavelength ranges. Other absorptive nanoparticles like nanotubes providing better thermodynamic stability of the designed material can be also considered.

Biography

Dr. Ivan Kislyakov is currently a visiting professor at Shanghai Institute of Optics and Fine Mechanics of Chinese Academy of Science. After obtaining his PhD in physics and math in 2004 from Saint Petersburg State University (Russia), he worked as the head of the Laboratory of Nanostructured Materials of Vavilov State Optical Institute and an associate professor at the Laser Optics Department of ITMO University in Saint Petersburg (Russia) for several years. In 2017 and 2018 he was awarded a Visiting Scientists under the CAS President's International Fellowship Initiative. He is engaged in two-dimensional nonlinear optical nanomaterials, effects and applications. He carries out the basic research on nonlinear optical effects of fullerenes, graphene, carbon nanotubes, boron nitride and other nanostructures and obtains original results discovering the physical properties and elaborating photonic devices and applications of materials. He is a member of OSA, and a corresponding author published in Optics Express, Applied Physics Letters, Optical Materials and other specialized journals.

- 09:00-09:45, August 8 -

Bio-mimetic nanophotonics (Tutorial)

Jean-Michel Nunzi

Queen's University, Canada

Abstract

Self-organization naturally provides materials that can manipulate light and light-matter interactions in a manner that allows buildind new nano-photonic devices. We show how light can naturally induce chiral structures, or help us design new light harvesting devices like NIR photodetector using the rectification effect induced by dipole orientation in a thin fim. Our designed device structure allows the fabrication of hot electron-based photodetectors that are highly sensitive to the NIR range, that are sensitive to polarization, and that are easy and cost-effective to fabricate. The approach developed herein represents a significant milestone towards the development of energy conversion devices based on hot electrons and plasmonics, which benefit integrated optoelectronics and photocatalysis.

Biography

Jean-Michel Nunzi graduated from l'Ecole de Physique et Chime, Paris in 1982, he joined l'Ecole Polytechnique for a PhD on the nonlinear optics of surface plasma waves (plasmons). He was then hired as full-time Researcher in Organic Photonics at the Atomic Energy Commission (Saclay) in 1984. He joined the Department of Physics at the University of Angers as Professor in 2000, where he built the Plastic Solar Cells Technology Research Team. He moved to Queen's University as Tier 1 Canada Research Chair in Chiral Photonics in 2006 and in Photonics for Life since 2013. He studies Organic and nano-Photonics, including the Chemistry, Instrumentation, Processing and Physics of nanomaterials and devices as well as their use for sustainable development. His Google H-factor is 53.

- 09:45-10:15, August 8 -

Tuning the graphene photonic properties by surface-confined supramolecular self-assembly

André-Jean Attias
Sorbonne Université, France

Abstract

Graphene has potential photonic applications in optical modulators, photodetectors, light harvesting or emitting devices. However, its zero-bandgap electronic structure limits graphene role to transparent electrode. This is why graphene needs to be combined with a complementary photonic material to create a hybrid component with novel properties for advanced photonics.

In this context, the supramolecular self-assembly of organic building blocks on graphene is an original bottom-up approach towards novel materials displaying unusual properties. Hence, the possible fine-tuning of inter-constituents distances and orientations offered by the design of the building blocks makes the self-assembly approach very appealing for adjusting graphene photonic properties.

The experimental proof of concept shows the suitability of self-assembly techniques for the development of multi-functional hybrid dye/graphene 2D materials for nanophotonics, optoelectronics, light emitting or harvesting devices.

Biography

André-Jean Attias is a Professor of Polymer Chemistry at Sorbonne Université (Paris, France). He received his engineer degree from 'Ecole Supérieure de Physique et de Chimie de Paris' (ESPCI), Paris, France in 1982 and joined the French Space Research Agency (ONERA) in 1983 and was awarded a Ph.D. degree in Macromolecular Science from Université Pierre & Marie Curie in 1988. In 2002 he moved to Université Pierre & Marie Curie to join the Chemistry Department as full professor and he founded a research group on organic optoelectronics. In 2017, he was appointed the founding director of the Building Blocks for Future Electronics Laboratory (2B-FUEL), an International joint research unit between CNRS-Sorbonne Université-Yonsei University, located in Seoul (Korea). Since 1st April 2017 he is adjunct professor at Yonsei University. His current research activity deals with surface-confined supramolecular self-assembly to generate nanostructures and function of patterned surfaces for applications in the areas of organic nano-photonics and-electronics, spintronics, and renewable energies. He is author or co-author of numerous papers in peer-reviewed high impact factor journals and gave since his academic position more than 50 invited talks, plenary and keynote lectures in international conferences and symposia.

- 11:00-11:30, August 8 -

Phosphor in glasses for white LED color conversion

Woon Jin Chung
Kongju National University, South Korea

Abstract

Due to high demands in lightings, automobiles and display applications, high power and high brightness white LEDs (wLEDs) have been extensively studied spurring their commercial applications. However, weak chemical and thermal stabilities of organic resins which embed color converting phosphors in conventional white LED deteriorated their color coordination and long term stability. Various inorganic color converters have been proposed to provide reliable high power wLEDs. Among them, phosphor in glass (PiG) has been successfully commercialized recently replacing organic resins with its long term stability and high versatility. PiG can be easily fabricated by simple mixture of a transparent glass and phosphors followed by a sintering process. When a PiG mixed with $Y_3Al_5O_{12}:Ce^{3+}$ (YAG:Ce^{3+}) and silicate glass was packaged with a blue LED, a white LED could be achieved and its color coordination could be easily varied with the

phosphor content and PiG thickness. The PiG showed improved thermal and long term stability and thus applied to the automobile headlamp for the first time. After its commercialization, extensive studies have been reported to further extend its application and improve color converting properties. In this talk, recent progress of PiG will be reviewed and various approaches to overcome technical issues related to PiG will be discussed.

Biography

1997. 2. ~ 2001. 8.: Ph.D., Dept. of Materials Sci. & Eng., Pohang Univ. of Sci. and Tech. (POSTECH)

2001. 9. ~ 2003. 5.: Post-doctral research staff, Dept. of Materials Sci. & Eng., Pohang Univ. of Sci. and Tech. (POSTECH)

2002. 3. ~ 2003. 2.: Post-doctral research staff, Institute for Materials Research, University of Leeds, U.K.

2003. 6. ~ 2006.3.: Senior research staff, IT Convergence & Component Laboratory, Electronics and Communications Research Institute (ETRI)

2006. 4. ~ Present: Div. of Advanced Materials Eng., Kongju National University

- 11:30-12:00, August 8 -

Progress on self-frequency-doubled Yb:$Ca_4YO(BO_3)_3$ laser crystal

Haohai Yu
Shandong University, China

Abstract

Self-frequency-doubled Yb:$Ca_4YO(BO_3)_3$ (Yb:YCOB) crystal with large size and different doping concentration can be easily grown by the Czochralski method. The crystal has good practical potential for self-frequency-doubling due to its excellent combination of nonlinear and laser properties. The fluorescence spectra and absorption spectra exhibited a small and broad anisotropic vibronic emission peak at about 1130 nm with the emission cross section of about 5×10^{-22} cm^2. Successfully, the fundamental wavelength of the polarized vibronic Yb:YCOB radiation shifted from 1130 nm to 1140 nm by suppressing the electronic emission.

Taking advantage of its shifting vibronic emission and self-frequency-doubling behavior of Yb:YCOB crystal, a watt-level self-frequency-doubled yellow laser at the 570 nm wavelength was realized with the cut direction along the optimized orientation out of the principal planes possessed the maximum effective nonlinear coefficient. The maximum output power at 570 nm came up to 1.08 W. This work provides a way for the realization of yellow lasers and promising, attractive source with a compact structure. Meanwhile, a maximum green light output power of 710 mW at 523 nm was obtained by cavity design, and the result is the best performance ever reported about the SFD green light with Yb:YCOB crystal.

Biography

Haohai Yu was born in Shandong, China, in 1981. He received the Ph.D. degree from Shandong University, Jinan, in 2008. He is currently with the State Key Laboratory of Crystal Materials and Institute of Crystal Materials, Shandong University. He is mainly engaged in the research of artificial crystals and crystal physics, and carried out systematic exploration in optoelectronic functional crystals, crystal physics and laser devices and applications. His current research interests are electron-phonon-coupled laser and nonlinear crystal devices, and some of the results have been industrialized and practical. He has published more than 80 SCI academic papers, some of which were published in Adv. Mater., JACS, ACS Nano, Appl. Phys. Lett. Opt. Lett. The paper has cited more than 1,800 times (SCI H-index = 28).

- 13:30-14:00, August 8 -

Relationship between structure and optical properties of oxide glasses

Hirokazu Masai
National Institute of Advanced Industrial Science and Technology, Japan

Abstract

Oxide glass prepared by melt-quenching is usually consisted of network former (NWF) and network modifier (NWM) groups. Although P_2O_5 is generally classified as NWF groups from the viewpoint of glass forming ability, P_2O_5 differs from other NWF oxides because of the P=O bond. Phosphate glass has significant potential for various applications, owing to its unique physical and structural properties. Understanding the network structure of a phosphate glass system is therefore one of the most important unresolved issues facing glass science.

Several metal oxides are classified as intermediate groups that can act as either NWF or NWM groups. ZnO is classified as being part of the intermediate group. Zinc phosphate (ZP) glass is a promising material for use as lead-free sealing glass, or as good host for emitting centers. For application of optical materials, examination of glass network is important, because the role of the intermediate group depends on the glass composition.

Here, we report on the relationship between network structure of ZP glass and the luminescence properties of the activators. We use a combination of ^{31}P magic angle spinning NMR, Zn K-edge extended X-ray absorption fine structure, as well as X-ray and neutron diffraction data to determine the dependence of this connectivity on the chemical composition and on the zinc coordination. Based on the network structure of several ZP glasses, we discuss the relationship between optical properties and structure of the activator-doped ZP glasses.

Biography

Dr. Hirokazu Masai received his Ph. D degree at Kyoto University (2005). He joined Tohoku University as an assistant professor in 2006 after postdoctoral researcher at Nagaoka University of Technology and Tohoku University. He was, then, employed as an assistant professor at Kyoto University for 7 years (2010 ~ 2017). From 2017, he joined National Institute of Advanced Industrial Science and Technology (AIST) as a senior researcher. His past results are organic-inorganic hybrid materials, functional glass-ceramics, oxide glass phosphors, and so on. He is currently studying the fabrication of functional amorphous materials and the relationship between the physical properties and structures of inorganic materials.

- 14:00-14:30, August 8 -

Low-noise plastic optical fiber for radio-over-fiber network

Azusa Inoue
Keio University, Japan

Abstract

A graded-index plastic optical fiber (GI POF) has been a promising medium for the indoor applications because of its flexibility, safety, and high bandwidth. Recently, we have proposed a low-noise GI POF that has noise reduction effects due to its strong mode coupling closely related to microscopic heterogeneous properties of the core material. Here, we develop a graded-index plastic optical fiber (GI POF) for radio-over-fiber (RoF) that allows for higher carrier-to-noise ratio or more carrier transmission than conventional multimode fibers (MMFs). This will pave the way to achieve RoF indoor networks, where various RF signals such as mobile (5G), wireless (WiFi), and broadcasting (4K/8K UHD) are transmitted, in the next-generation Internet-of-things (IoT) era.

Biography

Azusa Inoue Project Associate Professor/Deputy Director of Keio Photonics Research Institute at Keio University. Azusa Inoue received the B.S., M.S., and Ph.D. degrees in electrical engineering from Keio University, Yokohama, Japan, in 2002, 2004, and 2008, respectively. In 2008–2010, he was a Postdoctoral Fellow with Kyushu University, Fukuoka, Japan. From 2010, he has worked on graded-index plastic optical fibers with Keio University. Since 2018, he has been working as a Project Associate Professor with Keio University and a Deputy Director with Keio University Photonics Research Institute (KPRI).

- 14:30-15:00, August 8 -

TBA

Liangbi Su

Shanghai Institute of Ceramics, CAS, China

Abstract

TBA

Biography

TBA

- 09:00-09:30, August 9 -

Development of novel inorganic scintillators and analysis of the excited states dynamics responsible for scintillation

Masanori Koshimizu

Tohoku University, Japan

Abstract

The development of novel scintillators with high light yields and fast decay is of considerable interest. In my talk, I will briefly introduce some recent results of our development of novel inorganic scintillators. Conventionally, Ce^{3+} and Eu^{2+} have been extensively studied and applied as activators in various scintillators because of their fast and efficient parity-allowed 5d–4f emissions. In contrast, we have developed novel scintillators with high light yields with Yb^{2+} as a luminescence center. For example, we have developed $SrCl_2$:Yb^{2+} and $SrBr_2$:Yb^{2+} whose light yields were determined to be 54,000 and 62,000 photons/MeV, exceeding the light yield of a commercial halide scintillator, NaI:Tl+ (40,000 photons/MeV). As another approach, we have developed Tl-based self-activated scintillators whose light yields exceed 40,000 photons/MeV.

Also, basic process of excited states in inorganic scintillators will quantitatively discussed on the basis of our recent results of transient spectroscopy. Most scintillators are composed of an insulator host with dopants as the luminescence centers. In such scintillators, excited states are initially generated in the insulator host upon exposure to ionizing radiation. Subsequently, the excitation energy is transferred to the luminescence centers and, finally, scintillation occurs through the radiative transitions of the centers. Of these basic processes, little is known about the energy transfer process despite its importance. In this study, we analyzed the excited states in the host with the aim of better understanding the energy transfer process. The excited states in the host were analyzed using transient absorption spectroscopy.

Biography

Prof. Masanori Koshimizu is currently a member of Department of Applied Chemistry, Graduate School of Engineering, Tohoku University, Japan. He received his B.Eng. (1999), M.Eng. (2001) and Ph.D. (2007) degrees in quantum engineering and systems science from University of Tokyo. He held the position of Assistant Professor (2004) at the present Department, and was promoted to Associate Professor in 2011. He received Masao Horiba Award in 2012, and Award for Young Scientists from the Japan Society of Radiation Chemistry in 2013. His research interests include development of optical (including scintillation) materials based on nanostructures. His interests also covers the interaction of materials with ionizing radiation.

- 09:30-10:00, August 9 -

Polycrystalline transparent ceramics for demanding optical applications

Jian Zhang

Shanghai Institute of Ceramics, CAS, China

Abstract

Polycrystalline ceramics such as $Y_3Al_5O_{12}$, $MgAl_2O_4$, AlON, Y_2O_3, and etc. own high mechanical properties, broad UV-MIR transmission range, and excellent chemical and physical stability, which make them the ideal candidate for demanding optical applications including laser gain media, phosphor converters, and protective windows. During the past years, huge efforts have been focused on the processing development for high optical quality and high mechanical strength. In this work, the development progress of these materials have been reviewed. The key processing parameters for high optical quality of these ceramics were discussed. The microstructure evolution, sintering aid, and their effects on optical and mechanical properties were analyzed in detail. Some applications such as gain media for high power lasers, and protective windows were demonstrated. Finally, the future research directions of these ceramics were proposed.

Biography

Prof. Jian Zhang currently is the deputy director at the Research Centre for Transparent Ceramics, Shanghai Institute of Ceramics, Chinese Academy of Sciences (SICCAS). He got his PhD from SICCAS in 2005 and then he worked as a research assistant over there. From 2007 to 2012, he was the research fellow at Institute for Materials Research, University of Leeds (2007-2008), and Temasek Laboratories of Nanyang Technological University (2008-2012). His current research interests focused on processing science and technology for transparent ceramics (Garnet, Sesquioxide, Spinel and etc.), and exploring their optical and photonic applications such as laser gain media, optical windows, transparent armors and etc. In the above area, he and his team has published ~220 journal papers, 1 book and delivered ~50 invited/oral presentations for international and domestic conferences. He co-chaired the 7th (Singapore, 2011) and 11th (China, 2015) Laser Ceramics Symposium. From 2019, he served as the editorial committee member for Journal of Synthetic Crystals.

- 10:00-10:30, August 9 -

Observation of near-field chirality generation on an achiral plasmonic structure

Tomoya Oshikiri

Research Institute for Electronic Science, Hokkaido University, Japan

Abstract

The optical properties of localized surface plasmon resonances that occur on metallic nanostructures have been the subject of intense study for the past few decades. In particular, the chirality of the optical near-field has gained substantial interest. In this study, we observed photoemission electron images of the achiral rectangular gold nanostructure under the irradiation of left and right circular polarized (LCP and RCP) light using multi-photon photoemission electron microscopy (MP-PEEM). Gold nanostructures were fabricated on the ITO-coated glass

substrate using electron beam lithography. Near-field properties of Au rectangular structures with different aspect ratios, such as mapping and spectra, were investigated using MP-PEEM to explore the origin of near-field chirality generation. For example, a gold rectangular structure showed two near-field peaks derived from T- and L- modes and the near-field circular dichroism (CD) calculated by the difference of the near-field spectra in the local region of LCP and RCP excitation also showed two peaks. However, the peaks of near-field CD slightly differed from those of the near-field spectrum and matched with cross points of phase angles of two modes. We concluded that the origin of the near-field chirality can be traced to an interaction between T- and L-modes, which is maximized when their phase angles are harmonized.

Biography

Tomoya Oshikiri
Assistant Professor, Research Institute for Electronic Science, Hokkaido University
E-mail: oshikiri@es.hokudai.ac.jp
Academic background:
2005-2008 Ph.D. in Science, Osaka University, Japan
2003-2005 Master of Science, Osaka University, Japan
1999-2003 Bachelor of Science, Osaka University, Japan
Professional career:
2012-pres. Assistant Professor, Research Institute for Electronic Science, Hokkaido University
2008-2012 Researcher, Mitsubishi Rayon, Co. Ltd.
Research interests:
Plasmonics, Photochemistry, Artificial photosynthesis, Light energy conversion

- 11:00-11:30, August 9 -

Single-mode laser in sub-micron semiconductor optical microcavities

Hongxing Dong
Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

Single-mode lasers at nanoscale are highly desirable for practical applications, however, most of reported semiconductor nanolasers exhibit multimode structure. In this report, we firstly realize single-mode lasers in cesium lead halide perovskite microcavities covering the whole visible region at room-temperature. All-inorganic cesium lead halide ($CsPbX_3$, X = Cl, Br, I) microcavities with different morphologies are fabricated by a dual-source chemical vapor deposition method. Thank to smooth surface and regular spherical structure, single-mode laser is successfully realized in a sub-micron microcavity with a very narrow linewidth, low lasing threshold and a high Q factor(10^4). Modulating the halide composition and sizes of the microcavities, single-mode laser can be continuously tuned from 425 to 715 nm. The work illustrates that the well-controlled synthesizing metal cesium lead halide perovskite nano/microspheres may offer an alternative route to produce a widely tunable and greatly miniaturized single-mode laser.

Biography

Dr. Hongxing Dong is a professor of Shanghai Institute of Optics and Fine Mechanics. His current research interests are centered on the fabrication of functional nano/microstructures and the development of advanced optical cavity based optoelectronic devices. He has published more than 60 papers in peer-refereeing international journals, including PRL, ACS Nano, AOM, ACS Photonics etc.. He has been awarded with the Youth Top-notch Talent Support Program in Shanghai, the Youth Innovation Promotion Association, Shanghai Rising-star Program, First Prize in Science and Technology of Shananxi Colleges and Universities, Second Prize for Science and Technology of Shannxi Province.

Oral Talks

CIOP2019-2019-000244 (15:15-15:30, August 7)

Temperature insensitive FBG sensors based on multicomponent glass fiber

Ziyu Lin[1], Xu Feng[1], Yiping Wang[2], Changrui Liao[2], Jianrong Qiu[3], Shifeng Zhou[1]
1. School of Materials Science and Engineering, South China University of Technology, China
2. College of Optoelectronic Engineering, Shenzhen University, China
3. College of Optical Science and Engineering, Zhejiang University, China

Abstract: Measurement error caused by temperature fluctuation is a serious problem for fiber Bragg grating (FBG) sensors. Here we introduce a new strategy to reduce FBG temperature sensitivity based on composition modification of glass fibers.

CIOP2019-2019-000131 (17:00-17:15, August 7)

Controllability of refractive index of optical thin films and its application in antireflective coatings of multi-junction GaAs solar cells

Mengqi Shi*
Shanghai Institute of Space Power-sources, China

Abstract: The relationship between the deposition angle of the titanium oxide and silicon oxide was studied, a low refractive index silicon oxide film was obtained based on the oblique angle incident deposition method. A refractive index gradual anti-reflection film for multi-junction GaAs solar cells was designed.

CIOP2019-2019-000149 (17:15-17:30, August 7)

Self-powered photodetector based on vertical MoO_3/MoS_2 heterostructure with gate tunable photo-response

Xinli Ma, Jing Liu*
School of Precision Instruments and Optoelectronics Engineering of Tianjin University, China

Abstract: In this work, we developed a vertical MoO_3/MoS_2 heterojunction for photodetection and photovoltaic applications.

CIOP2019-2019-000027 (10:15-10:30, August 8)

Electronic, optical properties and effective masses of $Al_xGa_{1-x}As$ and $In_yGa_{1-y}As$ based on the first principle

Congcong Wang, Zhiyong Wang*
Beijing University of Technology, China

Abstract: The band structure, density of states, optical properties, effective masses and loss function of $Al_xGa_{1-x}As$ and $In_yGa_{1-y}As$ were performed by the first-principles method within the local density approximation.

CIOP2019-2019-000541 (15:00-15:15, August 8)

Core-shell nanoparticles as surface-enhanced Raman scattering substrates for sensitive detection of thiram

Yunjie Lv
Shenzhen University, China

Abstract: We report a nanostructure of Au@1,4-BDT@Ag as a surface-enhanced Raman scattering (SERS) substrate for the detection of thiram. The results suggest that the nanomaterials can be used for chemical trace analysis with high sensitivity and reproducibility.

CIOP2019-2019-000406 (11:30-11:45, August 9)

Size-dependent broadband nonlinear optical enhancement and origin in BP nanosheets and quantum dots

Baohua Zhu[1*], Fangfang Wang[2], Yuzong Gu[1]

1. Henan University, China

2. Shanghai institute of technical physics, CAS, China

Abstract: The broadband nonlinear optical absorption and refraction of BP are enhanced 21.5 times with the size decrease, which might be attributed to the photoinduced dipole moment, intrinsic dipole moment and local field effects.

CIOP2019-2019-000199 (11:45-12:00, August 9)

Effects on the surface and luminescence properties of GaAs by octadecanethiol solution passivation

Yumeng Xu, Baoxue Bo[*], Xin Gao

Changchun University of Science and Technology, China

Abstract: In order to effectively reduce the surface state density of GaAs and obtain a stable high-performance passivation film, the GaAs surface was passivated by using octadecanethiol solution. The effects of solvent and passivation time on the passivation of GaAs surface by octadecanethiol solution were researched by ellipsometry, photoluminescence and X-ray photoelectron diffractometry.

SC9 Optical Measurement and Metrology

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Laser interferometry for high precision and ultra-stable applications (Tutorial)

Denis Dontsov
SIOS Messtechnik GmbH Ilmenau, Germany

Abstract
The increasing of demands for high precision positioning and length measuring tasks needs improved solutions for the length metrology. Laser interferometers are established instruments for measurements of the displacement, angles, straightness and vibration with lowest uncertainty and high resolution.
The talk gives an overview over the current achievements in the field of the laser interferometry and shows applications of the interferometric method of measurements for applications with highest demands on precision and ultra-stability.
Multi-beam laser interferometers play an increased role in the length metrology and allow compensation of the geometrical errors of the measuring application. A one common coherent laser used for all interferometric channels is a basis for reliable and traceable results. The highest stability of the measurements can be achieved if optical setup of the system is based on the differential principle. In this case a part of the light path in air can be optically compensated and is not influenced by the fluctuations of the air refractive index.
The presentation will show, based on the physical background of the laser interferometry, measuring arrangements of the multi-beam interferometers for simultaneous measurements of several degrees of freedom of the displacement as well the achievable results for the setups based on differential principal of laser interferometry.

Biography
1988 to 1994: Study of the measuring technology at the National Technical University in Kiew, Ukraine
1995 to 2001 PhD work at the Technical University of Ilmenau, Germany at the field of laser vibrometry
2002 - 2010 Project manager and R&D engineer at SIOS Messtechnik
2010 - 2016 Director of Research and Developments of SIOS Messtechnik GmbH
Since 2016: Managing director of SIOS Messtechnik GmbH

- 14:15-14:45, August 7 -

A method determining the resolution and stability on nanometer scale of optical instrument

Wenhao Huang
University of Science and Technology of China, China

Abstract
The resolution and stability are two important technical specifications of optical instruments. It is more important for high precision optical measurement and metrology application up to sub-micron and nanometer scale.
Up to now, some methods used to measure the resolution and the stability are separately. Here we propose a specially designed reference material which can be used to determine the resolution and stability of the optical instruments at one time.

In this talk we will describe the principle of design of the patterns, the fabrication results and the application of this reference material.

Biography

Prof. Huang Wenhao was born on May 26,1944, graduated from Tsinghua Univ. in 1968 in the Department of Precision Instrumentation and Mechanics. Then he worked in a factory as a technician, and moved to USTC since 1978. 1989-1991 he worked as visiting scholar in STM lab in Universidad Autonoma de Madrid. He was Chairman of organizing committee of international forum on trends of nano-manufacturing in 2011,2012,2014,2016. He was selected as fellow of ISNM.

Now he is the consultant expert in manufacturing and engineering field of Ministry of Science and Technology of China, and he is also an expert of TC 201 of ISO. His research directions: Micro and nano scale manufacturing and measurement technology, Scanning probe microscopy, Femto second laser micro-nano fabricating, Nano metrology and standardization.

- 14:45-15:15, August 7 -

The development of ultra-precision displacement measuring laser interferometer at Harbin Institute of Technology

Pengcheng Hu

Harbin Institute of Technology, China

Abstract

Based on Michelson interference principle, the homodyne or heterodyne laser interferometry has the advantages of direct traceability, high resolution, long range and high accuracy up to several nanometers. Laser Interferometry has already been widely used in the field of ultra-precision manufacturing. It plays important roles in manufacturing/ metrology equipment. Recently, driven by the cutting-edge industries and astronomy, there are demands for next generation interferometry with sub-nm or deep sub-nm accuracy.

According to the error budget of laser interferometry, the key issues in developing next generation laser interferometry are enhancing laser wavelength accuracy, decreasing periodic error, enhancing phase resolution, etc. Over the past few years, our research group has conducted in-depth study on next generation laser interferometry. Firstly, with a water-cooling offset frequency locking method, the relative laser frequency accuracy/stability has been enhanced to 4.2×10^{-10}. Secondly, we have built heterodyne interferometers with spatially separated beams, in which the periodic nonlinearity error is under several tens of pico-meter. Lastly, different phase evaluate methods have been studied and optimized to achieve phase resolution as high as several pico-meter.

Biography

Prof. Pengcheng Hu is Professor of the instrument science & technology department at Harbin Institute of Technology (HIT). His professional interests are precision measurements and instrumentation, specialized in nm-level and dynamic laser interferometry for ultra-precision measurements and manufacture. He has joined the instrument science & technology department at Harbin Institute of Technology since 2008, and worked in PTB as a guest scientist from 2009 to 2010. During last decades he has published ~60 technical papers in peer-reviewed journals, ~10 presentations in conferences, and ~60 patents. He has been conferred a second-class honor in the 2013 National Technological Invention Award. He is currently secretary-general of CSM-MIC (Chinese Society of Measurement, Metrology Instrument Committee), senior member of CIE (Chinese Institute of Electronics), and senior member of IEEE (Institute of Electrical and Electronics Engineers). In 2019 Prof. Pengcheng Hu is supported National high level talents special support plan (outstanding young talents).

- 16:00-16:30, August 7 -

Full-field optical coherence tomography with an acousto-optically tuned external-cavity laser diode

Takamasa Suzuki
Niigata University, Japan

Abstract

Full-field swept source optical coherence tomography using an acousto-optically tuned external-cavity laser diode is proposed and demonstrated. The wavelength of the light source is controlled by diffraction in an acousto-optic modulator, instead of by mechanical motion. This allows tuning rates of over 100 kHz without mode hopping. For phase analysis, we used a continuous wavelet transform. This allows for accurate signal processing that reduces calculation error caused by the nonstationary features of an interference signal. We measured the two-dimensional thickness distribution of a thin glass plate at the tuning range of 68.9 nm, with a central wavelength of 832 nm. A complex Morlet wavelet was used as a mother wavelet in our calculations. The average thickness of the glass plate was found to be 147.0 µm.

Biography

Takamasa Suzuki received his BE and ME degrees in electrical engineering from Niigata University in 1982 and from Tohoku University in 1984, respectively, and his PhD degree in electrical engineering from Tokyo Institute of Technology in 1994. He is a professor of electronic, information and communication engineering program at Niigata University. His research interests include optical metrology and optical information processing.

- 16:30-17:00, August 7 -

Micro-optical coherence tomography for measurement of microanatomic and subcellular parameters

Linbo Liu
Nanyang Technological University, Singapore

Abstract

Optical coherence tomography (OCT) provides noninvasive cross-sectional and real time images of biological tissues. The subcellular resolution form of OCT is termed Micro-OCT. Micro-OCT is capable of measuring microanatomic and even subcellular parameters which are critical for the diagnosis of human diseases, such as gastrointensitinal cancers and respiratory airway diseases. We demonstrate measurement of size of nuclei in gastrointestinal tracts and mucociliary activities in the respiratory airways. The results of the measurement results are validated with the gold standard methods.

Biography

Liu Linbo received B.Eng in Precision Instrument in 2001, and M. Eng. in Optical Engineering in 2004, from Tianjin University, China. He received PhD in Bioengineering in 2008 from National University of Singapore before his postdoctoral training in Wellman Center in Photomedicine, Harvard Medical School (HMS) and Massachusetts General Hospital (MGH) from 2008 -2011. He was promoted as an Instructor in Dermatology at HMS. Dr Liu is currently an Associate Professor in the School of Electrical and Electronic Engineering and School of Chemical and Biomedical Engineering in Nanyang Technological University. His research interests are mainly focused on development and validation of non-invasive, cellular and sub-cellular resolution imaging methods for disease diagnosis and life science research.

- 17:00-17:30, August 7 -

Quantitative detection of biomolecules using coherent Raman microscopy

Fake Lu
State University of New York at Binghamton, USA

Abstract

Raman scattering serves as a valuable contrast mechanism for label-free chemical analysis and imaging when performed in a microscopy modality. However, the ultra-low signal level of spontaneous Raman severely limits speed of imaging at a high spatial resolution. Stimulated Raman scattering (SRS), a coherent and nonlinear Raman process, can amplify the Raman signals “linearly” by a few orders of magnitude, enabling rapid Raman imaging with microseconds pixel dwell time. In this talk, fundamental and state-of-the-art of SRS microscopy technology will be introduced. A few interesting biomedical imaging applications of SRS microscopy for label-free and quantitative cancer tissue characterization, as well as for drug delivery imaging, will be presented.

Biography

Dr. Fake Lu is an assistant professor in the Department of Biomedical Engineering at the Binghamton University, State University of New York (SUNY). Binghamton University is one of the top public universities, ranked #32 in the United States (USNEWS 2019). Dr. Lu received his PhD in Bioengineering from the National University of Singapore in 2010. He then completed 5-year postdoc training at Harvard University in Boston. Dr. Lu’s research interest focuses on developing multiphoton and nonlinear Raman microcopy technologies for biomedical and translational imaging applications. He has published on PNAS, JACS, Cancer Research, and Nature Communications. His research is being funded by NIH and other funding agencies.

- 09:00-09:30, August 8 -

Metrology in lithography: challenges and opportunities

Arie J. den Boef
ASML, Netherlands

Abstract

The continued shrink in semiconductor devices drives lithography requirements to extreme levels that results in the need for a robust control of the patterning process. This asks for continued improvements of metrology of CD and overlay in terms of speed, robustness, precision and accuracy. In this talk we will present some of the optical metrology techniques that are being used today. We will discuss the challenges that metrology is facing today and we will give an overview of the progress that is being made in dealing with these challenges.

Biography

Arie den Boef worked at Philips Research Laboratories from 1979 till 1992 in the area of laser diodes and optical interferometry. In 1991 he received a Ph.D. degree from the University of Twente with a thesis titled “Scanning Force Microscopy using Optical Interferometry”. From 1992 till 1995 den Boef worked at Philips Medical Systems on Magnetic Resonance Imaging and in 1995 he worked as system engineer on CD-Recordable systems. In 1997 he joined ASML where he started exploring optical sensors with emphasis on wafer alignment sensors and scatterometry for CD and overlay metrology. Den Boef was appointed part-time full professor in 2016 at the Vrije Universiteit of Amsterdam in the area of “nano-lithography and metrology”. At the university he is teaching a course on optical wafer metrology techniques and he has set-up a small research group that explores new optical techniques for metrology.

- 09:30-10:00, August 8 -

Precision phase measurement based on quantum weak value amplification

Hongliang Cui
Chongqing Institute of Green and Intelligent Technology, CAS, China
Jilin University, China

Abstract

Weak measurement, first proposed by Aharonov, Al¬bert, and Vaidman in 1988, is a concept primarily studied in conjunction with quantum measurement theory and has remained by and large a laboratory curiosity until recent years. It has attracted interest due to the attendant mechanism of weak value amplification (WVA) as a signal enhancement methodology, offering tantalizing promise of augmenting the detectable signal by several orders of magnitude without a concurrent amplification of technical noise. Its potential in pre¬cision measurement of variation of physical parameters in the presence of noise that overwhelms the useful signal, as in most practical cases of optical phase determination, has been recognized, and demonstrated in a number of scenarios using bulk optical components. To transform a WVA measurement system from a collection of bulk optical components mounted on an optical table to a fieldable sensor capable of measuring unprecedently small variations of such physical quantities as displacement, pressure, electric and magnetic fields, and gravity, requires the fiberization and modularization of the setup. In this talk I report on our first attempt at such an endeavor. Using a prototypical interferometric fiber optic hydrophone as an ex¬ample, we have explored the possibility of measuring small changes in the optical phase of the fiber interferometer, via the WVA technique. We experimentally demonstrated the anticipated improved performance for detecting small phase change (more than two orders of magnitude better than traditional fiber-optic hydrophone based on an interferometer) induced by minute variation of hydro-pressure.

Biography

Hong-Liang Cui received his undergraduate education from Changchun Institute of Optics and Fine Mechanics, obtaining a BE in laser physics in 1982, and his Ph.D. degree in theoretical physics from Stevens Institute of Technology in 1987. He is currently a chaired professor at Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Science, and Jilin University. He was previously a professor of physics and engineering physics at Stevens Institute of Technology, and a professor of applied physics at New York University. His research efforts have been concentrated in areas of solid-state electronics, fiber optical communications and sensing, high-frequency electromagnetic wave propagation and interaction with matter, and physics-based approaches to modeling of semiconductor and molecular devices.

- 11:00-11:30, August 8 -

Wavefront measurement in transmission of multiple-wavelength expressed by related Zernike coefficients

Sen Han
University of Shanghai for Science and Technology, China

Abstract

Wavefront aberration can reflect the performance of optical systems, the test of wavefront aberration is convenient to express in Zernike polynomials form. Transmission optical system wavefront changes with wavelength, testing at design wavelength is critical for the optical system, from now on only a few wavelength wavefront can be tested by laser interferometer. A new idea is put forward in this paper, transmission optical system wavefront can be calculated at any wavelength utilizing the relationship between transmitted wavefront Zernike coefficients and wavelength.

The optical system was modeled and Zernike coefficients at different wavelength were collected by Zemax, then the coefficients were fitted by Matlab curve fitting tool, finally we found Conrady-Zernike formula. The maximum error of the calculated Zernike coefficients is within 1%. The results show that the Zernike coefficients and the wavelength are basically consistent with Conrady-Zernike formula.

Biography

Sen Han obtained his Ph.D.in Optical Engineering from University of Stuttgart, Germany. Dr. Han is a Professor of University of Shanghai for Science and Technology and one of Co-Founder of H&L Instruments. He is both a SPIE Fellow and an Adjunct Professor of University of Arizona, USA. Dr. Han won R&D 100 Awards twice in USA.

- 11:30-12:00, August 8 -

Wavefront aberration measurement for lithographic projection lens

Xiangzhao Wang

Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract

As the core equipment for integrated circuit manufacturing, lithography tool is the key to determining the feature size and integration level of integrated circuits. Its improvement in key performance index is the important driving force for the continuous development of integrated circuit to higher integration according to Moore's law. Image quality is a key factor in determining the resolution and overlay of lithography tool. It is the continuous improvement of the image quality that enables the performance of the lithography tool to improve continually.

As the integrated circuit technology node enters below 130nm, the influence of wavefront aberration of projection lens of lithography tools on the imaging quality cannot be ignored. The high-accuracy measurement and control for wavefront aberration is an important guarantee for high-quality imaging. Our research group has been engaged in research work in the field of wavefront aberration measurement of projection lithography tools since 2002, and has achieved a series of innovative research results. This presentation systematically introduces these research work of our research group, including measurement techniques of primary image quality parameters, wavefront aberrations and polarization aberrations. The types of measurement techniques involved include exposure-based method, aerial-image-based method and interference-based method. The types of lithography tools involved include dry, immersion and EUV lithography tools.

Biography

Xiangzhao Wang received his BE degree in electric engineering from Dalian University of Technology, China, in 1982, and his ME and PhD degree in electric engineering from Niigata University, Japan, in 1992 and 1995, respectively. Now, he is a professor at the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. His research interests include lithography imaging theory and technology and information optoelectronics.

- 13:30-14:00, August 8 -

Advanced instrumentation and image reconstruction algorithms for optical mammography

Nanguang Chen

National University of Singapore, Singapore

Abstract

Imaging through multiple-scattering media, or turbid media, is scientifically challenging but very attractive for

numerous applications. For example, diffuse optical tomography is becoming a potential imaging modality for breast cancer early detection. We have been developing new approaches that addressed fundamental challenges of acquiring more useful information from diffusive photons and solving inverse problem of light transport in turbid media. The integrated image reconstruction framework leverages on the power of data-driven machine learning techniques and physics-driven regularization techniques, built upon big data collected from practical imaging systems, which performs Laplace domain optical measurements directly to enhance the signal to noise ratio and image quality.

Biography

Dr. Chen Nanguang is currently an Associate Professor of Biomedical Engineering at the National University of Singapore (NUS). He received his PhD in Biomedical Engineering in 2000 from Tsinghua University. He also received his MSc in Physics and BSc in Electrical Engineering in 1994 (Peking University), and 1988 (Hunan University), respectively. He joined the Optical and Ultrasound Imaging Lab at the University of Connecticut in 2000 as a postdoctoral fellow and then became an Assistant Research Professor in 2002. Since 2004, he has been a faculty member with NUS. His research interests include diffuse optical tomography, optical coherence tomography, and novel fluorescence microscopic imaging methods. He has published more than 70 papers in international leading journals and holds 5 international patents.

- 14:00-14:30, August 8 -

Polarization sensitive optical coherence tomography for breast tumor margin detection

Jianfeng Wang
University of Illinois at Urbana-Champaign, USA

Abstract

We report the development and implementation of an intraoperative polarization-sensitive optical coherence tomography (PS-OCT) system for enhancing breast cancer detection. A total of 3440 PS-OCT images were intraoperatively acquired from 9 human breast specimens diagnosed by H&E histology as healthy fibro-adipose tissue (n = 2), healthy stroma (n = 2), or invasive ductal carcinoma (IDC, n = 5). A standard OCT-based metric (coefficient of variation (CV)) and PS-OCT-based metrics sensitive to biological tissue from birefringence (i.e., retardation and degree of polarization uniformity (DOPU)) were derived from 398 statistically different and independent images selected by correlation coefficient analysis. We found the standard OCT-based metric and PS-OCT-based metrics were complementary for the differentiation of healthy fibro-adipose tissue, healthy stroma, and IDC. While the CV of fibro-adipose tissue was significantly higher (p0.001) than those of either stroma or IDC, the CV difference between stroma and IDC was minimal. On the other hand, stroma was associated with significantly higher (p0.001) retardation and significantly lower (p0.001) DOPU as compared to IDC. By leveraging the complementary information acquired by the intraoperative PS-OCT system, healthy fibro-adipose tissue, healthy stroma, and IDC can be differentiated with an accuracy of 89.4%, demonstrating the potential of PS-OCT as an adjunct modality for enhanced intraoperative differentiation of human breast cancer.

Biography

Dr. Jianfeng Wang is currently a Carle-Foundation Hospital – Beckman Institute Postdoctoral Fellow, working in Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign. His research focus on the development of polarization-sensitive optical coherence tomography, multiphoton microscopy and Raman spectroscopy for intraoperative breast tumor margin detection. He received his Ph.D. in biomedical engineering in 2017 from the National University of Singapore, and his M.Eng. in Optical Engineering in 2012 from Beijing Institute of Technology.

- 14:30-15:00, August 8 -

Spatially invariant resolution photoacoustic microscopy using wavefront engineering technology

Jiamiao Yang
California Institute of Technology, USA

Abstract

Photoacoustic microscopy (PAM) has been extensively applied in biomedical studies because of its ability to visualize optical absorption contrast in vivo in three dimensions. However, maintaining high resolution over a large axial range remains a challenge because the lateral resolution decreases rapidly with distance from the focal plane. Here, we propose motionless volumetric spatially invariant resolution photoacoustic microscopy (SIR-PAM) via wavefront engineering technology. To realize motionless volumetric imaging, SIR-PAM combines two-dimensional Fourier-spectrum optical excitation with single-element depth-resolved photoacoustic detection. To achieve spatially invariant lateral resolution, propagation-invariant sinusoidal fringes are generated by a digital micromirror device with wavefront engineering technology. Further, SIR-PAM achieves 1.5 times finer lateral resolution than conventional PAM. We built an SIR-PAM prototype, achieving a 45-fold improvement in depth of field over the conventional-PAM counterpart. Its superior resolution-invariant axial range of 1.8 mm was demonstrated in both inanimate objects and in vivo animals. Our work opens new perspectives for various high-resolution volumetric imaging technologies in biomedical sciences.

Biography

Dr. Jiamiao Yang works as a postdoctoral scholar in Andrew and Peggy Cherng Department of Medical Engineering, California Institute of Technology. He got his PhD degree in Beijing Institute of Technology, China. His main research interests focus on optical wavefront shaping, photoacoustic microscopy, optical measurement, and optical instrument researching. He has published more than 10 peer-reviewed articles in journals as the first author, including Nature Communications, Optica, Applied Physics Letters, and Optical Letters.

- 08:30-09:00, August 9 -

Identification of Chinese liquors by spectroscopic technology

Guoqing Chen
Jiangnan University, China

Abstract

The identification of the authenticity, brand, age of Chinese liquors objectively and accurately through scientific method is an urgent need for the market supervision. The spectroscopic technology is introduced in the detection of Chinese liquors. However, the spectral complexity of the multiple-component system limits the direct analysis. We use a variety of mathematics algorithms, wavelet transformation, parallel factor analysis, non-negative matrix decomposition, partial least squares, to realize the spectral data matrix decomposition and reconstitution. The fingerprint spectra and characteristic database of Chinese liquors are established. Artificial neural network is used to find the nonlinear relationship between the spectral characteristics and the information of the Chinese liquors. The support vector machine, the Euclidean distance and the threshold determination algorithm are also used for accurate identification of Chinese liquors.

Biography

Prof. Chen is the dean of School of Science, Jiangnan University and the president of Wuxi Physical and Mathematical Society. He has been long involved in research on the application of spectroscopic technology in food safety. Up to now, Prof. Chen has led and participated as the backbone member in 10 projects funded by the NSFC, National Key R&D Program of China and other provincial and ministerial foundation Meanwhile, Prof. Chen has already published 10 textbooks and more than 100 academic papers so far, most of which are SCI and EI indexed. 6 inventive patents have been granted. Moreover, Prof. Chen has received awards of third prize in Science and Technology Progress in Wuxi, and second prize for Science and Technology Progress of China National Light Industry Council.

- 09:00-09:30, August 9 -

High precision surface metrology and structure characterization methods for making advanced X-ray reflective optics

Qiushi Huang
Tongji University, China

Abstract

X-ray reflective optics have been widely used in many fields including photo-lithography, synchrotron radiation facility, high energy astronomy, and so on. The reflective optics consists of nanoscale multilayer coatings and high precision substrates, both of which require accurate metrology and characterization in order to manipulate the X-ray light efficiently and precisely. For the X-ray multilayer, each layer thickness is only a few nanometers, the interface and surface quality of these layers are crucial for achieving high reflectance. X-ray reflectometry is very sensitive in analyzing the layer thickness, interface width, and even the surface contamination. The layer morphology and composition can be measured by electron microscopy and spectroscopy techniques. To probe the layer structure inside nondestructively, spectroscopy techniques combined with standing wave has been developed. For the mirror substrate, nanometer figure accuracy is demanded by the perfect wavefront control. This is especially difficult for the measurement of a curved surface. A stitching interferometry method has been developed to solve this issue and low repeatability error of 0.4 nm RMS has been achieved on a spherical mirror with 100m radius of curvature. The absolute accuracy of the measurement has been compared with other metrology tools.

Biography

Dr. Qiushi Huang has received his PhD degree in optics in Tongji University, 2012. He worked in the FOM institute (DIFFER) and University of Twente from 2012 to 2014 as a postdoc. In 2014, he joined the Institute of Precision Optics and Engineering in Tongji University as an assistant professor. He is currently an associate professor in Tongji University. He was sponsored by Shanghai Pujiang Program in 2015 and Shanghai Rising-Star Program in 2019. He has published more than 50 journal papers. His main research interests include extreme ultraviolet and X-ray multilayers, X-ray grating optics, high precision mirror metrology and manufacture.

- 09:30-10:00, August 9 -

Development of tomographic Mueller-matrix scatterometry for nanostructure metrology

Xiuguo Chen
Huazhong University of Science and Technology, China

Abstract

Optical scatterometry is one of the most important techniques for measuring the critical dimension and overlay of nanostructures in current semiconductor manufacturing due to its inherent noncontact, nondestructive, time-effective, and relatively inexpensive merits over other metrology techniques, such as scanning electron microscopy and atomic force microscopy. Along with the advantages of optical scatterometry, there are some challenges or limitations to this technique with the ever-decreasing dimensions of advanced technology nodes, such as the parameter correlation issue. In addition, optical scatterometry is mostly suitable for measuring repetitive dense structures while infeasible for the measurement of isolated or the general non-periodic structures. To address the challenges or limitations in conventional optical scatterometry, we have recently developed a novel instrument called the tomographic Mueller-matrix scatterometer (TMS). The TMS illuminates sequentially a sample by a plane wave with varying illumination directions (incidence angles 0~65.6° and azimuthal angles 0~360°) and records, for each illumination direction, the polarized scattered filed along various directions of observation (scattering angles 0~67°) in form of scattering Mueller matrices. Due to the rich scattering information collected by the developed instrument, it is expected that the TMS would gain wide applications in the metrology of not only periodic nanostructures but also isolated or the general non-periodic structures. It is also expected that the TMS would gain applications in the inspection of defects in nanostructures.

Biography

Xiuguo Chen received his PhD degree in Mechanical Engineering from Huazhong University of Science and Technology (HUST) in 2013. From 2013 to 2015, he was working as a Postdoc at the School of Mechanical Science and Engineering in the same university. From 2016 to 2018, he was working a JSPS Research Fellow at the Department of Nanomechanics, Tohoku University (Sendai, Japan). He is now an associate professor at HUST. He has authored/co-authored more than 60 peer-reviewed journal papers and held more than 20 patents related with theory, instrumentation and application of ellipsometry, especially Mueller matrix (imaging) ellipsometry, for nanoscale characterization.

Oral Talks

CIOP2019-2019-000364 (15:15-15:30, August 7)

LED arrays as illumination for imaging and metrology systems

Xinrui Cao*, Stefan Sinzinger
TU Ilmenau, Germany

Abstract: In this contribution, we apply LED arrays in two optical systems - Fourier ptychography and Lau effect, to investigate the influence of the spatial coherence properties of illumination on imaging.

CIOP2019-2019-000387 (10:00-10:15, August 8)

Automated test station for multiwavelength laser-induced damage threshold measurements

Jie Li*
Research Center of Laser Fusion, China Academy of Engineering Physics, China

Abstract: An automated test station is presented to improve the efficiency for multiwavelength laser-induced damage threshold measurements.

CIOP2019-2019-000066 (10:15-10:30, August 8)

Ultrahigh resolution and ultrahigh precision spectroscopy and its applications

Jinping He*
Nanjing Institute of Astronomical Optics and Technology, Chinese Academy of Sciences, China

Abstract: A VIPA spectroscopic system calibrated with laser frequency comb is demonstrated, with spectral resolution of ~1 million and calibration precision of ~3.3 cm/s.

CIOP2019-2019-000085 (10:00-10:15, August 9)

Three-dimensional spatial resolution technique for characterizing laser-induced optical film defect damage

Chong Shan
Shanghai Institute of Laser Plasma, China

Abstract: We propose the three-dimensional spatial resolved method to research the defect information and laser resistance of optical film accurately. Our method provides a new way to detect the defect characteristics of optical film.

CIOP2019-2019-000134 (10:15-10:30, August 9)

One-shot common-path phase-shifting holography based on micropolarizer camera and large-shearing Wollaston Prism

Canlin Zhou[1*], Shuchun Si[1], XiaoLei Li[2], Zhenkun Lei[3], Yanjie Li[4]
1. School of Physics, Shandong University, China
2. School of Mechanical Engineering, Hebei University of Technology, China
3. Department of engineering mechanics, Dalian University of Technology, China
4. School of civil engineering and architecture, Jinan University, China

Abstract: The most conventional digital holography configuration requires a separately generated reference and object beams that result in a low stability. The paper presents an One-shot common-path phase-shifting holography based on micropolarizer camera and large-shearing Wollaston Prism. Experiments are conducted to prove the validity of the proposed method.

SC10 Infrared and Terahertz Technologies

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Challenges and opportunities for THz wave liquid photonics (Tutorial)

Xi-Cheng Zhang
University of Rochester, USA

Abstract
Normal universal matters are made of four states: solid, liquid, gas, and plasma. The generation of THz wave from solids, gases, and plasmas has been demonstrated, used, and understood for decades. However, the THz wave generation from liquid sources was conspicuously absent, especially from liquid water due to water's infamously strong absorption characteristics in the THz regime. It is reasonable to expect that liquids might have unique properties if they could be harnessed as THz sources. Liquids have a high molecular density, close to that of solids, meaning that light over a certain area will interact with many more molecules than an equivalent cross-section of gases. We present a systematic study of THz photonics in liquids by using laser induced micro-plasma. Specially we report the generation of broadband THz waves from liquids, include aqueous solutions (normal and heavy water, salty water, sugar water, alcohol solution), and over 20 different liquids (with different polarity and pH levels).

Biography
Xi-Cheng Zhang – Parker Givens Chair of Optics, the Institute of Optics, University of Rochester, USA. Dr. Zhang is a Fellow of AAAS, APS, IEEE, OSA, and SPIE. His honors and awards include: Alexander von Humboldt Prize ('18); Australia Academy of Science Selby Fellow ('17); IRMMW-THz Kenneth Button Prize ('14); OSA William F. Meggers Award ('12); IEEE Photonics Society William Streifer Scientific Achievement Award ('11); Rensselaer William H. Wiley 1866 Award ('09). He serves as Editor-in-Chief of Optics Letters ('14-'19).

- 14:15-14:45, August 7 -

2D materials based mid-infrared and terahertz optoelectronics

Qijie Wang
Nanyang Technological University, Singapore

Abstract
Mid-infrared (MIR) and Terahertz (THz) spectral region, hereafter defined as the ~3 – 300 μm wavelength range, hosts particular scientific and technological interests. Many molecules have strong and rich spectral fingerprints in this MIR region, therefore, MIR photonic and optoelectronic devices are potentially very promising for a breath of applications such as environmental and bio-chemical sensing, defense and security, industrial control, and medicine, etc. Since the discovery of graphene in 2004, two-dimensional (2D) materials have attracted tremendous research interests due to their unique and intriguing electrical and optical properties. In this talk, I am going to present our research in applying 2D materials for applications in the MIR and THz regime. In particular, I will show our recent demonstrations of a room temperature broadband PtSex-based photodetector and a high responsivity hybrid MIR photodetector based on graphene integrated with broadband oxide based nanoparticles.

Biography

Dr. WANG Qijie received the B.E. degree in electrical engineering from the University of Science and Technology of China (USTC), Hefei China, in 2001 graduating one year in advance; and the Ph.D degree in electrical and electronic engineering from Nanyang Technological University, Singapore, in 2005, with NTU and Singapore Millennium Foundation (SMF) scholarship. After completing his Ph.D, he obtained the 2005 SMF postdoctoral fellowship working in NTU. Then he joined School of Engineering and Applied Science, Harvard University, in Prof. Federico Capasso's group as a postdoctoral researcher in Jan. 2007. In October 2009, he was assigned as a joint Nanyang Assistant Professor at the School of Electrical and Electronic Engineering (EEE) and the School of Physical and Mathematical Sciences (SPMS). Since Feb. 2015, he has been promoted to tenured associate professor in school of EEE and SPMS, NTU.

Dr. Wang has published/co-published more than 120 papers (including 9 invited papers) in top international journals (like Nature Photonics, Nature Materials, and Nature Communications), more than 100 conference papers (including numerous invited talks) and co-authored 10 U.S. patents. He was the recipient of the top prize for the Young Inventor Awards of the SPIE Photonics Europe Innovation Village in 2004; a golden award from the Fifth Young Inventor's Awards in 2005 organized by HP and Wall Street Journal; and the co-recipient of the IES (Institution of Engineers Singapore) Prestigious Engineering Achievement Team Award of Singapore Twice in 2005 and 2017, respectively, 30th World Culture Special Recognition Award 2013, the prestigious Singapore Young Scientist Award 2014, and Nanyang Research Award 2015 (Young Investigator).

- 14:45-15:15, August 7 -

THz technology for van der waals heterostructures

Xinlong Xu

Northwest University, China

Abstract

Graphene/semiconductor Van der Waals heterostructures demonstrates the improvement of traditional electronic and optoelectronic devices due to their outstanding charge transport properties inside and at the interfaces. However, very limited information has been accessed from interface properties by traditional measurement. Herein, we present an active THz surface emission spectroscopy from graphene on SiO_2/Si (Gr/SiO_2/Si) for the interface build-in potential and charge detrapping time constant evaluation. The active THz generation presents an intuitive insight into the depletion case, weak inversion case, and strong inversion case at the interface in the heterostructure. The investigate will not only highlight the THz surface emission spectroscopy for the graphene-based interface analysis, but also hold a potential for the enhancement of THz emission by the heterostructures.

Biography

Professor Xinlong Xu received his PhD degree from Institute of Physics, Chinese Academy of Sciences. He is a professor of Optics and Condensed Matter Physics in Institute of Photonics & Photon-Technology, Northwest University, Xi'an, China.

His research interest focuses on ultrafast physics, especially terahertz photonics and devices based on ultrafast laser.

- 16:00-16:30, August 7 -

Control of THz pulse polarization by two crossing DC fields during femtosecond laser filamentation in air

Weiwei Liu
Nankai University, China

Abstract
Terahertz (THz) radiation induced by the femtosecond laser filament in air can be strongly enhanced through applying external DC field. In the present work, this technique has been extended to two-dimensional biasing, namely two pairs of electrodes, which are placed perpendicular to each other, are applied to provide two crossing DC fields. The experimental results have demonstrated that the amplitudes of two orthogonally components of the polarized THz pulse could be modulated by the electric field parallel to it, in an in-situ and real-time manner, while the phase delay between them keeps constant. Hence, the polarization of the output THz pulse could be freely controlled by adjusting the voltages of the two crossing DC fields, achieving arbitrary ellipticity. It might be the simplest method to manipulate the THz polarization during the femtosecond laser filamentation in air.

Biography
Prof. Weiwei Liu received his Ph.D degree from Laval University in 2005, and jointed Nankai University in 2007 as full professor. He is a world specialist in intense femtosecond laser propagation in optical media; i.e. intense femtosecond laser filamentation. He has already published more than 130 scientific papers in peer-reviewed journals in our field of research including Nature Photonics, Phys. Rev. Lett., Appl. Phys. Lett., Opt. Lett., etc. The total citation number of these publications is more than 4200 and his H-index reaches 33.
Now, he is serving as the director of Institute of modern optics, member of the standing committee of Chinese Optical Society and vice president of Optical Society of Tianjin. Based on his excellent achievement obtained during the past few years, Prof. Weiwei Liu was awarded the 'Wang Daheng's Optics Prize for middle-aged and youth of the Chinese Optical Society',Tianjin's Outstanding Contribution Expert.

- 16:30-17:00, August 7 -

Ultrafast dynamic control of emergent phases in transition metal oxides

Jingdi Zhang
The Hong Kong University of Science and Technology, Hong Kong, China

Abstract
In correlated transition metal oxides (TMOs), interactions between the electron, lattice, spin and orbital degrees of freedom (DOFs) have proven to be a fertile land of emergent quantum phenomena and competing quantum phases. The delicate balance between these competing quantum phases are often sensitive to conventional external stimuli, including pressure, magnetic and electric field, offering avenues for new functionalities and unveiling fundamental physics of quantum materials. In the past decades, profound advancement of material science and ultrafast science opens up exciting possibilities for exploiting ultrafast laser spectroscopy to dynamically study and control emergent phases in quantum materials with photons. In this talk, I will describe state-of-the-art ultrafast spectroscopic technique that enabled us to access the photo-induced states in TMOs. I will show examples that demonstrate ultrafast dynamic control of strongly correlated quantum materials by mode-selective excitation with pulsed electromagnetic field. These include: (i) Recent discovery of a new collective mode induced by optical excitation in a stripe-ordered cuprate superconductor $La_{2-x}Ba_xCuO_4$, evidenced by time-domain THz spectroscopy. (ii) Cooperative photo-induced metastable

"hidden" phase in a colossal magnetoresistance (CMR) manganite $La_{0.67}Ca_{0.33}MnO_3$, investigated by ultrafast far-field pump-probe spectroscopy and near-field scanning optical microscopy.

Biography

Dr. Jingdi Zhang is currently an assistant professor of Physics at the Hong Kong University of Science and Technology (HKUST). He received B.S. at University of Science and Technology of China (2007) and Ph.D. in Physics at Boston University (2014). He moved to coastal La Jolla, California in 2015, and worked as a postdoctoral fellow at UC San Diego before joining the faculty of HKUST Physics. His main research interest is the study of strongly correlated electron materials, metamaterials and plasmonics using ultrafast spectroscopy.

- 17:00-17:30, August 7 -

Non-scanning terahertz wave sub-diffraction-limited imaging enable by near-field compressive sensing

Liguo Zhu

China Academy of Engineering Physics, China

Abstract

In this talk, I'll present an experimentally demonstrated novel non-scanning near-field THz imaging with resolution of ~λ /133 (@0.5 THz), which is realized by compressive sensing the near-field THz imaging. In our proposed non-scanning THz near-field imaging, a digital micro-mirror device (DMD) was used to spatially code the incident 800 nm femtosencond (fs) -laser pulses with designed patterns (Hadamard masks), and the patterned fs-laser pulses further spatially modulate THz pulse through exciting 100nm thick vanadium dioxide (VO_2) thin film. The phase transition material VO_2 was utilized as spatial light modulator. With single-pixel Hadamard detection of the evanescent waves, we reconstructed the THz wave near-field image of an object from a serial of encoded sequential measurements, yielding improved signal-to-noise ratio by one-order magnitude over standard raster-scanning technique. Further, we demonstrate the acquisition time was compressed by a factor of over four with 90% fidelity using total variation minimization algorithm. The proposed terahertz wave near-field imaging technique inspires new and challenging applications, such as cellular imaging.

Biography

Li-Guo Zhu, PhD, is a professor of optics in China Academy of Engineering Physics (CAEP). He received his Ph.D. from Tsinghua University (Beijing, China) in 2011. And, he worked as a joint-PhD student (2009-2011) in Case Western Reserve University (Ohio, US). Now, he is the director of Terahertz Spectroscopy and Imaging Research Lab and vice director of Fast Optoelectronics and Application Research Lab in CAEP. His current research majors in ultrafast terahertz spectroscopy and imaging, material dynamic response studied by terahertz wave, and terahertz techniques for biomedical applications. He authored/co-authored >40 SCI papers and gave >10 invited/keynote talks. He was awarded with PhD Scholarship (2009-2011) from CSC, President's Scholarship (2015-2018) and "Double-Hundred Talents" project (the 7th batch, 2016-2022) from CAEP, and two prizes for scientific innovation (2016, 2017).

- 08:30-09:00, August 8 -

Electrical and magneto-optic properties of 3D topological materials in terahertz regime

Chao Zhang
University of Wollongong, Australia

Abstract
We discuss some optical and transport properties of three dimensional Dirac materials. (1) In 3D Dirac materials, the energy equipartition theorem gives rise to an average energy of kBT. This is twice of the energy in traditional materials. This enhanced energy leads to an enhanced thermionic cooling efficiency which is higher than that in normal metal and in graphene. (2) Fast charge dynamics has been studied, taking into account the electron-acoustic photon and electron-optical phonon interaction. Results indicate that the charge relaxation is directly proportional to the gap. (3) The shape of the Fermi surface of topological nodal-ring semimetals at low carrier concentrations is characterized by the ring radius b/hvF. This peculiar topological property may not have a clear signature in measurable physical quantities. We demonstrate an accurate and definitive method to determine the radius of topological nodal-ring semimetals. Under a magnetic field along the ring axis, the axial magneto-optical response has a giant peak. The position of this ultra strong response is at the frequency of exactly 2b in terahertz regime and is independent of the strength of the magnetic field.

Biography

Professor Chao Zhang received his PhD in physics in 1987 from City University of New York, USA. From 1987 to 1989, he was a postdoctoral fellow at Max-Planck-Institute for Solid Research in Stuttgart, Germany, working on quantum magneto-transport in semiconductor nanostructures. From 1989 to 1992, He was a research associate at Canada's Meson Research Facility in Vancouver, working on quantum coherence and dissipation in solids. Since 1993, he has been a tenured faculty member in the School of Physics, University of Wollongong, Australia. Currently he is a senior professor of physics. From 2004-2014, he served as the associate director of the Institute of Superconducting and Electronic Materials. He is a Fellow of Australian Institute of Physics. He is the associate editor of Frontier of Optolelectronics and a member of the editorial board of Scientific Reports. He is an advisory member of the International Organizing Committee for Infrared, Millimeter and Terahertz Waves. His research interest is in the areas of quantum transport of nanostructures, terahertz photonics, nonlinear dynamics of semiconductors, graphene and topological insulators.

- 09:00-09:30, August 8 -

Spin dynamics in magnetic materials observed by pump-probe spectroscopy and THz-TDS

Takeshi Moriyasu
University of Fukui, Japan

Abstract
Spin dynamics in magnetic materials, especially ultrafast ones, are attractive topics because of the potential application in the developments of spin control, spintronics, quantum computing. In solid-state materials, elementary excitations such as phonons and magnons play important roles, and many of those dynamics appear in the terahertz region of the electromagnetic wave. We investigated the ultrafast spin dynamics of isolated and correlated spin systems in crystals using the pump-probe technique and terahertz time-domain spectroscopy (THz-TDS).
In the presentation, In the presentation, we show that the optical pumping and the light shift effect are very useful to generate and control the magnetization in a isolated spin system, and that the time-domain spectroscopies have a large potential for the sensitive and accurate measurements of the terahertz region in correlated spin system. The dynamics of the isolated spin system was studied by the pump-probe technique in Rb atom and a Tm^{2+} doped

crystal. On the other hand, the ultrafast spin dynamics of correlated spin systems was studied in single crystals of antiferromagnets MnO and NiO. The magnon modes were observed with higher accuracy than previous technique by using the pump-probe spectroscopy and THz-TDS experiments. the frequency of an antiferromagnetic magnon mode lies in the terahertz region, and the spectroscopically investigation in this frequency region is very important because of the significance of elementary excitations in the condensed matter physics.

Biography

Takeshi Moriyasu is a senior assistant professor of Department of applied physics at University of Fukui, currently. He was an assistant professor in Univ. of Fukui from 2016 to 2018, a part-time lecture in Osaka Dental Univ from 2011 to 2016. and a project researcher in Kobe Univ. from 2009 to 2016.

He received his B.A. degree in 2004 from Konan University, and then, Master of science in 2006 and Doctor of science in 2009 from Kobe University, respectively. He has been studying the interaction of light and matter, so far. His main works include the all optical control of spin and observation of antiferromagnetic magnon modes using pump probe method and THz-TDS.

- 09:30-10:00, August 8 -

Tailoring terahertz radiation in spintronic terahertz sources

Xiaojun Wu

Beihang University, China

Abstract

In this talk, I will briefly introduce our recent work on spintronic terahertz radiation from ferromagnetic/heavy metal heterostructures driven by femtosecond laser pulses. Not only we verify the inverse spin Hall effect based highly efficient terahertz radiation, but also, we observe radiated terahertz electric field component parallel to the applied magnetic field directions. Since this polarization of such kind of novel terahertz source can be controlled by the external magnetic field direction, we generate elliptical terahertz beam when engineering the applied magnetic field distribution. Furthermore, we can even have the chance to generate circularly polarized terahertz beams when we use cascaded generation schemes. Hopefully, this work can not only help with further understanding the femtosecond magnetics but also contribute for the next-generation novel terahertz sources.

Biography

Prof. Xiaojun Wu got her Ph.D degree in the Institute of Physics, Chinese Academy of Science in 2013. During August 2014-April 2017, she was awarded the Alexander von Humboldt Fellowship. From January 2014 to December 2015, she served for Member and Education Services Council of the Optical Society of America (OSA). In May 2017, she joined in Beihang University and started a terahertz research group. She has participated in more than ten projects from National Natural Science Foundation of China (NSFC), Deutsche Forschungsgemeinschaft (German Research Foundation, DFG), and European Research Council (ERC), and has contributed as a core member in Prof. Franz X. Kaertner' group for the project "Frontiers in Attoseconds X-ray Science: Imaging and Spectroscopy" funded by ERC, and recently for the project of "GW super strong terahertz source and its applications" funded by NSFC.

- 11:00-11:30, August 8 -

Detection of terahertz waves by photoconductive antenna array

Wei Shi
Xi'an University of Technology, China

Abstract

Based on the traditional THz-TDS system, it is a terahertz detection method to detect terahertz waves with photoconductive antenna. In order to solve the problem that the terahertz spot area is much larger than the clearance area of the antenna detector, this paper designed an array antenna to improve the utilization rate of terahertz spot, so as to improve the detection efficiency.

Biography

Wei Shi mainly engaged in ultrafast optoelectronic technology, terahertz science and technology and other aspects of research, has chaired one National Major Research and Development Projects of Scientific Instruments, one National Natural Science Foundation of China's key project, five National Natural Science Foundations of China, one National Major Basic Research Pre-project, and a number of provincial and ministerial projects. He has published more than 90 SCI papers in famous international journals.

- 11:30-12:00, August 8 -

Ultrabroadband and sensitive photodetection from ultraviolet to terahertz by improved thermoelectric materials

Yingxin Wang
Tsinghua University, China

Abstract

High-performance ultrabroadband photodetection from the ultraviolet to terahertz range of the electromagnetic spectrum using a single element has promising applications in communication, imaging, sensing, and spectroscopy. However, it is still a challenging task due to lack of appropriate detection mechanisms and photoactive materials. Bandgap-independent photothermoelectric (PTE) detectors derived from thermoelectric materials may serve as good candidates for such requirements because of their advantages of simple device geometry, uncooled and self-powered operation, and high integration level. In this talk, I will report a PTE detector based on the $EuBiSe_3$ single crystal, an alloy of rare-earth element Eu and conventional thermoelectric material Bi_2Se_3. Benefiting from the large Seebeck coefficient of $EuBiSe_3$, our device shows a nearly uniform photovoltage responsivity of as high as 1 V/W and a noise-equivalent power below 1 nW/√Hz from ultraviolet (375 nm) to terahertz (163 μm). The response time is nearly 2 orders of magnitude faster than silicon-based heterojunction ultrabroadband photodetectors. The $EuBiSe_3$ crystal has a natural needle-like shape, intrinsically facilitating integration of the detector. In addition, I will also present our study of using three-dimensional microporous graphene to further enhance the sensitivity of PTE detectors.

Biography

Yingxin Wang is an associated professor of Engineering Physics department in Tsinghua University. He obtained his B.S. and Ph.D degrees in Tsinghua in 2004 and 2009 respectively. His major research field is focused on terahertz photonics and optoelectronics, with particular interests in the theory, technology, and applications of terahertz detection, spectroscopy and imaging. He has published more than 60 papers, including Science Advances, Nano Letters, ACS Photonics (cover), etc.

- 13:30-14:00, August 8 -

All-dielectric subwavelength terahertz systems

Weili Zhang
Oklahoma State University, USA

Abstract

Composite materials comprised of subwavelength-sized resonators arranged in a periodic array may be designed to interact with the terahertz field of propagating or surface waves in ways not observed in natural materials. Recent advances in plasmonics and metamaterials have opened up a pathway toward integrated functional terahertz devices. Subwavelength systems made from thin metallic films, however, are subject to strong ohmic losses inherently decreasing the efficiency. We study all-dielectric subwavelength systems using the state-of-the-art terahertz time-domain spectroscopy and terahertz near-field spectroscopy in both fee space and near field with an ultimate goal of developing high-efficiency next-generation integrated devices and components functioning in the terahertz regime.

Biography

Weili Zhang joined the faculty of Tianjin University in 1992 and Oklahoma State University in 2002. He is currently professor of Electrical Engineering at Oklahoma State University and visiting professor of the Center for Terahertz Waves at Tianjin University. His research interests include terahertz optoelectronics, nano- and micro-structured materials optics, and ultrafast phenomena. He serves as Associate Editor of PhotoniX, Topical Editor of Chinese Optics Letters, and Editorial Board Member of a number of peer-reviewed journals. He is a Fellow of The Optical Society (OSA).

- 14:00-14:30, August 8 -

Recipe for efficient EO sampling of THz waves

Masahiko Tani
University of Fukui, Japan

Abstract

The authors have been working for efficient THz wave detection by electro-optic sampling and techniques as listed below.

i) Cherenkov Phase matching

A high EO coefficient does not mean an efficient EO sampling detection of THz waves if a good phase matching condition is not realized in the EO crystal. Non-collinear Cherenkov phase matching solves this problem and makes it possible to use crystals with a high EO coefficient but with a bad phasing matching condition, such as $LiNbO_3$.

ii) Focusing of THz waves by metallic parallel plate waveguide

EO signal can be enhanced by tightly focusing THz waves. By using a tapered parallel plate waveguide, THz waves can be tightly focused more than by using ordinary optics.

iii) Polarization filtering

In the ordinary $\pi/2$ phase biased EO sampling, the modulation depth in the probe beam intensity per THz electric field is fixed by the properties of the EO crystal and not adjustable. By using polarization filtering, the modulation depth in the probe beam intensity can be optimized depending on the available probe beam power. In this paper, these techniques are reviewed with experimental data and discuss the recipe for optimization of THz EO sampling detection system.

Biography

Masahiko Tani, Mr., Ph.D. in Engineering
Present Position:
Professor and Director of Research Center for Development of Far-Infrared Region, University of Fukui
President of Terahertz Technology Forum, Japan
Executive board member of the Spectroscopical Society of Japan
Educational background:
1987 Graduated from Kyoto University (Department of Physics Engineering)
1989 MD from Kyoto Univ. (Dept. PE)
1992 Ph.D. from Kyoto Univ. (Atomic and Molecular Physics and Spectroscopy)
Work Experience:
1992 Research Official with Kansai Advanced Research Center (KARC), Communications Research Laboratory, Japan
1997 Senior Research Official with Kansai Advanced Research Center, Communications Research Laboratory, Japan
2000 Associate Prof. with Research Center for Superconductor Photonics, Osaka University
2004 Associate Prof. with Institute of Laser Engineering, Osaka University
2008 Prof. with Research Center for Development of Far-Infrared Region, University of Fukui
2014-Present Director of Research Center for Development of Far-Infrared Region, University of Fukui

- 14:30-15:00, August 8 -

Structured silicon based spatial terahertz modulator

Qiye Wen
University of Electronic Science and Technology of China, China

Abstract

The real-world applications of terahertz (THz) technology necessitate versatile adaptive optical components, for example, the spatial THz modulators (STM), which allows fast THz imaging with a single detector. Recently, silicon based all-optical modulators attract a lot of attention due to their capability of fabricating STM with dense pixels and broadband operation.

In this talk, we firstly give a simple review of the recent progress of Si based STM, and then we introduced two kinds of performance-enhanced STM based on surface-structured silicon wafer. One STM is based on silicon nanotip array. This nanolayer can serve as an antireflective layer for both THz and optical light, and thus significantly decrease the insert loss of the device and increase the modulation depth to 75.8%. Another STM, however, is based on micro-textured silicon. This micro-textured surface also acts as an optical antireflection (AR) layer and reduces the reflection to about 10% from 400nm-1000nm. The enhanced light absorption effiency, together with the enlarged modulation area, endows this modulator with a modulation speed of 146.6kHz and a MD of 94.17% when illuminating by 638nm laser. By combining with high-speed digital micro-mirror device (DMD), a reconfigurable, cost-effective and power-efficient imaging system with a single-pixel detector has been demonstrated and fast THz imaging are well demonstrated.

Biography

Qi-Ye Wen is a professor in the School of Electronic Science and Engineering, University of Electronic Science and Technology of China. He was honored as a Changjiang sholar (youth project, 2016-2018). His research interests include terahertz imaging and communication and the related materials and devices. He has a particular interest in adapting micro- or nano- materials and metamaterial/metasurface for terahertz modulation, sensing and absorption. Published over 130 referred papers (two ESI 1% top-cited paper), international conferences and book chapters, 2 books, and 12 patents. His h-index is 20, and the total number of citations (web of Science) is above 2000 as of Dec. 2018.

- 08:30-09:00, August 9 -

Terahertz quantum cascade laser and its applications

Juncheng Cao
Shanghai Institute of Microsystem and Information Technology, CAS, China

Abstract
The terahertz (THz) quantum cascade laser (QCL), based on unipolar inter-subband transitions, has proven to be a promising radiation source for THz applications. Significant progress has been made over the last ten years. We have realized high power terahertz QCLs with a series of wavelengths, both working at pulsed mode and at continuous mode. Along with the remarkable development of THz QCLs, the wavelength of peak response of quantum-well infrared photodetectors has been extended into the THz region. The THz quantum-well photodetector (QWP) has been used as the THz detector for characterization of the emission spectrum of THz QCL. Terahertz QWP with one-dimensional reflection-grating coupler will also be presented, which has achieved peak responsivity 20% higher than that of the traditional 45-degree facet samples. The applications of these quantum devices to communication and imaging have been introduced. We demonstrate the transmission of real-time audio/video signal by using the THz QCL as a source in continuous wave mode and the THz QWP as a receiver.

Biography

J. C. Cao was born in Jiangxi, China, in 1967. He received the Ph.D. degree in electrical engineering from the Southeast University, Nanjing, China, in 1994. He is currently the professor of the Key Laboratory of Terahertz Solid-State Technology at Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, China. From 1999 to 2000, he was a Senior Visiting Scientist at the National Research Council, Ottawa, ON, Canada. His current research interests include THz semiconductor quantum devices and their applications in THz communication and imaging. Dr. Cao received the National Fund for Distinguished Young Scholars of China in 2004. He got the Excellent Teacher Award from Chinese Academy of Sciences twice in 2006 and in 2011.

- 09:00-09:30, August 9 -

Chiral broadband terahertz wave emission from the Weyl semimetals

Jingbo Qi
University of Electronic Science and Technology of China, China

Abstract
A crucial element of the ultrafast coherent control is the generation of light or electromagnetic wave pulses with tunable polarization in a broad spectral range. Here, we discover strong chiral broadband terahertz emission from the topological Weyl semimetals and demonstrate unprecedented manipulation over its polarization and chirality on femtosecond timescale. Such controllability is achieved via polarization-dependent, colossal ultrafast photocurrents generated using the circular and/or linear photogalvanic effect. Our finding opens a new route to realize chiral photon sources using quantum materials.

Biography

Jingbo Qi, a professor in the School of Electronic Science and Engineering, UESTC. He got his Ph.D. from Vanderbilt University. He was ever a postdoctoral associate in the National High Magnetic Field Laboratory (USA) and Los Alamos National Laboratory, respectively. His research interest focuses on using the ultrafast optical spectroscopy and terahertz spectroscopy to study the dynamics properties of various materials.

- 09:30-10:00, August 9 -

Spin order based THz wave generation and spectroscopy

Guohong Ma
Shanghai University, China

Abstract

The interaction between THz radiations with antiferromagnetic structure has been received special attention in recent year, due to the both academic concern as well as the potential applications in high dense data storage and fast reading and writing speed compared to the widely-used ferromagnetic structure. In this talk, I would like to introduce the latest research about the terahertz spintronics at ultrafast photonics Lab of Department of physics, Shanghai University. First of all, I would like to present our latest study on ultrafast THz emission based on the ferromagnetic structure. A new THz source, with compacted size, high efficient and broad band, is proposed. After that, I would like to give a brief introduction about the spin wave excitation, manipulation as well as the spin reorientation phase transition based on a canted antiferromagnetic structure probing with THz transient. Finally, I would like to touch on the strong coupling between the THz photon and magnon, and the formation of a hybrid excitation: magnon-poalriton in this kind of antiferromagnet.

Biography

Guo-Hong Ma obtained his Ph.D degree in Optics from Fudan University in 2001. He had been a research fellow in National University of Singapore during 2001-2005. He became a full professor at Shanghai University since 2005. Dr. Ma was awarded as "Pujiang Scholar" in 2006, and "Eastern Scholar" in 2008. Dr. Ma is the member of Optical Society of America (OSA) as well as the member of Singapore Materials Research (SMR). Prof. Ma's research interests cover ultrafast photonics, terahertz photonics and terahertz spintronics, he also pays attention on the control and optical manipulation of electronic spin in semiconductor and ordered magnetic system. Dr. Ma published more than 150 peer-reviewed papers, and he gave more than 40 oral presentations including 20 invited talks in international conferences.

- 11:00-11:30, August 9 -

Research on multifunctional and high performance sensor based on THz metamaterials

Xu Chen
Xi'an Institute of Optics and Precision Mechanics, CAS, China

Abstract

Due to the characteristics of spectral resolution, non-destructive and label-free features, terahertz (THz) sensing technology based on electromagnetic metamaterials has very important application prospects in the fields of material identification, qualitative/quantitative analysis and biomedical detection, becoming an interesting research topic. However, most of the THz metamaterials sensors are currently constructed of metal materials, and there are two major problems of ohmic loss and difficulty in active modulation, which greatly limits the performance of the sensors. In this talk, with the following three aspects of numerical research works, the multifunctional and high efficiency THz sensor can be realized. One hand, designing and studying the THz metamaterials structure with toroidal dipole resonance response dominated to achieve high quality factor, and combining this toroidal metamaterials structure with the microfluidic channel, a THz sensor with ultra-high sensing performance figure-of-merit can be designed to realize sensing of gases and liquids. The other hand, by using low-loss high-index dielectric materials instead of metals, designing and constructing THz metamaterials sensors to solve ohmic losses that metal materials cannot avoid, and improving sensing performance. At last, designing metamaterials sensors by using graphene instead of metal, the graphene's Fermi level can be changed by means of external bias voltage, thus realizing the active modulation of the sensor.

Biography

Dr. Xu Chen received his PhD degree from Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences (2018). He is currently an assistant researcher of the State Key Laboratory of Transient Optics and Photonics at Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China. He was awarded the National Postdoctoral Program for Innovative Talents of China in 2018. His main research interest focuses on terahertz functional devices based on metamaterials/metasurfaces. Relevant research works have been published on journal papers such as Carbon, Optics Letters, Scientific Reports, and so on.

- 11:30-12:00, August 9 -

High speed THz on-chip modulator with the active meta unit-cell

Yaxin Zhang
University of Electronic Science and Technology of China, China

Abstract

The past decades witnessed a substantial increase in THz research activities. Utilizing THz waves to transmit data for communication and imaging places high demands in phase and amplitude modulation. However, till now active THz devices including modulators and switches still cannot meet the demands of THz systems.

In this presentation, we present the high speed THz on-chip modulator by combing the microstrip line and active 2DEG meta unit-cell. The experimental results show that such modulator can reach to more than 10 Gbps modulation speed with 90% modulation depth. More important, this modulator can be integrated on chip for compact THz application systems.

Biography

Dr. Zhang Yaxin. Professor of School of Electronics Science and Engineering, University of Electronic Science and Technology of China. He received the B.Sc.degree from Sichuan University, Chengdu, China, in 2003, and the M.Sc. and Ph.D. degrees from the University of Electronic Science and Technology of China, Chengdu, in 2006 and 2009, respectively.

He is selected into the National youth talent support program and New century excellent talents in university of Ministry of Education of China. His main research interests include terahertz high-speed wireless communication technology, including new terahertz signal source for wireless communication and terahertz functional devices (terahertz modulator, resonator, filter, etc.). He has already published more than 60 SCI papers including Nano letters, Phys. Rev. Lett., Nanophotonics, ACS Photonics, Laser & Photonics Reviews and so on.

- 13:30-14:00, August 9 -

Continuous-wave terahertz computed tomography

Dayong Wang
Beijing Institute of Technology, China

Abstract

Due to the unqiue non-destructive propagation and imaging capabilities, terahertz (THz) radiation has been widely adopted for variety of applications in security, biomedical imaing, and industrial inspection. Various three-dimensional (3D) THz tomogrpahic imaging approaches have been proposed, among which THz computed tomography (CT) is

usually based on the state-of-the-art continuous-wave (CW) THz sources and geometrical optics that inspired from X-ray CT. In this presentation, the principals of projection data acqusition and 3D reconstruction algorithm would be introduced. THz illumination field manipulation approaches which have been successfully embeded into THz CT would be presented. Compared with traditional Gaussian illumination beam, the depth-of-view of THz CT system is expanded meanwhile the fidelity of reconstctrution is enhanced by using Bessel beam illumination. The application of CW THz CT for chicken ulna bone would also be introduced. In spite of lower spatial resolution compared with x-ray, THz imaging clearly discerns a compact bone from a spongy one.

Biography

Prof. Dr. Dayong Wang received his B.S. in 1989 from Huazhong University of Science and Technology, China, and Ph.D. in 1994 from Xi'an Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. From 1994 to 1996, he did his postdoctoral work in Xidian University, China. In 1996, he joined the Department of Applied Physics, Beijing University of Technology (BJUT). From 1998 to 2000, he worked at the Weizmann Institute of Science, Israel, as a visiting scientist. Since 2000, he has been a professor in the College of Applied Sciences, BJUT. In 2016, he worked in University of California, Los Angeles as a senior visiting scientisit. His research interests include optical information processing, optical storage, holography, terahertz imaging and microwave photonics. He is a member of the COS, SPIE and OSA.

- 14:00-14:30, August 9 -

Generation and characterization of terahertz special beams

Xinke Wang

Capital Normal University, China

Abstract

With the maturation of terahertz (THz) technology, current THz systems have possessed stronger inspection ability and broader application fields. To further exploit the application potentials of THz technology on fundamental research and industry, the development of THz special beams has received growing attention. Because THz special beams have unique field distribution and diffraction characteristics, these THz beams show significant application advantages in the fields of particle manipulation, optical imaging, and optical communications. In this paper, some recent investigation advances of our group on THz special beams are discussed, including THz Bessel beam, THz vortex beam, THz Airy beam, THz bottle beam, and so on. The field distributions, diffraction characteristics, and application prospects of these THz beams are systematically analyzed and compared. We believe that these works are valuable for the development of future THz technology.

Biography

Xinke Wang, associate professor, Capital Normal University. Xinke Wang received his doctor degree in optics from Harbin Institute of Technology in 2011. From 2009 to 2010, he worked in Rensselaer Polytechnic Institute as a visiting scholar. Since 2011, he always works in Capital Normal University. In 2013, he was appointed as associate professor in the department of physics. He mainly works on investigations about THz focal-plane imaging, THz meta-surface, THz special beams, and so on. He has received 4 funding projects, 3 patents, and published over 30 refereed journal papers, including Advanced Optical Materials, Optics Letters, Optics Express, Applied Physics Letters, Scientific Reports, and so on.

- 14:30-15:00, August 9 -

Terahertz read-only multi order nonvolatile rewritable photo-memory based on indium oxide nanoparticles

Bo Zhang
Capital Normal University, China

Abstract

We investigate terahertz (THz) read-only multi-order nonvolatile rewritable photo-memory based on indium oxide (In_2O_3) nanoparticles. Optical excitation of an In_2O_3/quartz sample increases its conductivity, which attenuates its THz transmission. When the optical excitation is terminated, the modulated THz transmission can recover back to its original value in air. However, the THz transmission shows no obvious change over a long-term when In_2O_3/quartz is encapsulated in an inert gas (nitrogen). Multi-order nonvolatile digital information storage is obtained under different light intensities, and the photo-memory can be rewritten after thermal annealing. Different THz transmissions are used as coded signal units, which are programmed to store information. These results show that THz read-only multi-level nonvolatile rewritable photo-memory can be realized.

Biography

Bo Zhang, associate professor, Capital Normal University. He received the B.S. degree from Capital Normal University (CNU), Beijing in 2007 and the Ph.D. degree from Beijing Jiaotong University (BJTU), Beijing in 2012, respectively. His research interests include terahertz spectroscopy, THz functional device. Relevant research has been published more than forty journal papers such as Appl. Phys. Lett., Opt. Lett., Opt. Express, etc.

Oral Talks

CIOP2019-2019-000185 (15:15-15:30, August 7)

A dual band and tunable terahertz perfect absorber with grating coupled graphene ribbon array

Fei Yan[1*], Qi Li[1], Li Li[2], Hao Tian[3]

1. National Key Laboratory of Science and Technology on Tunable Laser, Harbin Institute of Technology, China
2. College of Physics and Optoelectronic Engineering, Harbin Engineering University, China
3. School of Physics, Harbin Institute of Technology, China

Abstract: A dual-band tunable THz perfect absorber based on sub-wavelength grating coupled graphene ribbon array is proposed. The absorber exhibits a symmetrical linear absorption spectrum with ultra-high quality factor Q and strong field localization.

CIOP2019-2019-000145 (10:00-10:15, August 8)

Towards mJ-level ultrashort terahertz generated by optical rectification with a compact Terawatt laser

Jean-Gabriel Brisset, Magali Durand, Pierre Sevillano, Emilien Gontier, Antoine Courjaud[*]

Amplitude Laser Group, France

Abstract: We developed a compact diode-pumped Terawatt laser for generation of intense terahertz pulses by optical rectification in $LibO_3$. It delivers 250mJ at 50Hz with 480fs pulse duration, holding the potential to generate 1mJ-level Terahertz ultrashort.

CIOP2019-2019-000168 (10:15-10:30, August 8)

Metamaterial beam splitter design based on new coding scheme at terahertz frequencies

Xiaohua Xing, Yongchang Lu, Yanfeng Li[*], Jiaguang Han, Weili Zhang

Tianjin University, China

Abstract: In order to obtain higher degrees of freedom in beam splitting, 2-bit or higher-bit coding elements are usually introduced into metamaterial beam splitters based on the coding theory. In this paper, a new /offset/ coding design method using only the 1-bit coding elements of /0/ and /1/ is presented, which allows more beam splitting degrees of freedom to be obtained, thus providing new strategies for the design of beam splitters.

CIOP2019-2019-000253 (15:00-15:15, August 8)

Circularly polarized terahertz generation in spintronic terahertz emitters

Xinhou Chen[1], Fengwei Guo[1], Chun Wang[2], Tianxiao Nie[3], Xiaojun Wu[1*]

1. School of Electronic and Information Engineering, Beihang University, China
2. School of Physical Sciences, University of Chinese Academy of Sciences, China
3. Beihang-Goertek Joint Microelectronics Institute, Qingdao Research Institute, Beihang University, China

Abstract: We realize the generation of a circularly terahertz beam in cascaded spintronic terahertz emitters pumped by femtosecond laser pulses, and demonstrate that the terahertz chirality and ellipticity can be flexibly manipulated.

CIOP2019-2019-000407 (15:15-15:30, August 8)

Rapid and label-free detection of pathogenic bacteria by terahertz metamaterials

Ke Yang, Xiang Yang, Weiling Fu[*]

Department of Laboratory Medicine, Southwest Hospital, Third Military Medical University, China

Abstract: Terahertz metamaterials have the ability to detect the species of bacteria and evaluate their living states. It has the potential to be developed as a new method for rapid and accurate identification of pathogenic bacteria.

CIOP2019-2019-000263 (10:00-10:15, August 9)

Pump wavelength dependent terahertz emission in ferromagnetic metal/heavy metal heterostructures

Fengwei Guo[1], Xinhou Chen[1], Chun Wang[2], Tianxiao Nie[3], Xiaojun Wu[1*]

1. School of Electronic and Information Engineering, Beihang University, China
2. Institute of Physics, Chinese Academy of Sciences, China
3. Fert Beijing Institute, BDBC, and School of Microelectronics, Beihang University, China

Abstract: We systematically investigate the terahertz emission properties influenced by the pump central wavelength and sample thickness, and we find that for a fixed sample thickness, there exists an optimal pumping central wavelength.

CIOP2019-2019-000298 (10:15-10:30, August 9)

Research on terahertz image denoising using quadtree-based non-local means

Yue Wang[*], Qi Li

National Key Laboratory of Science and Technology on Tunable Laser, Harbin Institute of Technology, China

Abstract: In this paper, a quadtree-based non-local means image denoising method for terahertz images is used. The experimental results of THz image denoising show that the method can effectively remove the background noise caused by the imaging system, and has a good denoising effect on terahertz image.

CIOP2019-2019-000267 (15:00-15:15, August 9)

All-dielectric metasurface THz absorbers and sensor applications

Dongying Zhu[1,2], Yue Wang[1,2*], Zijian Cui[1,2], Lisha Yue[1]

1. Xi'an University of Technology, China
2. Harbin University of Science and Technology, China

Abstract: Three types all-dielectric metasurface THz absorbers using N-doped silicon are proposed which can achieve single band, dual-band and broadband absorption. Experiments have demonstrated that the proposed absorbers can act as a high sensitivity sensor.

CIOP2019-2019-000161 (15:15-15:30, August 9)

Resolving terahertz generation inhomogeneity in electro-optic bulk ZnTe crystal using laser terahertz emission microscope

Jiangpeng Dong[1], Kazunori Serita[2], Murakami Fumikazu[2], Iwao Kawayama[2], Masayoshi Tonouchi[2], Wanqi Jie[1], Yadong Xu[1*]

1. State Key Laboratory of Solidification Processing, Northwestern Polytechnical University, China
2. Institute of Laser Engineering, Osaka University, Japan

Abstract: Te inclusions are the dominated grown-in defects in ZnTe crystals. We evaluated the local area of ZnTe bulk crystal using laser terahertz emission microscope. These results not only afford comprehensive understanding of THz radiation from Te inclusion in ZnTe crystal, but also put forward LTEM as a noncontact method for characterizing the electric field distribution.

CIOP2019-2019-000289 (15:30-15:45, August 9)

Terahertz absorber based on graphene coating

Panpan Ren, Guanmao Zhang[*], Litao Qiao, Yaping Zhao, Zhihao Guo

School of Information Science and Engineering, Lanzhou University, China

Abstract: A terahertz absorber based on graphene is proposed. The monolayer graphene enhances the coherent superposition of incident and reflected light and results in a significant increase in the absorption of this proposed absorber.

SC11 Optical Imaging, Display and Storage

Invited Talks

- 13:30-14:00, August 7 -

Time reversal optical focusing for deep tissue imaging

Changhuei Yang
California Institute of Technology, USA

Abstract

We appear opaque because our tissues scatter light very strongly. Traditionally, optical imaging and the focusing of light in biological tissues is confounded by the extreme scattering nature of tissues. Interestingly, optical scattering is time-symmetric and we can exploit optical phase conjugation methods to reverse scattering effects. Over the past decade, my team has worked on wavefront control technologies to meaningfully focus light through living tissues for imaging and optogenetic stimulation purposes. I will report on our recent experimental findings. In addition, I will also talk about how the interplay between scattering and wavefront control is rich and tangled, with surprising optical opportunities waiting to be uncovered. For example, the incorporation of scattering within an optical system can actually improve system performance – a cloudy piece of plastic can actually be a better optical element than a well made lens!

Biography

Education PhD, EECS, MIT, 2002 BSc, Mathematics, MIT, 2002 MEng, EECS, MIT, 1997 BSc, Physics, MIT, 1997 BSc, EECS, MIT, 1997 Field of Study Professor Yang's research efforts are in the areas of novel microscopy development and time-reversal based optical focusing. Prof. Yang joined the California Institute of Technology in 2003. He is a professor in the areas of Electrical Engineering, Bioengineering and Medical Engineering. He has received the NSF Career Award, the Coulter Foundation Early Career Phase I and II Awards, and the NIH Director's New Innovator Award. In 2008 he was named one of Discover Magazine's 20 Best Brains Under 40'. He is a Coulter Fellow, an AIMBE Fellow and an OSA Fellow. His research efforts can be categorized into two major groups – high throughput microscopy development and time-reversal based optical focusing.

- 14:00-14:30, August 7 -

Computational imaging for 3D microscopy and tissue imaging

Guillem Carles
University of Glasgow, UK

Abstract

Microscopy is used to image in 3D, but is two-dimensional in its roots: the job of the instrument is to focus light from the sample onto a (flat) camera plane, and the depth-of-field for high-resolution microscopy is less than a micrometer, so thick samples simply cannot be imaged in one snapshot. Z-stacking or other techniques such as light-sheet-, confocal-, multiphoton-, and single-molecule-localisation microscopy, record 3D information, but are based on time-scanning and therefore fundamentally incapable of snapshot or video-rate imaging, required to image transients or moving samples. Further, a major obstacle to in-tissue imaging is light scattering. Advanced microscopy techniques aim at suppressing its effects to extract useful sample information. The talk will discuss Computational Imaging techniques to provide high-resolution, time-resolved, depth-extended and three-dimensional microscopy. By definition, extending

the depth-of-field voids any optical sectioning capability, and so image recovery assumes samples are sparse in their volume, such as membrane-like surfaces in biological samples or 3D profiling in industrial inspection. Further sparsity is found on imaging point-like sources, such as in particle tracking or single-molecule-localisation microscopy. Application of extended-range 3D microscopy into these areas will be discussed, to enable 3D particle tracking over large volumes and super-resolution microscopy through thick samples. The talk will further discuss how light scattering affects images, looking at retinal tissue as an example, where controlling scattered light enables to extract information; and how simulation tools such as Monte-Carlo modelling of optical systems involving turbid media enable optimisation of computational imaging solutions for in-tissue imaging.

Biography

Dr. Guillem Carles obtained a BSc and MSc in Physics at the University of Barcelona, MSc in Computer Vision and Artificial Intelligence at the University Autonomous of Barcelona, and PhD in Physics on Computational Imaging at University of Barcelona in 2011. He moved to University of Glasgow in 2012 and conducted research in various aspects in Computational Imaging. His research includes multi-camera super-resolution imaging in the visible and infrared, foveated multi-aperture optics, computational imaging for retinal screening, Monte-Carlo modelling of light propagation in turbid media, computational imaging for extended-range 3D microscopy, and 3D particle tracking and super-resolution microscopy. He is currently a Leverhulme Trust Early Career fellow.

- 14:30-15:00, August 7 -

Compressed ultrafast photography: imaging light-speed events in a snapshot

Jinyang Liang

Institut National de la Recherche Scientifique (INRS), Canada

Abstract

Direct imaging of transient events can greatly aid the understanding of many underlying principles in materials science, chemistry, and biology. These events, often probabilistic and occurring at sub-nanosecond time scales, require real-time imaging at ultra-high temporal resolutions. However, established ultrafast imaging methods fall short due to their requirement for repetitive measurements. To overcome these limitations, we have developed compressed ultrafast photography (CUP)—the world's fastest imaging technology with an imaging speed of up to 10 trillion frames per second [Light Science & Applications 7 42 (2018)]. CUP has made first-ever real-time recording of a number of optical phenomena, including faster-than-light propagation of non-information, laser-pumped fluorescence emission [Nature 516 74-77 (2014)], time-resolved light backscattering [Scientific Reports 5 15504 (2015)], and propagating photonic Mach cones [Science Advances 3 e1601814 (2017)]. Recently, the concept of CUP has been implemented in transmission electron microscopy [Micron 117 47 (2019)] and standard CMOS cameras [Optics Letters 44 1387 (2019)]. Given CUP's passive, ultrafast, and real-time imaging capability, we envision it to facilitate widespread applications in both fundamental and applied sciences.

Biography

Dr. Jinyang Liang is currently an Assistant Professor at the Institut National de la Recherche Scientifique (INRS) - Université du Québec. His research interests cover a broad range of areas, including ultrafast imaging, photoacoustic microscopy, wavefront engineering, and high-precision laser beam shaping. His research primarily focuses on implementing optical modulation techniques to develop new optical instruments for applications in physics and biology. He has published over 50 journal papers and conference proceedings, including Nature (cover story), Science Advances, and Light: Science & Applications. He holds two U.S. patents on ultrafast optical imaging technology. He received his B.E. degree in Optoelectronic Engineering from Beijing Institute of Technology in 2007, and his M.S. and Ph.D. degrees in Electrical Engineering from the University of Texas at Austin, in 2009 and 2012. From 2012 to 2017, he was a postdoctoral trainee in Washington University in St. Louis and California Institute of Technology.

- 16:00-16:30, August 7 -

Ultrafast 3-D nanofabrication based on digital holography

Shih-Chi Chen
The Chinese University of Hong Kong, Hong Kong, China

Abstract

In this seminar, I will present a revolutionary laser nanofabrication process based on two-photon polymerization (TPP) and an ultrafast random-access digital micromirror device (DMD) scanner. By exploiting binary holography, the DMD scanner can simultaneously generate and control one to tens of foci from a femtosecond laser for parallel nanofabrication; the trajectory of each laser focus can be arbitrarily planned and updated at the DMD pattern rate, i.e., 22.7 kHz. As the control of focus position and laser dosage is entirely discretized, the multi-point DMD scanner can fabricate micro-/nano-structures with substantially improved throughput, grayscale control, precision, and repeatability. Single- and multi-focus laser scanning experiments will be performed to fabricate complex 3-D trusses and woodpile structures, showing a resolution of ~500 nm. The nanofabrication system may be used for largescale nano-prototyping or creation of complex structures, e.g., overhanging structures, that cannot be easily fabricated via conventional raster-scanning-based systems, bringing significant impact to the world of nanomanufacturing.

Biography

Prof. Shih-Chi Chen received his B.S. degree in Mechanical Engineering from the National Tsing Hua University, Taiwan, in 1999. He received his S.M. and Ph.D. degrees in Mechanical Engineering from the Massachusetts Institute of Technology, Cambridge, in 2003 and 2007, respectively. Following his graduate work, he entered a post-doctoral fellowship in the Wellman Center for Photomedicine, Harvard Medical School, where his research focused on biomedical optics and endomicroscopy. From 2009 to 2011, he was a Senior Scientist at Nano Terra, Inc., a start-up company founded by Prof. George Whitesides at Harvard University, to develop precision instruments for novel nanofabrication processes. Joining since 2011, he is presently an Associate Professor in the Department of Mechanical and Automation Engineering at the Chinese University of Hong Kong. His current research interests include ultrafast laser applications, biomedical optics, precision engineering, and nanomanufacturing. Prof. Chen is a member of the American Society for Precision Engineering (ASPE), American Society of Mechanical Engineers (ASME), SPIE, The Optical Society (OSA), and Institute of Electrical and Electronics Engineers (IEEE). He received the prestigious R&D 100 Award in 2003 and 2018 for developing a six-axis nanopositioner and an ultrafast nanoscale 3-D printer respectively. In 2013, he received the Early Career Award from University Grants Committee of Hong Kong.

- 16:30-17:00, August 7 -

Configuring superfluid Bose-Einstein condensates with sculptured light

Tyler Neely
University of Queensland, Australia

Abstract

Ultracold atomic Bose-Einstein condensates (BECs) are one of the most isolated and controllable systems for the investigation of diverse quantum superfluid phenomena. These features are provided by the BEC's isolation inside an ultrahigh vacuum chamber, along with externally defined and controlled trapping potentials. Optical dipole traps provide the best means for trapping and microscopically patterning and manipulating these superfluid systems within the vacuum chamber. In my talk, I will describe our approach that uses direct imaging of a digital micromirror array (DMD) for the production of arbitrary and dynamic optical traps for BECs. These traps allow for the generation of configurable and homogenous BECs, and enable new types of nonequilibrium superfluid experiments in quasi-

2D. In addition to the hard-walled potentials produced by the binary DMD device, I will describe our approach of using halftone DMD patterns for achieving smooth optical potentials. Our method utilises image-recognition and normalisation of the measured BEC density, for comparison with a target image. Using this data, we implement feedforward correction of the optical trap. In the second part of my talk, I will describe how these techniques have enabled diverse studies of quantum turbulence and other superfluid phenomena in our laboratory, including the first observations of high-energy vortex clusters in a quantum fluid.

Biography

Dr Tyler Neely joined the ARC Centre of Excellence for Engineered Quantum Systems at the University of Queensland (UQ) in 2012. He began construction on a new BEC apparatus aimed at novel optical trapping for BECs, with the aim of studying superfluid phenomena and superfluid transport. Prior to UQ, he completed a postdoc at the National Institute of Standards and Technology (NIST) in Boulder, CO, USA, where he developed mid-infrared femtosecond lasers for molecular spectroscopy. He obtained his PhD in Optical Sciences at the University of Arizona in 2010.

- 08:30-09:00, August 8 -

Super-resolution: better, deeper, and richer information

Peng Xi

Peking University, China

Abstract

The 2014 Nobel Prize in Chemistry is an award to praise the development of super-resolution microscopy, which has pushed the fluorescence microscopy to a new summit. However, there still exist challenges for further application of super-resolution: (1) Better spatial resolution is always preferred especially at no additional cost; (2) Deeper imaging depth inside the scattering specimen; and (3) Richer biological information. I will introduce three technologies we developed recently for these aims. Firstly, with mirror-enhanced super-resolution, we are able to convert a STED system to a STED-4Pi, with ~4x STED intensity and ~2-fold of resolution, with the same STED power (MEANS-STED). Secondly, benefitted from the rich choice of energy levels of up conversion nanoparticles, we have achieved 28 nm resolution with intermediate state STED, with only 30mW CW laser power. Further, by modulating the STED beam as Bessel beam while maintaining the excitation beam as Gaussian, we have achieved 155 um deep STED imaging (GB-STED). Thirdly, we have also achieved a new super-resolution technique through the demodulation of fluorescent dipole orientation (SDOM). The dipole orientation describes the underlying structures it attaches to. A series of biological structures can be revealed by SDOM, but not conventional polarization microscopy.

Biography

Dr. Peng Xi is an associate professor in College of Engineering, Peking University, China. His current research interests are focused on research and development of optical super-resolution microscopy techniques. He has published over 60 scientific papers in peer-reviewed journals including Nature, and holds 10 issued invention patents, including 3 US patents. He is elected as a senior member of OSA since 2015. He has been awarded the Beijing Distinguished Young Scholar by Beijing Natural Science Foundation in 2018. He is on the editorial board of 5 SCI-indexed journals: Light: Science and Applications, Advanced Photonics, Scientific Reports, Microscopy Research and Techniques, and Micron. His research is sponsored by the National Science Foundation of China, and Ministry of Science and Technology in China. He has been invited to give many invited talks in international conferences hosted by OSA and SPIE.

- 09:00-09:30, August 8 -

Metalens-based integrated imaging

Tao Li
Nanjing University, China

Abstract

Recently, metasurfaces arrested considerable research interest owing to its strong capability in manipulate the light within an ultrathin flat device, which possibly promises tremendous applications in state-of-art optical instruments and technology. Although there have been a lot of advantages based on such subwavelength design, metasurfaces still suffer from several important flaws compared with conventional optical elements, e.g., the working efficiency, working bandwidth, chromatic aberration, and so on. Among these, the uniqueness and necessity of the ultrathin flat platform of metasurface are always questioned if it only works together with other optical elements in a conventional scheme. Here, I would first introduce our recent progresses in chromatic dispersion engineering in metalens, which were developed for achromatic focusing and imaging, depth-of-field (DOF) imaging by metalens array, and spectra-tuned chromatic metalens. Moreover, aiming to achieve the integrated imaging function, we are approaching for a direct integration of the ultrathin metalens and lens array to a camera, where the imaging aberration, chromaticity, image merging, field of view (FOV), and resolution will be discussed. We expect our efforts and approaches will be helpful to develop real unique and applicable meta-photonic devices.

Biography

Lao LI, received his PhD degree in Physics in NJU, 2005. He joined CEAS of NJU in 2008, and was promoted to full professor in Dec. 2013. He was selected to “Dengfeng Talent Program B” of NJU in 2012, and won the “National Funds for Outstanding Young Scientists” and “K.C. Wong Education Foundation” in 2013, award “Person of Year 2017” by Scientific Chinese and “Young and middle-aged leading scientists, engineers and innovators” by MOST in 2018. He is specialized in research of micro-nano photonics, plasmonics, and metamaterials. Up to date, he has published more than 80 peer-reviewed journal papers (including Nature Nanotech., Nature Comm., Phys. Rev. Lett., Nano Lett., Light Sci. Appl., Laser Photon. Rev., etc), which received more than 2500 citations with a current H-index of 28 (Web of Science).

- 09:30-10:00, August 8 -

Spatial-spectral volume holographic bioimaging

Yuan Luo
National Taiwan University, Taiwan, China

Abstract

The biggest challenge on the path towards bio-imaging is obtaining spatial and spectral information of a volumetric sample in real-time. Advances in this field are of vital importance for biology, material sciences, and medical applications. For example, cancer is one of the leading causes of death in the world, thus gaining a mechanistic understanding of cancer cell processes will significantly impact therapies targeting cancer metastasis pathways. Revealing the entire process with its surrounding environment will require real-time HD imaging systems that will open the way for better understanding of cancer onset and tissue morphology. This talk will introduce real-time 3D volume holographic imaging systems, which are based on multiplexed volume holographic gratings acting as spatial-spectral filters used in conventional optical imaging systems. This allows the acquisition of spatial images with spectral selectivity but without scanning in both transverse and longitudinal directions. In addition, with proper multiplexed holographic pupil engineering, the volume holographic imaging systems can provide multiple depth-resolved phase-

contrast imaging in real time and quantitative phase imaging in a single shot. Furthermore, the talk will address volume holographic techniques incorporating other state-of-the-art methods to better manipulate light for imaging as well as illumination.

Biography

Yuan Luo received the MSc and PhD degrees in College of Optical Sciences in 2007 and 2008, respectively, from the University of Arizona. After post-doctoral work at Massachusetts Institute of Technology (MIT, 2009-2011), he joined the faculty at National Taiwan University (NTU) in 2011, where he is now Associate Professor of Institute of Medical Device and Imaging, and holds the Associate Professorship in NTU Molecular Imaging Center, as well as NTU YoungLin Institute of Health. He has worked or held visiting appointments at the Singapore-MIT Alliance for Research and Technology (SMART) Centre in Singapore. His research interests are three-dimensional (3D) and spectral imaging; shift-invariant optics theory and implementation with 3D active structured light. He is member of the Optical Society of America (OSA), and International Society for Optical Engineering (SPIE).

- 11:00-11:30, August 8 -

FACED: High-speed, multi-contrast and multi-dimensional microscopy with infinity mirrors

Kevin Tsia
The University of Hong Kong, Hong Kong, China

Abstract

Driven by the challenges in biological and clinical research to visualize living cells and organisms at different imaging scale in both time (from sub-millisecond dynamics to hours-to-days evolution) and space (from single-cell to whole organism level), we recently developed a new type of high-speed all-optical laser-scanning technique, called free-space angular-chirp-enhanced delay (FACED). This technique allows us to transform the static laser beam into an ultrafast line-scanning beam using an almost-parallel mirror pair, resembling the concept of “infinity mirror”. We have employed FACED imaging to enable ultrahigh throughput microfluidic single-cell imaging with multiple image contrasts, ranging from quantitative phase and fluorescence, and multi-photon contrasts (e.g. two-photon fluorescence, second harmonic generation) at a line-scan rate beyond 10’s MHz (i.e. an imaging throughput up to ~100,000 cells/sec). This empowers new generation of deep image-based single-cell analysis. Using an ultrafast two-photon fluorescence microscope enabled by FACED, we also demonstrate neural activity imaging in vivo at 1,000 frames per second and submicron spatial resolution. This ultrafast imaging method enabled monitoring of electrical activity down to 300 μm below the brain surface in head fixed awake mice. Furthermore, using the concept of FACED combined with multiplexed plane-wide encoding, we demonstrate a new type of scanless volumetric imaging technique that exploits a parallelized 3D light-sheet fluorescence imaging strategy. It bypasses the widely adopted coherent multi-light-sheet generation concept and its complication in precise phase control and mechanical scanning/dithering for volumetric imaging. Not only can such this 3D imaging technique maximize spatial duty-cycle and signal-to-noise ratio, but also can outperform the majority of the scanning-based 3D imaging modalities in further reduction in photobleaching. This would be well-suited for long-term dynamical volumetric live cellular, tissue, and organism imaging, as well as high-throughput volumetric

Biography

Kevin Tsia received his Ph.D. degree at the Electrical Engineering Department, at University of California, Los Angeles (UCLA), in 2009. He is currently an Associate Professor in the Department of Electrical and Electronic Engineering, and the Program Director of the Biomedical Engineering Program, at the University of Hong Kong. His research interest covers a broad range of subject matters, including ultra-fast optical imaging for imaging flow cytometry and cell-based assay; high-speed in-vivo brain imaging; computational approaches for single-cell analysis. His pervious researches, such as the World’s fastest optical imaging system, have attracted worldwide press coverage and featured in many science and technology review magazines such as MIT Technology Review, EE Times and Science News. He received Early Career Award 2012-2013 by the Research Grants Council (RGC) in Hong Kong. He also received the Outstanding Young Research Award 2015 at HKU as well as 14th Chinese Science and Technology Award for Young Scientists in 2016. His recent research on ultrafast optofluidic imaging technologies, dubbed "ATOM" and "FACED", have also been covered by media and scientific magazines. He is author or coauthor of over 160 journal publications, conference papers and book chapters. He holds 3 granted and 4 pending US patents on ultrafast optical imaging technologies. He is a co-founder of start-up company commercializing the high-speed microscopy technology for clinical diagnostic applications.

- 11:30-12:00, August 8 -

Multi-modality imaging and spectroscopy platform for biology

Peng Gao

Xidian University, China

Abstract

With the progress of biomedical studies, people desire for utilizing different approaches to investigate a biological system, providing multi-dimensional information on a sample. Aiming to this, we integrate phase and fluorescence imaging modalities, as well as fluorescence correlation spectroscopy (FCS), in a confocal laser scanning microscopy (CLSM) system. To perform phase imaging, the depth of field (DOF) of the CLSM system was extended by using a tunable acoustic gradient index of refraction (TAG) lens. A few intensity images of a sample at different defocusing distances were recorded under transmitted illumination, and a quantitative phase image was reconstructed from these intensity images. For the fluorescence imaging, the sample was scanned in 3D, providing a 3D, sectioned fluorescence image of targeted structures. The obtained phase/fluorescence images with pixel-to-pixel correspondence reveal for the same sample complementary information (structural/functional). Moreover, FCS was performed on the same sample to screen the dynamics of fluorescently labeled biomolecules. It was realized by recording intensity traces when the fluorescently labeled biomolecules diffuse through the focus volume of the CLSM system. The auto/cross-correlations of the intensity traces reveal the concentration, hydrodynamic radius, fluorescence kinetics of the investigated molecules, and their interactions. The multimodality imaging/spectroscopy platform was tested on live HeLa cells, of which the membranes were coated with fluorescent cell masks. The combination of the phase/fluorescence imaging enables standalone determination of the refractive index of live cells; the results from FCS characterizes the fluidity of the membranes. The obtained multi-dimensional information is potentially useful in disease diagnosis.

Biography

Peng Gao, Ph. D, Professor at Xidian University. He studied Physics and received his Ph.D at the Xi'an Institute of Optics and Precision Mechanics (XIOPM) in 2011. He was a "Humboldt Fellow" in University Stuttgart (2012-2014) and later Marie-Curie Fellow (IEF) in KIT/University Manchester. He is currently appointed as a full professor at Xidian University and leads a biological imaging and spectroscopy group there, funded by the "Ten-thousand talents program". The main research lines include but not limited to: (a) phase microscopy in term of digital holographic microscopy (DHM) and reference-less phase retrieval; (b) Super-resolution microscopy and correlation spectroscopy. He had authored around 50 peer-review papers, including Nature Photonics, Advance of Optics and Photonics, and Optics Letters. Some of their works were highlighted by "Nature Methods", "IOP selection", "Spotlight on Optics", and international media such as Science Daily, Physics News, Advance of Engineering.

- 13:30-14:00, August 8 -

Fast fringe projection profilometry with a special gray-code

Kemao Qian
Nanyang Technological University, Singapore

Abstract
Fringe projection prolilometry is important for 3D shape measurement (3D imaging). In this paper, we introduce an interesting special gray-code to reduce the number of fringe patterns to be projected and thus achieve higher-speed data acquisition. First, through a weighted optimization algorithm, special binary code patterns are designed. These patterns will be projected and defocused into special ternary or quaternary gray codes, which are more expressive for information coding. Second, these codes will be expectedly distorted due to the object shape, but also undesirably distorted due to the imperfect experimental condition such as non-uniform object surface property and ambient light. A normalization-denoising-clustering process is then used to recover the ideal gray codes for successful phase unwrapping. Finally, continuity/geometry constraints are integrated with this phase unwrapping method to further reduce the number of required patterns. As a result, a high-quality 3D shape can be reconstructed by only five binary patterns effectively and efficiently.

Biography
Dr Qian Kemao is an Associate Professor in the School of Computer Science and Engineering (SCSE) at Nanyang Technological University (NTU). He graduated from University of Science and Technology of China (USTC), where he got his BE, ME and PhD degrees. His research interests include optical metrology, image processing, parallel computing, and computer vision.

- 14:00-14:30, August 8 -

Time-stretch imaging: advances and trends in biomedical applications

Cheng Lei
Wuhan University, China

Abstract
Recently, imaging flow cytometry has been proven advantageous over conventional non-imaging methods in terms of information content for its capability of providing single-cell images, from which, multidimensional biomedical information can be extracted via digital image processing. Those phenotypic variations observed from the cellular images are found to be connected with cellular action mechanisms, which can be used in various field, such as hematology, pharmacology and immunology. However, the throughput of currently available imaging flow cytometry is severely limited to about 1,000 cells/s by the performance of the imaging techniques applied, namely, the shutter speed and frame rate of CCD or CMOS imaging sensors, which hinders its application in large-scale single-cell analysis. Time-stretch imaging breaks through the speed limitation of CCD and CMOS sensors by applying optical shutter and single-pixel detection. When combined with microfluidic technique, time-stretch imaging is able to achieve high-quality and high-speed image acquisition with a spatial resolution of 780 μm and throughput exceeding 1,000,000 cells/s, respectively, which means similar image quality but 2-3 orders of magnitude higher throughput compared with conventional imaging flow cytometry. In addition, by virtue of machine learning technique, numerous subtle cellular features can be extracted from single-cell images and then accurately analyzed to evaluate cellular action mechanisms. Here we present recent advances and trends of time-stretch imaging in the applications of biomedical research and treatment, such as drug responses detection of cancer cell and evaluation of thrombotic disorders.

Biography

Cheng Lei is a Professor in The Institute of Technological Sciences, Wuhan University. He obtained his B.E. degree from Huazhong University of Science and Technology in 2008 and his Ph.D. from Tsinghua University in 2013, both in electronic engineering. In 2018, he joined Wuhan University as a professor. His research interests include ultrafast optical imaging, imaging flow cytometry, artificial intelligence, fiber optics, etc.

- 14:30-15:00, August 8 -

High performance meta-holograms based on geometric phase in visible light

Guoxing Zheng
Wuhan University, China

Abstract

Geometric metasurface (GEMS) that consists of an array of metal or dielectric nanobricks with spatially varying orientations, has shown continuous and accurate phase control of light with limited losses, representing a new model for the design of high performance optical elements and devices such as holograms. In this presentation, we show the design and experiments of various meta-holograms developed in our group, including metal-insulator-metal (MIM) based hologram with efficiency as high as 80% and broadband response (600-1100 nm), dielectric Fourier and image holograms with aspect ratio as low as 1.5, and transflective meta-holograms which can generate holographic image filling the full 4π Space. Taking the advantages of ultracompactness, continuous phase modulation, flexible design and ease of fabrication, GEMS based holograms could be utilized for various applications including anticounterfeiting, optical information encryption and decryption, compact display and optical storage, etc.

Biography

Guoxing Zheng is a professor at the Electronic Information School, Wuhan University. He received his Ph. D from the Institute of Optics and Electronics, Chinese Academy of Sciences in 2005. From 2014 to 2015, he was a visiting scholar at the University of Birmingham, UK. Dr Zheng's current research focuses on metamaterials (metasurfaces) and their applications in scientific research and industry. He has published over 30 inventive patents and more than 50 research papers in optical related fields including Nature Nanotechnology, Nature Communications, Science Advances, Light: Science & Applications, ACS Nano, Scientific Reports, Optics Letters, and Optics Express, etc. Dr Zheng has undertaken more than 10 research projects including 4 funds from NSFC and one Hubei Provincial Funds for Distinguished Young Scientists. Currently, he is an executive member of the Hubei Optical Society, editorial committee member of Journal of Applied Optics (in Chinese) and senior member of the Chinese Optical Society, etc.

- 08:30-09:00, August 9 -

Metasurfaces: towards high performance depth sensing

Yuanmu Yang
Tsinghua University, China

Abstract

Metasurfaces can provide great flexibility to shape the wavefront of light with a spatial resolution at the sub-wavelength level, which opens up new avenues for many applications including, but not limited to, imaging, display, and holography. One application we are particularly interested in is depth sensing. Sensing 3D (depth) information can enable facial and object recognition, and can be of vital importance in augmented reality, robotics, autonomous driving, and a wide range of other applications. Metasurfaces can play unique roles in both types of mainstream depth

sensing approaches, namely structured light, and time-of-flight. In this talk, I will share our preliminary results on how metasurfaces can be used to generate structured light pattern with extremely high efficiency, high uniformity, and large field of view. I will also discuss the opportunities and challenges of using metasurfaces for electro-optical beam steering, towards the realization of integrated 3D sensing, imaging, and display systems.

Biography

Yuanmu Yang (杨原牧) is an Associate Professor at the Department of Precision Instrument, Tsinghua University. He received his PhD degree in Interdisciplinary Materials Science from Vanderbilt University in 2015. From 2015 to 2017, he was a postdoctoral appointee at Sandia National Laboratories. From 2017 to 2018, he was a metamaterials scientist at Intellectual Ventures, and participated in the foundation of Lumotive Inc., the world's first solid-state lidar company based on the metasurface technology. He has co-authored more than 15 scientific contributions published in peer-reviewed journals including Nature Photonics, Nature Physics, Nature Communications, and Nano Letters, receiving over 2000 citations. His research interests include nanophotonics, metamaterials, and nonlinear optics.

- 09:00-09:30, August 9 -

Adaptive optics methods in a 4pi single molecule switching microscope

Jingyu Wang

University of Oxford, UK

Abstract

An adaptive optics (AO) assisted 4Pi single molecule switching (SMS) microscope for ultra-high spatial resolution single molecule imaging will be present. Super-resolution microscopes provide nanometer spatial resolution for cell biological studies; however, the axial resolution of standard SMS microscopes is inferior to the transverse resolution. By using two opposing objective lenses for coherent detection of fluorescent emission, a SMS microscope in 4Pi configuration enables ultra-high axial resolution with an improved signal collection efficiency. Due to the nature of 4Pi imaging, even a moderate sample thickness will inevitably introduce aberrations that affect the focusing performance of the system. More importantly, the aberrations experienced by the two arms of the 4Pi cavity are different and will vary differently as the imaging position moves axially. For these reasons, the axial resolution and imaging efficiency deteriorate quickly with depth in thick samples. This limits the axial imaging range and makes imaging large cells with uncompromised resolution impossible without compensating the depth dependent aberrations. The nature of aberrations in a 4Pi cavity has been described and the effect on the system performance was studied. Based on this knowledge, we demonstrate aberration correction methods using a novel sensorless AO approach. Two deformable mirrors (DM) are employed in the microscope, one for each objective. A compact interferometer is devised for accurate DM calibration and control, and we estimate the aberrations base on imaging metrics. The AO 4Pi SMS microscope is tested in imaging whole biological cells, and it allow a significant larger axial imaging range.

Biography

Jingyu Wang, from a Biomedical engineering background, obtained his PhD From Prof. Adrian Podoleanu's group, University of Kent, working on parallel detection Optical coherence tomography. After that, he switched to the fields of microscopy methods. He built a six-color single molecule fluorescence microscope for DNA repair study in Dr. Neil Kad's group, in University of Kent. Jingyu joined Prof. Martin Booth's Dynamic Optics and Photonics group in University Oxford in 2017 as a Post-doctoral Research Scientist. He has been working on applying adaptive optics methods on various microscopes, including 2-photon microscope, Third-Harmonic microscope, light sheet microscope and single molecule localization super-resolution microscope. He recently works on developing a novel adaptive optics method on a 4Pi single molecule switching microscope, with collaboration with Joerg Bewersdorf's group (Yale, U.S.), Jonas Ries group (EMBL, Germany) and St Johnston's Group, Cambridge (U.K.).

- 09:30-10:00, August 9 -

Towards smarter and faster quantitative phase microscopy

Renjie Zhou
The Chinese University of Hong Kong, Hong Kong, China

Abstract

Quantitative phase microscopy (QPM) is a label-free imaging technique that has been widely applied to biological imaging and material metrology. Our lab has recently empowered QPM with artificial intelligence (AI) and ultra-high 3D imaging capability to address cutting-edge applications. In the first development, we have integrated artificial neural networks into a QPM system for human white blood cell (WBC) classification. Our QPM can automatically classify healthy human WBC subtypes with 90% accuracy, similarly or better than current standard methods. In the second development, we have implemented high speed digital micro-mirror devices (DMDs) and a high-speed image sensor for achieving phase imaging at 10,000 fps. This system has been further advanced to achieve 3D phase imaging of transparent structures with ~200 nm lateral resolution and ~ 400 nm axial resolution at 100 fps speed. We will present our current progresses on using such high-speed system for biomedical imaging and material metrology applications.

Biography

Dr. Renjie Zhou is an Assistant Professor in the Department of Biomedical Engineering at The Chinese University of Hong Kong. He directs the Laser Metrology and Biomedicine Laboratory. Dr. Zhou received his doctoral degree in Electrical and Computer Engineering from the University of Illinois at Urbana-Champaign in 2014 and took a postdoc training at the George R. Harrison Spectroscopy Lab at MIT. His current research interest is in developing optical based technologies for material metrology and biomedical imaging applications. He has co-authored > 50 journal and conference papers.

- 11:00-11:30, August 9 -

Optical focusing through and inside scattering media

Yuecheng Shen
Sun Yat-Sen University, China

Abstract

Focusing light through and within scattering media is critically important in many applications, such as high-resolution optical imaging, photodynamic therapy, and optical manipulation. However, in scattering media such as biological tissue, light gradually loses the memory of its initial propagation direction, which makes it difficult to create a focus beyond the optical diffusion limit (~1 mm deep). To break this limit, wavefront shaping has been developed with the capability of focusing light through and inside scattering media. Based on the time-reversal principle, this technique first measures the scattered wavefront through holography, and then compensates the wavefront distortion using a spatial light modulator. In this talk, I will present some of the most recently achieved results, including extending the limit of focusing depth by more than an order of magnitude and implementing a new high speed wavefront shaping scheme. These works show the promise of time-reversal based wavefront shaping techniques to revolutionize biomedicine with deep-tissue noninvasive optical imaging, manipulation, and therapy.

Biography

Dr. Yuecheng Shen received his BSc in applied physics from the University of Science and Technology of China (2010) and his Ph.D. in electrical engineering from Washington University in St. Louis (2015). He then did his postdoc research under the tutelage of Dr. Lihong V. Wang at California Institute of Technology. He is now an associate professor in the school of electronics and information technology at Sun Yat-sen University. Dr. Shen's research interests focus on developing wavefront shaping technologies, which overcome optical scattering effects and enable deep tissue noninvasive optical imaging, optogenetics, optical tweezing, and phototherapy. He has published more than 30 articles in peer-reviewed journals (including physical Review Letter and Optica) and has 10 U.S. patents/provisional patents.

- 11:30-12:00, August 9 -

Image-activated cell sorting and beyond

Keisuke Goda
University of Tokyo, Japan

Abstract

I introduce a newly developed technology known as "Image-Activated Cell Sorting" [Cell 175, 266 (2018)] that realizes real-time image-based intelligent cell sorting at an unprecedented rate. It integrates high-throughput cell microscopy, focusing, sorting, and deep learning on a hybrid software-hardware data-management infrastructure, enabling real-time automated operation for data acquisition, data processing, intelligent decision-making, and actuation. I also show the broad utility of the technology to real-time image-activated sorting of microalgal and blood cells for studying photosynthesis and atherothrombosis, respectively. The technology is highly versatile and expected to enable machine-based scientific discovery in biological, pharmaceutical, and medical sciences.

Biography

Keisuke Goda is a professor of chemistry at the University of Tokyo. He obtained a BA degree from UC Berkeley summa cum laude in 2001 and a PhD from MIT in 2007, both in physics. At MIT, he worked on the development of gravitational-wave detectors in the LIGO group which led to the 2017 Nobel Prize in physics. After several years of work on high-speed imaging and microfluidics at Caltech and UCLA, he joined the University of Tokyo as a professor. His research group focuses on the development of serendipity-enabling technologies based on molecular imaging and spectroscopy together with microfluidics and computational analytics. His pioneering work has been published in a number of top journals such as Nature and Cell. He has received numerous honors and prizes including Japan Academy Medal, Yomiuri Gold Medal, and JSPS Prize.

SC11

Oral Talks

CIOP2019-2019-000031 (15:00-15:15, August 7)

Effect of recording location on phase-shifting radial-shearing digital holography

You Li, Junyong Zhang, Yanli Zhang
Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

Abstract: The recording location will affect the quality of the reconstructed image. In this paper, an improved technology is investigated in detail that can be useful for an understanding of the phase-shifting radial-shearing digital holography.

CIOP2019-2019-000047 (15:15-15:30, August 7)

Motion estimation and quality enhancement for a single image in dynamic single-pixel imaging

Shuming Jiao[1*], Mingjie Sun[2], Yang Gao[1], Ting Lei[1], Zhenwei Xie[1], Xiaocong Yuan[1]
1. Shenzhen University, China
2. Beihang University, China

Abstract: In single-pixel imaging (SPI), when the object is moving fast, the reconstructed image may contain heavy noise and blur. A motion estimation and quality enhancement scheme is proposed to address this problem in dynamic SPI.

CIOP2019-2019-000063 (17:00-17:15, August 7)

Ultrafast X-ray detector with resolution of 4 ps and spatial resolution of 100 μm

Houzhi Cai, Wenyong Fu, Jinyuan Liu
Shenzhen University, China

Abstract: In this paper, a new x-ray detector is reported by coupling pulse-dilation technique with a traditional detector.

CIOP2019-2019-000079 (17:15-17:30, August 7)

Watermarking structured light patterns for one-shot, complete 3D scanning

Xuanli Chen[1*], Luc Van Gool[1,2]
1. KU Leuven, Belgium
2. ETH Zurich, Switzerland

Abstract: We present a 3D face capture system allows multi structured light pairs work simultaneously. by watermarking the patterns system can automatically reconstruct the single-pattern part by structured light while overlapping the multi-view stereo.

CIOP2019-2019-000386 (17:30-17:45, August 7)

Single photon counting 3D imaging implemented under signal-to-noise ratio less than one

Yan Kang[1,2], Tongyi Zhang[1,2*], Lifei Li[1], Biao Wang[3,4], Wei Zhao[1,2]
1. State Key Laboratory of Transient Optics and Photonics, Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China
2. University of Chinese Academy of Sciences, China
3. Science and Technology on Electromagnetic Scattering Laboratory, China
4. School of Electronic Engineering, Xidian University, China

Abstract: We report a photon-efficiency photon counting 3D imaging approach based on adaptive range gating and spatial correlation, experimentally verified that this method can realize single photon counting 3D imaging under signal-to-noise ratio less than 1.

CIOP2019-2019-000097 (10:00-10:15, August 8)

Complex object retrieval through scattering media with a large field of view

Meiling Zhou[1], An Pan[1], Runze Li[1], Yansheng Liang[2], Junwei Min[1], Tong Peng[1], Chen Bai[1], Yao Baoli[1*]
1. Xi'an Institute of Optics and Precision Mechanics, CAS, China
2. Xi'an Jiaotong University, China

Abstract: With the combination of ptychography and shower-curtain effect, a novel configuration for the retrieval of complex objects through scattering media with a large field of view is proposed.

CIOP2019-2019-000171 (10:15-10:30, August 8)

All-fiber reflection-based scattering NSOM with low phase drift for nanophotonic waveguide characterization

Yi-Zhi Sun[1,2], Han Zhang[3], Wei Ding[1,2*]
1. Institute of Photonics Technology, Jinan University, China
2. Institute of Physics, Chinese Academy of Sciences, China
3. Institute of Laser Engineering, Beijing University of Technology, China

Abstract: An all-fiber phase-resolved reflection-based near-field scanning optical microscope with a phase-drift-rate of 0.06°/s is developed. By raster scanning atomic force microscope probe, we acquire the complex near-fields and analyse the standing-wave-spectrograms in silicon nano-waveguides.

CIOP2019-2019-000310 (15:00-15:15, August 8)

Two-angle illumination compressive holography

Hua Zhang, Liangcai Cao
Tsinghua University, China

Abstract: Two-angle illumination compressive holography is proposed with one exposure to enhance the axial resolution by 14 times compared with the classical compressive holography. The particle flowing field is imaged dynamically with large FOV and high DOV.

CIOP2019-2019-000299 (15:15-15:30, August 8)

Study of technology on spectral polarization imaging

Yang Liu[1,2], Qiang Fu[1], Xianzhu Liu[1], Juntong Zhan[1], Huilin Jiang[1*]
1. NUERC of Space Optoelectronics Technology， Changchun University of Science and Technology, China
2. Changchun University of Science and Technology, College of Opto-Electronic Engineering, China

Abstract: This paper first introduces the current situation of spectrum, polarization and intensity imaging at home and abroad. On this basis, the idea of three-in-one solution of spectral polarization imaging is proposed.

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CIOP2019-2019-000258 (10:00-10:15, August 9)

Compact auto-stereoscopic display based on directional back-light using side-glowing polymer optical fiber array

Yong He
College of Information Science and Engineering, Huaqiao University, Xiamen, Fujian, China

Abstract: Compact auto-stereoscopic display based on directional backlight using side-glowing polymer optical fiber array

CIOP2019-2019-000545 (10:15-10:30, August 9)

Imaging of a moving object with ghost imaging using intensity difference correlation

Shuai Sun, Wei-Tao Liu, Hui-Zu Lin
National University of Defense Technology, China

Abstract: We demonstrate a temporal intensity difference correlation ghost imaging scheme, whichis of good performance in tracking and imaging a moving object in complex scene.

CIOP2019-2019-000507 (12:00-12:15, August 9)

High-speed light focusing through multimode fiber for spot-scanning imaging

Hui Chen[1,2], Yi Geng[1,2], Chengfang Xu[1,2], Bin Zhuang[1,2], Liyong Ren[1,3*]
1. Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China
2. University of Chinese Academy of Sciences, China
3. Shaanxi Normal University, China

Abstract: Based on wavefront modulating and shaping technologies, a series of focused spots are formed through the multimode fiber (MMF) using spatial light modulators. Our method does not require iteration process and realizes light focusing efficiently.

SC12

SC12 Optical communications and networks

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Performance monitor by digital signal processing for dynamic optical network (Tutorial)

Zhenning Tao
Fujitsu Research and Development Center, China

Abstract
In the next generation flexible and dynamic optical network, operators need more intelligent network management. One fundamental requests of such smart network management is to acquire the network status accurately and timely. On the other hand, coherent detection converts the complete information of optical field into electrical digital domain, so that the powerful digital signal processing (DSP) provides large room for performance monitor. In this talk, we review various monitor technologies and discuss challenges for future. In coherent detection, the DSP compensates various impairments, such as chromatic dispersion, polarization mixing, optical filtering, transceiver imperfections, frequency offset. Based on such compensation function, DSP also knows the impairment itself and could provide the monitor function. With carefully designed training sequence, DSP could monitor optical signal to noise ratio with high nonlinear tolerance. The WDM channel spacing and linear crosstalk could also be monitored. Machine learning is another powerful tool for monitoring, in particular for the complicated task, such as nonlinear distortion monitoring. At transmitter side, DSP could stamp a label on the light, so that the lightpath could be identified in the network.

Biography
Zhenning Tao is one of the pioneers in coherent detection and digital signal proccing for optical communication. He leads a research group in Fujitsu R&D center to explore the next generation technology of Fujitsu optical transmission. He and the group proposed various DSP algorithms for optical communication, including the perturbation based nonlinear compensation in coherent detection. The novel algorithm significantly reduces the computation complexity and was used in the world first nonlinear compensation product. He and his colleague got the 65th Award of Electrical Science and Engineering in 2017, Japan owing to commercialization of nonlinear compensation. His current research interests include DSP in optical communication, transceiver technology and monitor technology for next generation optical network. Zhenning Tao has published more than 200 papers in letters, journals and conferences. He holds a doctor degree in communication and information system from Peking University. He is the visiting professor of Beijing University of Posts and Telecommunications.

- 14:15-14:45, August 7 -

Chaotic encryption schemes for secure OFDM-PONs

Chun-Kit Chan
The Chinese University of Hong Kong, Hong Kong, China

Abstract
We will discuss encryption schemes based on a 7-D Hyperchaotic System as well as a real-valued chaotic orthogonal matrix transform so as to improve the physical layer security in orthogonal frequency division multiplexing passive optical networks (OFDM-PONs).

Biography

Prof. C. K. Chan received his B.Eng., M.Phil. and Ph.D. degrees from the Chinese University of Hong Kong, all in Information Engineering. Upon graduation, he joined the Department of Electronic Engineering at the City University of Hong Kong as a Research Assistant Professor. At both universities, he worked on high-speed all-optical tunable channel multi-access networks and surveillance techniques for fault identification in various kinds of optical network elements. Later, he joined Bell Laboratories, Lucent Technologies, Holmdel, NJ, as a Member of Technical Staff where he worked on an optical packet switch fabric with terabit-per-second capacity. Then, he served as Senior Optical System Engineer at Jedai Broadband Networks, Inc. in NJ, USA where he worked on the design of optical access networks and optical-wireless systems. In August 2001, he joined Department of Information Engineering at the Chinese University of Hong Kong and now serves as a Professor as well as the Chairman of the Department. He has served as members of the Technical Program Committees of many international conferences, including OFC, OECC, ICCCAS, Photonic in Switching, APOC, ICOCN, COIN, ICCS, ICCC, ICCT, PGC, ChinaCom, ICAIT, IPOC, etc. He was an Associate Editor for OSA Journal of Optical Networking and IEEE/OSA Journal of Optical Communications and Networking. He served as the Chairman for IEEE Photonics Society Hong Kong Chapter during 2012-2013. Dr. Chan has published more than 200 technical papers in refereed international journals and conferences, two book chapters on passive optical networks and one edited book on optical performance monitoring. He holds two issued US patents. His research interests include enabling technologies for optical metro/access networks, high-speed optical signal processing techniques, optical performance monitoring and optical network design.

- 14:45-15:15, August 7 -

Machine-learning for low-margin dynamic optical networks

Shuangyi Yan
University of Bristol, UK

Abstract

The emerging 5G network will bring a huge amount of network traffic with big variations to optical transport networks. Software-defined optical networks and network function virtualization share a vision for future programmable, disaggregated, and dynamic optical networks. Programmable optical hardware with a reduced link margin improved the hardware utilization by introducing flexible network functions. Therefore, future optical networks will be more dynamic in network functions and network services, with high-frequency network reconfigurations. To configure network dynamically, real-time network abstractions are required for both current links and available-for-deploy links. The former abstraction guarantees the established links not be interfered by the newly established link while the latter abstraction provides information for network optimizations. In this talk, we use machine-learning technologies to process the collected monitoring data in a field-trial testbed to abstract performances of multiple optical channels. Based on the abstract information, a new channel can be established with maximum performance and minimized interferences on the current signals. We demonstrated the dynamic network abstraction over a 560-km field-trial testbed for 8 dynamic optical channels.

Biography

Dr Shuangyi Yan is a lecturer in High Performance Networks group at the department of Electrical & Electronic Engineering, University of Bristol. He received the B.E degree in information engineering from Tianjin University, Tianjin, China in 2004. In 2009, he got the PhD degree in optical engineering from Xi'an Institute of Optics and Precision Mechanics, CAS, Xi'an, China. From 2011 to 2013, he worked on the spectra-efficient long-haul transmission system and low-cost short-range transmission system in Photonics Research Centre, Dept. EIE of the Hong Kong Polytechnic University, Hong Kong. In July 2013, he joined the High Performance Networks Group at University of Bristol. His research interests include multi-dimensional programmable optical networks, multi-layer network analytics for network optimization, and next generation data center networks. He is the author or co-author of over 60 publications, of which consist several post deadline papers in optical communication related top-level conferences.

- 16:00-16:30, August 7 -

Indoor near-infrared optical wireless communications with spatial diversity

Ke Wang
RMIT University, Australia

Abstract

Optical wireless technologies have been widely studied in short-range indoor applications to provide high-speed wireless communications in personal working and living spaces and to meet the rapidly growing bandwidth demand of end users. In previous studies, we have demonstrated over 10 Gb/s data rate using the near-infrared indoor optical wireless communication technology, by combining limited mobility with user localizations. However, the system has two major limitations: firstly, since the direct line-of-sight (LOS) is used for high-speed optical wireless data transmission, the system is vulnerable to physical shadowing and blocking; and secondly, the mobility can be provided is limited since the maximum transmission power is constrained by safety regulations. To overcome these issues, we proposed and investigate the use of spatial diversity principle, where multiple transmitters are used for near-infrared optical wireless communications simultaneously. Robust indoor optical wireless communications with data rate of 10 Gb/s are experimentally demonstrated. Both the space-time-block code (STBC) and the repetition code (RC) based schemes are studied, and results show that the RC scheme is capable of achieving better bit-error-rate (BER) results. Results also show that the spatial diversity schemes require precise synchronization to achieve the benefit, which is challenging in high-speed wireless communications. To overcome this issue, we further propose and demonstrate a delay-tolerant optical wireless communication system with spatial diversity, which is achieve by using orthogonal spatial filters. Experimental results show that there is no BER degradation even with up to 10 symbol delays.

Biography

Dr Ke Wang receives his B.Sc. degree from Huazhong University of Science and Technology, and the PhD degree from The University of Melbourne, Australia, in 2014. He is currently an Australian Research Council (ARC) DECRA Fellow and a Senior Lecturer at the School of Engineering, Royal Melbourne Institute of Technology (RMIT University). Before joining RMIT, Dr Wang was an Assistant Professor at Stanford University, USA. Dr Wang's major research areas include high-speed wireless communications, optical wireless technologies, optical interconnects, quasi-passive optical nodes, and silicon photonic integrations. He has published over 115 papers, including over 20 invited papers. Dr Wang is an Assessor for ARC, and is also the Academic Mentor of the OSA RMIT Branch. Dr Wang has received numerous prestigious awards for his research excellence, including the Victoria Fellowship, the AIPS Young Tall Poppy Science Award, the Fresh Science Award, and the Marconi Society Paul Baran Young Scholar Award.

- 16:30-17:00, August 7 -

A novel microwave photonics RF Front-end with integrated OEO-based down convertor and self-Interference cancellation

Lei Deng
Huazhong University of Science and Technology, China

Abstract

In order to further increase the capacity of wireless communication, co-frequency co-time full duplex (CCFD) technique is proposed for 5G system. Because the key challenge of CCFD is self-interference cancellation (SIC), we focus on the realizing of wideband and high carrier frequency SIC by using microwave photonics techniques. In our work, we have proposed a novel optimized SIC method based on integrated dual-parallel Mach Zehnder modulator (DP-MZM). Moreover, in order to process RF signals with high carrier frequency and realize down conversion, a self-polarization

stabilizing optoelectronics oscillator (OEO) is integrated to the SIC system, and a microwave photonics down convertor is realized simultaneously. Thus, a microwave photonics RF processing setup with LO generation, down conversion, and self-interference cancellation is realized and integrated into one DP-MZM. In our experiment, 35 dB SIC ratio for single-tone and wideband OFDM signal is observed in 2.4 GHz center frequency. Meanwhile 5×20 MHz LTE-A signal with central-frequency of 12.6 GHz is down-converted to 2.6 GHz, and about 28 dB cancellation ratio is achieved experimentally. Moreover, the phase noise of -108.66 dBc/Hz at 10 kHz away from the carrier (10 GHz) is achieved. These researches provide a solution for integrated microwave photonics RF front-end and promote the using of microwave photonics technique in CCFD wireless communication for 5G and future system.

Biography

Lei Deng, professor in school of optical and electronic information, Huazhong University of Science and Technology. His research interests include high-speed fiber communications and fiber wireless communications with high performance optoelectronic integrated chip, advanced modulation formats and radio over fiber technologies. He is now undertaking and participating many national projects, such as National 863 Advanced Technology Foundation Project of China, National Nature Science Foundation Program of China, and Fundamental Research Funds for the Central Universities' HUST. He was able to publish more than 80 journal and conference papers, of which more than 40 journal papers have been indexed by SCI. All the published papers have been cited more than 900 times, and the H-factor is 14.

- 09:00-09:30, August 8 -

Zone-based cooperative content caching and delivery for radio access network with mobile edge computing

Gangxiang Shen

Soochow University, China

Abstract

Mobile edge computing (MEC) is a promising solution to meet the latency requirement for delay-sensitive services in a 5G radio access network (RAN). Its key idea is to deploy computing and storage capacities at the edge of the RAN to quickly provision content and processing capacities as required by users. Efficient content caching and delivery are key issues to ensure the success of this technique. This paper proposes a zone-based cooperative content caching and delivery scheme for a RAN supporting MEC (MEC-RAN), where the RAN is modelled as a zone and is further sub-divided into multiple sub-zones. Content items are cooperatively cached and delivered among multiple sub-zones. The caching problem is formulated as a mixed integer linear programming (MILP) model. We also develop a heuristic cooperative content caching strategy (MixCo) to decide the content items to be cached in each MEC server. This novel strategy divides the storage space in each MEC server into two parts. The first part caches locally popular contents and the second is used to cooperatively cache zone-wide popular items. We study the proposed scheme both through simulations and implementation on a testbed that consists of a subnetwork on our campus and a commercial cloud service from Ali-Cloud. Both of these show that the proposed zone-based scheme performs better than other typical caching strategies in terms of average content delivery latency and balanced loading of the MEC servers.

Biography

Gangxiang Shen received his B.Eng. degree from Zhejiang University, China; his M.Sc. degree from Nanyang Technological University, Singapore; and his Ph.D. degree from the University of Alberta, Canada, in January 2006. He is a Distinguished Professor with the School of Electronic and Information Engineering of Soochow University in China. Before he joined Soochow University, he was a Lead Engineer with Ciena, Linthicum, Maryland. He was also an Australian ARC Postdoctoral Fellow with University of Melbourne. His research interests include integrated optical and wireless networks, spectrum efficient optical networks, and green optical networks. He has authored and co-authored more than 150 peer-reviewed technical papers, among which one of the papers received the highest citations among all the papers published in IEEE/OSA JOCN. He was a Lead Guest Editor of IEEE JSAC Special Issue on “Next-Generation Spectrum-Efficient and Elastic Optical Transport Networks,” and a Guest Editor of IEEE JSAC Special Issue on “Energy-Efficiency in Optical Networks.” He is an associated editor of IEEE/OSA JOCN, and an editorial board member of Optical Switching and Networking and Photonic Network Communications. He has served as TCP chairs for various international conference in the area of optical networking, including general TPC co-chair of ACP 2018 and symposium lead chair of GLOBECOM 2017. He received the Young Researcher New Star Scientist Award in the “2010 Scopus Young Researcher Award Scheme” in China. He was a recipient of the Izaak Walton Killam Memorial Award from the University of Alberta and the Canadian NSERC Industrial R&D Fellowship. He is a “Highly Cited Chinese Research Scholar” selected by Elsevier (from 2014 to 2017) and an “Excellent Young Research Scholar” sponsored by NSFC. He was a Secretary for the IEEE Fiber-Wireless (FiWi) Integration Sub-Technical Committee. He is serving as a member of IEEE ComSoc Strategic Planning Standing Committee and an IEEE ComSoc Distinguished Lecturer (2018-2019).

- 09:30-10:00, August 8 -

Overloading 5G/IoT fronthaul networks: from principle to hardware implementation

Paikun Zhu

The Graduate School for the Creation of New Photonics Industries (GPI), Japan

Abstract

In 5G/IoT and beyond, the larger traffic volume, higher connection density and/or more stringent requirement on latency will put heavy burden on the radio access networks including their edge -- fronthaul. In this talk, we will introduce some recent progress of “overloading” techniques based on digital signal processing to improve fronthaul utilization with low latency. The technical principles and hardware implementation aspects will be discussed. This work was partially supported by the R&D contract (FY2017~2020) “Wired-and-Wireless Converged Radio Access Network for Massive IoT Traffic” for radio resource enhancement by the Ministry of Internal Affairs and Communications, Japan.

Biography

Paikun Zhu received Ph.D. degree in 2017 from Peking University, China. Since 2017 he has been a project assistant professor at GPI, Japan, collaborating with NICT, Japan. He has co-authored over 60 IEEE/OSA publications. He has served as a journal reviewer of Optics Express, IEEE Photonics Technology Letters, etc. He is a recipient of 2016 SPIE Optics & Photonics Education Scholarship. His current research interests include fiber-wireless converged system, signal processing and optical networks.

- 10:00-10:30, August 8 -

Application of artificial intelligence in performance monitoring of optical networks

Xin Li

Beijing University of Posts and Telecommunications, China

Abstract

In recent years, artificial intelligence (AI) is becoming increasingly important and many countries have taken it as the future research focus in the next few years. In the field of operation, administration and maintenance (OAM) of optical networks, AI also has a significant guiding and application value. It can decrease the complexity and improve the implementation efficient of the OAM of optical networks, and helps to optical network optimization design. AI is a collective name, covering a variety of individual technologies such as decision tree, association rules, support vector

machine (SVM), artificial neural networks (ANN), Bayesian networks, genetic algorithms, etc. In the presentation, the speaker will first give a brief introduction to the above technologies. Then, he focuses on the application of artificial intelligence in performance monitoring of optical networks. The problem of optical signal-to-noise ratio (OSNR) prediction and availability prediction for light-paths and light-trees will be elaborated in detail.

Biography

Dr. Xin Li is currently a Lecturer at Beijing University of Posts and Telecommunications. He received the Ph.D. degree in communication and information system from Beijing University of Posts and Telecommunications in 2014. From Jul. 2015 to Jul. 2017, he did postdoctoral research in Beijing University of Posts and Telecommunications. He has been actively undertaking several national projects, published more than 50 journals and conferences, and applied for more than 20 patents. He was awarded the Best Achievement Award by State Key Laboratory of Information Photonics and Optical Communications in 2018. His current research interests include the networks designing and planning, routing algorithms and performance analysis, software-defined optical networking, artificial intelligence, network survivability, photonic firewall, etc.

- 11:00-11:30, August 8 -

High-precision large-scale network time synchronization and its applications in optical networks

Nan Hua

Tsinghua University, China

Abstract

Time synchronization technologies enable accurate resource and control coordination in distributed systems and begin to show great potential in optical networking and related areas. Low-cost and precise network time synchronization may play a critical role in future access/metro/regional infrastructure, intra-datacenter networking, cloud/edge computing, optical network status/performance monitoring, optical network security, network operation automation, etc. This talk will share our knowledge of the latest progress in the development of network time synchronization. Also, our high-precision network time synchronization prototype system, as well as some of its preliminary application results in optical networking will be presented.

Biography

Prof. Dr. Nan Hua received his B.S. and Ph.D. degrees in electronic engineering from Tsinghua University, Beijing, China, in 2003 and 2009, respectively. He is now an associate professor with the Department of Electronic Engineering at Tsinghua University. He has authored or coauthored more than 100 publications and is the holder of more than 20 issued patents. His current research interests include the control and management of optical networks, all-optical switching technologies, enabling technologies for multi-domain heterogeneous networks, datacenter optical networks, satellite networks, time synchronization networks, network automation, etc. He is a member of the IEEE and OSA.

- 13:30-14:00, August 8 -

Advanced modulation formats for beyond 100G datacenter optical interconnects

Fan Li

Sun Yat-Sen University, China

Abstract

In this paper, we firstly reviewed our recent research on advanced modulation formats including PAM, bit-loading DMT, DFT-spread DMT for beyond 100 G datacenter optical interconnect. And then we will demonstrate and discuss possible schemes for future 400 G and 800 G optical datacenter optical interconnects.

Biography

Fan Li, Associate Professor, Sun Yat-Sen University. He obtained the Ph.D. degree in information and communication engineering from Hunan University, Changsha, China, in 2014. From 2012 to 2014, he worked as a visiting scholar in Georgia Institute of Technology under the supervision of Professor Gee-Kung Chang. After that, he worked as a research engineer in optical transmission labs in ZTE TX, New Jersey for two years. His research interests include Datacenter optical interconnects, Fiber wireless integration, Direct-detection and coherent transmission systems, Optical OFDM.

- 14:00-14:30, August 8 -

Channel compensation in optical offset-QAM OFDM systems

Jian Zhao

South China University of Technology, China

Abstract

Offset quadrature amplitude modulation orthogonal frequency division multiplexing (offset-QAM OFDM) can eliminate the cyclic prefix required in OFDM for channel compensation. However, conventional compensation schemes in offset-QAM OFDM are only applicable to cases where dispersion-induced delay difference between subcarriers is much smaller than the OFDM symbol period. In this talk, we will analyze the fundamental mechanism limiting the dispersion tolerance of offset-QAM OFDM, and show that the orthogonality between the signal and the intrinsic imaginary interference (IMI) can be maintained even when any subcarrier has any time delay, provided that the phase difference between subcarriers satisfies a certain condition and the sampling phase of each subcarrier is recovered. Based on the analysis, we propose several channel compensation schemes to enhance the dispersion tolerance beyond the point where the maximal delay difference between subcarriers is comparable to or larger than the OFDM symbol period. Simulations and experiments are performed to verify the effectiveness of the proposed schemes. We also compare offset-QAM OFDM based on the proposed schemes and conventional OFDM, and show that offset-QAM OFDM gives better transmission performance than conventional OFDM.

Biography

Jian Zhao received the B.Eng. degree from the University of Science and Technology of China in 2002, and the M.Phil. and Ph.D. degrees from the Chinese University of Hong Kong in 2004 and 2007, respectively. In August 2007, he joined Tyndall National Institute, where he established an independent team in 2012. In 2018, he joined the South China University of Technology (SCUT) as a full professor, under the support of the “1000 Youth Talent Program”. At Tyndall, he captured €2.4 million funding as the principal investigator from Science Foundation Ireland (SFI), European Commission, Industry, and Enterprise Ireland. He was also the Co-PI of two Hong Kong RGC projects. He was the recipient of SFI Career Development Award, Starting Investigator Research Award, and Technology Innovation and Development Award. The team he led was the EMEA finalist in Alcatel-Lucent Innovation Competition. Prof. Zhao has published 130+ technical papers (18 invited) in peer-reviewed international journals and conferences. His current research interests include optical OFDM, advanced modulation and detection schemes, fiber nonlinearity mitigation, and visible light communications. Prof. Zhao served in 10+ international conferences as a TPC member, and is a reviewer for Funding for Scientific Research Belgium, HK RGC, and various journals including Nature Communications, Optics Express, Journal of Lightwave Technology (a top reviewer of 2015 and 2016), etc.

- 14:30-15:00, August 8 -

Carrier-to-signal power ratio measurement techniques for optical single-sideband transmission system

Tianwai Bo
Korea Advanced Institute of Science and Technology (KAIST), South Korea

Abstract

The optical single-sideband (SSB) technique has attracted considerable interest due to its capability to overcome the frequency-dependent power fading induced by fiber chromatic dispersion. It also doubles the spectral efficiency, compared to double-sideband transmission systems. One of the key system parameters of optical SSB transmission system is the carrier-to-signal-power ratio (CSPR). It is crucial to optimize this parameter in every system since a large CSPR degrades the receiver sensitivity, whereas a low CSPR makes the optical SSB system suffer from the signal-signal beat interference, nonlinear distortions inherent in the direct detection of optical SSB signal. However, it is not always straightforward and easy to measure the CSPR accurately since the optical carrier is located just next to the information-bearing signal, in most cases, without any frequency gap in the spectrum. In this talk, we review the CSPR measurement techniques for optical SSB signals. The focus will be placed on our recent work on the time-domain CSPR measurement techniques. We present the experimental evaluation of our proposed techniques by comparing them with the conventional frequency-domain techniques using the optical spectrum analyzer.

Biography

Tianwai Bo received the B.Eng. degree from Jilin University, China, in 2012 and Ph. D. degree in the area of optical communications from The Chinese University of Hong Kong, Hong Kong, in 2016. Then, he joined KAIST in 2016 as a Postdoctoral Research Fellow. From 2019, he is a Research Assistant Professor at the same institute. His current research interests include short-/medium-reach communication, optical performance monitoring, and digital signal processing for optical communication.

- 09:00-09:30, August 9 -

The key technologies for both digital and analog radio-over-fiber based next generation mobile fronthaul

Haibo Li
China Information Communication Technologies Group Corporation, China

Abstract

With the flourish of high-speed internet access, high resolution multi-media entertainment with virtual reality and machine-to-machine communications, the global mobile data traffic in the 5G era will grow exponentially. As the key component of centralized radio access network, mobile fronthaul (MFH) faces great challenges such as demands of higher capacity, higher bandwidth efficiency, lower latency, and lower cost. To address these issues, both digital and analog radio-over-fiber based MFH architectures have been widely investigated, due to the excellent immunity to nonlinear distortions and high bandwidth efficiency, respectively. However, the digital MFH has the drawback of relatively low bandwidth efficiency; analog MFH suffers from high sensitivity to nonlinear distortions and the relatively high implementation complexity, which are the key issues in 5G MFH. To resolve the key problems above, we propose and experimentally demonstrate the digital MFH architecture employing high order delta-sigma modulator with PAM-4 format, differential pulse coding modulation with employing noise shaping, enhanced noise shaping based pulse code modulation, and discrete cosine transform combined with multi-band quantization, respectively. Besides this, the analog MFH architecture employing digital code-division multiplexing (CDM) channel aggregation is firstly proposed.

Synchronous transmission of both the I/Q waveforms of wireless signals and the control words used for the purpose of control and management using the CDM approach is also presented and proof-of concept experiments are carried out. Finally, a code reservation technique is proposed to reduce the peak-to-average power ratio (PAPR) of CDM based channel aggregation for analog MFH.

Biography

Haibo Li is currently a research engineer in the State Key Laboratory of Optical Communication Technology and Network, China Information Communication Technologies Group Corporation. He received the B.S. degree in the Institute of Mathematics and Statistics from Huazhong University of Science and Technology in 2009, M.S. degree in department of Electronics and Information Technology from Huazhong University of Science and Technology in 2012, and Ph.D. degree in Wuhan National Laboratory for Optoelectronics & School of Optical and Electronic Information, Huazhong University of Science and Technology in 2018. His current research interests include high speed optical access networks, mobile fronthaul, radio-over-fiber technology, passive optical networks, advanced modulation technology, real-time optical communication, coherent optical communication, and long distance transmission.

- 09:30-10:00, August 9 -

Dynamical adjustment of lamp mounting plan to minimize dead zone in indoor visible light communication

Jian Chen

Nanjing University of Posts and Telecommunications, China

Abstract

In great efforts to explore high capacity information transmission capability over visible light spectrum, technologies mainly including advanced modulation formats, different solid-state lighting sources and channel equalizations are involved in enabling several Gigabit of the transmission rate over up to meters. However, in pushing visible light communication (VLC) into actual indoor application, lots of considerations should be put in the first place. Those issues include low complexity modulation, only conventional white light LED bulbs as lighting device for the reason of its wide deployment, and moderate equalization in the receiver for the sake of keep Eco system philosophy, etc. It should be pointed out that indoor VLC is in a mobile networking, which can neither be under the strict line-of-sight (LOS) calibration nor lack of the functionality of anti-blocking and anti-shadowing. In such a cooperating system with dual lighting and communication system, multi-Lamps with plenty of non-line-of-sight (NLOS) transmission components are of great importance to alter the rule of thumb in lighting structure design procedure. This talk will be focus on the lighting infrastructure design considering full converge of VLC across a room with as little dead zone as possible. The exploration mainly reveals how to keep the signal-to-noise ratio (SNR) flatten/maximized and inter-symbol interference minimized, under the condition of energy saving lighting infrastructure design fulfilling international office lighting standardization first. Such an infrastructure design should be dynamical which always be ready to be adapt indoor VLC connections along with time-varying environment changes.

Biography

JIAN CHEN received the B.S., M.S., and Ph. D. degrees in electronic engineering from Southeast University in 1988, 1990, and 1994, respectively. From 1999 to 2001, he was with the Department of Electrical Engineering of the Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea. In 2002, he was with the Institute for Communication Research of National University of Singapore (NUS) as member of technical staff. From 2003, he joined the Communications & Devices Division of the Institute of Infocomm Research (I2R) as a research scientist, Singapore. From 2010 up to now, He is appointed as a full professor in NUPT. He has been engaged in research on optical fiber communication systems and optical access networks for almost 30 years, and in pioneering works in VLC research and development since 2005. His current interests are focusing on visible light communication (VLC) and digital signal processing in coherent optical communications.

- 11:00-11:30, August 9 -

Experimental progress in single-photon quantum key distribution

Shuang Wang
University of Science and Technology of China, China

Abstract
Based on the fundamental laws of quantum physics, quantum key distribution (QKD) promises to achieve the unconditional security in communication without making assumptions on the computational power of the potential eavesdropper. Single-photon QKD is one of the most in-depth and hottest research directions, and some companies even have launched related commercial products. The presentation will introduce the motivation and the current state of the art of experimental works in single-photon QKD. In particular, the concepts of single-photon QKD together with its assumption, security and limitations are discussed. After presentation of some practical QKD systems and field QKD networks, the latest developments in measurement-device-independent QKD, round-robin differential phase shift QKD, and twin-field QKD are introduced.

Biography
Shuang Wang, received the Ph.D. degrees in optics from the University of Science and Technology of China in 2011. In the same year, he joined and CAS Key Laboratory of Quantum Information, University of Science and Technology of China, and became a professor in 2017. His current research interest is quantum key distribution (QKD) or quantum cryptography, including the security and systems of QKD, QKD network, quantum random number generator, and single photon detector.

- 13:30-14:00, August 9 -

High capacity transmission system towards 100 Tb/s

Yi Yu
Huawei Technologies Co, LTD, China

Abstract
After 100-Gb/s coherent transponder is commercialized, wavelength-division-multiplexing (WDM) technique enables 8-Tb/s total capacity of single mode fiber in core-network. Bandwidth demand of various internet services drives network capacity improvement continuously. Single channel speed has increased from 100-Gb/s to 400-Gb/s and beyond, while commercial system capacity have reached 19.2 Tb/s, which is expected to increase to 100-Tb/s in future. However, as the capacity is improved in terms of higher order modulation, the transmission distance is reduced. Thus, advanced modulation technologies, such as constellation shaping and spectrum shaping, are used to extend transmission distance in different ways. Moreover, additional available band of optical fiber can increase system capacity further. Nevertheless, it is required to carefully handle fiber nonlinearity in high density WDM system, which becomes significant as channel number increases. Nonlinear effect mitigation and compensation play a key role of capacity improvement, after the linear performance has been closed to Shannon limit. In addition, low-loss large-effective-area fiber is proposed to be an effective solution for next generation high capacity transmission system which brings the benefits of OSNR improvement and nonlinearity mitigation.

Biography
Dr. Yu Yi got Ph.D degree from National University of Singapore in 2015, and joined network technology research department in Huawei Technologies from 2015. His research work is focused on high capacity transmission system and oDSP. He published more than 30 Academic papers and 6 patents in related area.

- 14:00-14:30, August 9 -

The application of machine learning in optical fiber communication

Jing Zhang
University of Electronic Science and Technology of China, China

Abstract

With the development of hardware facilities and parallel computation, machine learning (ML) has once again received widespread attention and been introduced into nonlinearity mitigation, optical performance monitor and optical network, etc. The operating mechanism of most ML based equalizers is nonlinear classification, which generates a nonlinear classification boundary through supervised or unsupervised training, e.g. the clustering, deep neural network (DNN) , statistical learning algorithm. There is also growing interest in deep learning to realize different parameters' monitoring and overcome the bottleneck of monitoring when different impairments are physically inseparable in traditional OPM. We review our recent work on the application of machine learning in optical fiber communication, especially the nonlinear equalization and optical performance monitoring, including OSNR and chromatic dispersion. We use different neural network (NN) equalization schemes to mitigate the fiber nonlinearity. The BER can be reduced by half. We propose to use transfer learning for ONSR monitoring. The root mean squared error (RMSE) of OSNR estimation can be less than 0.1 dB.

Biography

Jing Zhang, received the B.S. and Ph.D. degree in optical engineering from the University of Electronic Science and Technology of China, Chengdu, China, in 2013. She has been with the University of Electronic Science and Technology of China since 2007, where she is currently an Associate Professor. From 2015to 2016, she was a Visiting Research Scholar with the Department of Electrical and Computer Engineering, National University of Singapore, Singapore. Her current research interests include optical fiber communication and network, digital signal processing at the transceiver, nonlinear equalization with machine learning.

Oral Talks

CIOP2019-2019-000030 (15:15-15:30, August 7)

Laser communication for air and space applications - system engineering considerations

Markus Knapek
Mynaric, Germany

Abstract: The presentation will show the fundamental tools including the link budget simulations for inter-satellite links and LEO to ground links, the performance analysis for the laser terminals under the specific micro vibrations on a satellite, estimation of the link acquisition time considering the specific uncertainty cone, the specific radiation environment depending on orbit and operational period, and thermal management aspects.

CIOP2019-2019-000132 (17:00-17:15, August 7)

SDM-WDM-based multiple objects visible light positioning by using conventional monitoring system

Can Shi[1], Min Zhang[1*], Dahai Han[1], Xiaodong Wang[1], Bo Zhang[1], Minghui Wang[2]
1. Beijing University of Posts and Telecommunications, China
2. System Engineering Research Institute China State Shipbuilding Corporation, China

Abstract: We propose a MIMO system which can monitor multiple objects at the same time via SDM, WDM and UPSOOK. The experimental results show that the proposed system can achieve accuracy of 10cm.

CIOP2019-2019-000144 (17:15-17:30, August 7)

Novel routing, spectrum and module allocation for maximizing fiber switching in software-defined AoD optical networks

Xiaoxue Gong, Lei Guo
Chongqing University of Posts and Telecommunications, China

Abstract: Architecture on Demand (AoD) provides a customizedarchitecture based on network traffic requirements. We propose a novel scheme of routing, spectrum allocation and module configuration of AoD optical nodes, and the algorithm superiority is demonstrated.

CIOP2019-2019-000184 (11:30-11:45, August 8)

Adaptive routing strategy based on deep neural network for datacenter interconnection

Tao Jiang[1,2], Ming Tang[1*], Rui Lin[3], MaoQI Zhang[1], LiWei Kuang[2]
1. Huazhong University of Science and Technology, China
2. Fiberhome Telecommunication Technologies Co., China
3. Dept. of Electrical Engineering at Chalmers Tekniska Högskola, Sweden

Abstract: A DNN model is trained to learn from the traffic distribution of the underlying network and generate a routing path which achieves the best end to end quality of service for next generation datacenter interconnection.

CIOP2019-2019-000188 (11:45-12:00, August 8)

Performance enhancement of EDFA based scintillation mitigation using Manchester OOK and HPF in free space optical communication

Yan-Qing Hong, Won-Ho Shin, Sang-Kook Han
Yonsei University, Electrical and Electronic Engineering, South Korea

Abstract: This paper proposes M-OOK with HPF to improve the performance of EDFA based turbulence-induced scintillation mitigation in FSO. The experimental results illustrated that scintillation effect was mitigated effectively using the proposed method.

CIOP2019-2019-000189 (15:00-15:15, August 8)

Interference mitigation of received multiple mobile optical signals in optical camera communication

Sung-Jin Kim, Joon-Woo Lee, Sang-Kook Han
Dept. of Electrical and Electronic Engineering, Yonsei University, South Korea

Abstract: We propose received optical signal area and gamma function based channel interference mitigation technique to overcome nonlinear distortions of received multiple optical signals caused by Bokeh effect and varying transmission distance in optical camera communication.

CIOP2019-2019-000295 (15:15-15:30, August 8)

High reliability transmission system in mobile fronthaul using a maximal ratio combined receiver with direct and lite-coherent detections

Jun Qin, Xingjun Wang

1. State Key Laboratory of Advanced Optical Communication Systems and Networks, Peking University, China
2. Nano-optoelectronics Frontier Center of Ministry of Education, Peking University, China

Abstract: We demonstrate a novel Maximal Ratio Combined receiver which combines direct and lite coherent detections for mobile fronthaul network. By using the receiver, the EVM performance can be reduced to be smaller than 10%.

CIOP2019-2019-000204 (10:00-10:15, August 9)

Fading mitigation using a single subcarrier time delay diversity in satellite optical communications

Jae-young Choi, Won-Ho Shin, Sa ng-Kook Han

Dept. Electrical and Electronics Engineering, Yonsei University, South Korea

Abstract: A single subcarrier intensity modulation with temporal delay diversity is proposed to mitigate atmospheric channel fading for satellite optical communications. The proposed scheme reduces the size of the system and avoids burst error simultaneously.

CIOP2019-2019-000286 (10:15-10:30, August 9)

Research on optimal persistent formation algorithm of wireless ultraviolet collaboration UAV

Taifei Zhao, Shixue Zhao, Dandan Cao

Faculty of Automation and Information Engineering, Xi'an University of Technology, China

Abstract: This paper proposes a persistent formation generation algorithm for the location information of UAVs that are not shared, enables formation to generate anetwork topology with the least communication links and low energy consumption.

CIOP2019-2019-000287 (11:30-11:45, August 9)

Bee colony drone formation ultraviolet non-ranging positioning method

Peng Gao, Taifei Zhao, Minhua Cheng

Faculty of Automation and Information Engineering, Xi'an University of Technology, China

Abstract: After calculation and analysis, the relative position information with less error can be provided by this method in the bee colony formation while using wireless ultraviolet communication.

CIOP2019-2019-000265 (11:45-12:00, August 9)

Study of the modulating efficiency of white LED with different rated powers

Lin Gui, Suzhen Song, Yuxuan Zhu

Shanghai Polytech university, China

Abstract: The modulating efficiencies of white light LED with the rated power 1W, 0.5W and 0.1W are measured experimentally, the nonlinearity of the Pr-Vt curve will affect the modulating efficiency of LED.

CIOP2019-2019-000293 (14:30-14:45, August 9)

Research on light-flux fluctuations reciprocity of bidirectional atmospheric laser transmission channel

Yi Liu[1,2], Xiaolong Ni[1], Zhi Liu[1], Jiaxu Zhao[3], Huilin Jiang[1*]

1. NUERC of Space Optoelectronics Technology, Changchun University of Science and Technology, China
2. Changchun University of Science and Technology, College of Opto-Electronic Engineering, China
3. Changchun University of Science and Technology, College of Electronic Information Engineering, China

Abstract: In this paper, under the condition of weak-fluctuation, according to the Rytov approximation theory, the relationship between the correlation of optical signal of receiving terminal and transmission path of bidirectional free space laser transmission link is deduced and analyzed, and then the coaxial atmospheric laser transmission link of bidirectional transmitting and receiving is built for field experiment.

SC13 Optical Fiber and Waveguide Technologies

Invited Talks

- 13:30-14:00, August 7 -

Hybrid integration of chalcogenides on silicon-based materials

Duk-Yong Choi
The Australian National University, Australia & Jinan University, China

Abstract
Chalcogenide glasses (ChGs), containing S, Se or Te as major constituent elements, stand out for nonlinear photonics materials in infrared band because of their wide transparency far into 20 μm and very high optical nonlinearities, two to three orders of magnitude greater than silica. However, ChGs faces a few serious issues; incompatibility with the complementary metal-oxide-semiconductor (CMOS) process; high scattering loss resulted from the sidewall roughness of a waveguide induced during patterning process; and free space coupling in/out at the chip end facets and resulting high coupling loss. In order to mitigate these drawbacks, we hybridized ChGs with CMOS compatible platforms, including silicon, silica, Ge-doped silica, and silicon nitride. In this talk I present the structural designs, fabrication procedures, and the experimental results of these hybridization schemes. I also discuss the pros and cons of each approach and conclude with my personal outlook on the schemes.

Biography
Brief biography: Dr. Duk-Yong Choi Associate Professor at the Australian National University and Part-time professor at Jinan University, Guangzhou Qualifications: BSc (1992), M.Sc (1994), PhD (1998) in Materials Science and Engineering / Seoul National University Employment: 2005. 1 – present, Laser Physics Centre / Australian National University 1998. 8 - 2004.12, Samsung Electronics Research Interests: - Chalcogenide photonic devices in near and mid Infrared - Silicon photonics: Hydrogenated amorphous silicon, c-SOI - Photonic nanostructures (metasurfaces) - Nanostructured color filters - Quantum Light-Matter Interface Publications: Last five years ~60 SCI publications

- 14:00-14:30, August 7 -

Properties and manipulation of hollow-core photonic crystal fibres for ultrafast nonlinear optics

Francesco Tani
Max Planck Institute for the Science of Light, Germany

Abstract
Gas-filled hollow-core photonic crystal fibres (HC-PCFs) provide a convenient platform for studies of nonlinear dynamics as well as for applications such as ultrashort pulse compression to a single-cycle duration and efficient generation of broadband radiation, which can be tuned across the deep and vacuum ultraviolet (UV) spectral region. As these nonlinear processes rely on the weak and spectrally flat dispersion of HC-PCFs, spectral anti-crossings between the fundamental core mode and core-wall resonances influence them by altering the dispersion. Here I discuss the effects of anti-crossings on the nonlinear propagation of ultrashort laser pulses in gas-filled HC-PCFs. The spectrally localised modification of the real part of the modal refractive index introduces new phase matching routes for nonlinear parametric process. Moreover, I show that anti-crossings lying close to the pump wavelength are detrimental for soliton self-compression and UV generation and demonstrate how to mitigate these effects by tailoring the core-

wall thickness. Finally, I discuss how to further manipulate the properties of HC-PCFs via tapering them and show that fibres with remarkably small core diameters (6 μm) and capillary core-wall thickness (90 nm) can be obtained by post-processing.

Biography

Francesco Tani leads the ultrafast nonlinear optics sub-group in Philip Russell's division at the Max Planck Institute for the science of light. In 2010 he received his master degree in theoretical physics from the university of Rome La Sapienza with a thesis on laser-plasma acceleration. In 2014 he received a PhD in physics from the Max Planck Institute, where he investigated the nonlinear dynamics of ultrashort pulses propagating in gas-filled photonic crystal fibre and exploited these to develop novel light sources. In 2016 after two years as a postdoctoral research fellow in the same institute, he became team leader of the ultrafast nonlinear optics sub-group.

- 14:30-15:00, August 7 -

Stimulated Raman scattering in gases-filled hollow-core fibers

Zefeng Wang
National University of Defense Technology, China

Abstract

Gas stimulated Raman scattering (SRS) has been demonstrated to be an effective method to obtain high-power narrow-linewidth lasers of otherwise unobtainable wavelengths, especially in the ultra-violet and mid-infrared spectral range. In traditional gas cells the effective interaction length is very short and the system can be bulky and cumbersome, limiting the applications of these lasers. The advent of anti-resonance hollow-core fibers and their properties of long effective interaction length, high optical confinement, and the possibility of control of the effective gain spectrum make it possible to develop a novel type of laser, named fiber gas Raman lasers, which combines the advantages of both fiber and gas lasers. By properly designing the transmission bands of hollow-core fibers, selecting active gases and pump sources, fiber gas Raman lasers can potentially provide a wide range of emission wavelengths from the UV to the IR pumped with commercial 1μm lasers. Owing to the nature of transitions in atomic and molecular gases, fiber gas Raman lasers are spectrally narrow even without additional linewidth limiting measures. We have demonstrated efficient high-power, narrow-linewidth 1.5 μm, 2 μm and 3 μm fiber gas Raman lasers using hollow-core fibers filled with different gases from 1064 nm solid-state lasers. Our work provides a very possible way to obtain high-power, narrow-linewidth mid-infrared fiber lasers by gas stimulated Raman scattering in hollow-core fiber pumped with normal 1μm lasers.

Biography

Zefeng Wang, Professor, Ph.D. supervisor, College of Advanced Interdisciplinary Studies, National University of Defense Technology (NUDT). He received Doctor degree in Optical Engineering from the NUDT in June 2008, and visited Bath University in UK from October 2012 to July 2014. He has published more than 100 journal papers. His research interests cover mainly fiber lasers, gas lasers by hollow-core fibers, fiber gratings fabrications and applications.

- 16:00-16:30, August 7 -

Gas detection with fiber-enhanced stimulated Raman spectroscopy

Wei Jin
The Hong Kong Polytechnic University, Hong Kong, China

Abstract
Micro- and nano-structured optical fibers enable enhanced non-linear light matter interaction over a long distance. This talk presents recent developments in the use of hollow-core optical fibers and sub-wavelength nanofibers for stimulated Raman spectroscopy with enhanced performance. With stimulated Raman gain and dispersion spectroscopy, we have demonstrated hydrogen sensors with hollow-core and tapered nanoscale optical fibers and achieved ppm (parts per million) level detection resolution and dynamic range of five orders of magnitude. Distributed detection of hydrogen over 100 meters of hollow-core fiber is also demonstrated with response time of less than 1 min and dynamic range of over three orders of magnitude. We also report the first demonstration of group delay tuning with stimulated Raman scattering induced dispersion in a hydrogen-filled hollow-core optical fiber. Tunable pulse delay is realized by changing pump power as well as hydrogen pressure. With ~80-m-long hollow-core fiber filled with hydrogen, we achieved continuously tuning of pulse delay up to 1.4 ns by varying the Raman gain from 0-10 dB. This work could be useful for slow light applications such as buffering in data communication systems.

Biography
Wei Jin received a BEng degree from Beijing University of Aeronautics and Astronautics in 1984 and a Ph.D degree from University of Strathclyde in 1991. He joined Hong Kong PolyU as an assistant Professor in 1996 and is currently the Chair Professor of Photonic Instrumentation. He researched on various fiber components and sensor systems, and is currently working on micro-structured photonic devices and sensors. He edited two books, delivered >70 invited/keynote/plenary talks, author/co- authored >260 journal papers and 15 patents. He received PolyU President's Award for Outstanding Performance, PolyU's Outstanding Professional Services and Innovation Award, Chiang-Jiang Chair Professor Award, Distinguished Young Scholar Award (Category-B) as well as six best conference/student paper awards. He is a fellow of OSA.

- 16:30-17:00, August 7 -

Time-Lens based signal processing for optical communications

Pengyu Guan
Technical University of Denmark, Denmark

Abstract
Due to the massive increase in users and required data capacity in optical communication networks, the demand for transmission of ultra-high definition video and cloud computing are driving the need for higher capacities in signal transmission and signal processing. Alongside the challenge of bandwidth, another serious concern is energy consumption and resulting CO_2 emissions. The Internet is already today responsible for about 9% of the global electricity consumption and this energy demand is still rising. It is of utmost importance to reduce the energy per bit with 20-30% traffic growth rates. It is also becoming increasingly important to utilize the installed network resources flexibly to support more intelligent applications e.g. Internet of Things (IoT), Industry4.0 and autonomous cars. In this paper, we provide an overview of recent progress on advanced optical signal processing using time lens based optical Fourier transformation. The time lens based optical Fourier transformation is an extremely attractive tool for many different applications. We will outline time lens based all-optical processing of spectrally-efficient signals, scalable WDM regeneration and our most recent activities on optical access networks.

Biography

Dr. Pengyu Guan received his Ph.D. degree in communications engineering from Tohoku University, Sendai, Japan, in 2012. For his achievements during the Ph.D, he received the Student award "Best paper Prize" from IEEE Sendai Section in 2009, the Chinese Government Award for Outstanding Self-financed Students Abroad in 2011, and the Tohoku University President's Award in 2012, which is the highest honor at Ph.D. graduation. Currently he is a researcher in the High- Speed Optical Communications Group, DTU Fotonik, where he is involved in research on high-speed optical signal processing and optical communication systems. Dr. Guan has been innovative and led to a number of impressive world- first achievements at record high bit rate and channel counts. He has authored or co-authored more than 72 peer reviewed publications, including 6 postdeadline papers, 3 top-scored papers, 10 invited papers in top IEEE/OSA journals and world-renowned conferences. He hold 4 patents as the first inventor and have won 4 prizes (1 within the group), as well as 4 highly competitive grants including a very prestigious VILLUM Young Investigator grant.

- 09:00-09:30, August 8 -

Recent advances in soft-glass/polymer microstructured fibres

Xin Jiang

Max Planck Institute for the Science of Light, Germany

Abstract

Photonic crystal fibres (PCFs) made from soft glasses (e.g., heavy-metal oxide, fluoride or chalcogenide) and polymers have attracted much attention because of novel optical properties and functionalities which are not observed in silica-based fibers. Drawing soft-glass, or soft-glass/polymer hybrid fibres is however, very challenging due to a much faster change in viscosity with temperature, which means that the drawing temperature must be controlled within a narrow range (less than ±25°C), as well as compatible pairs (thermal, optical and structural properties) for drawing soft-glasses and polymers together. Over the last few years, with the recent emergence of 3D printing, we have been developing novel fabrication techniques through glass extrusion and etching, so as to be able to draw PCFs with nanoscale features that are deemed very difficult if not impossible to realise by "stack-and-draw". These novel PCFs are used for various applications such as opto-mechanical interactions, photochemistry, quantum optics and nonlinear dynamics. In the talk, we will first present work on our recent achievements on fibre fabrication. After that I will report new procedures making use of 3D printing, as well as techniques for drawing chiral twisted fibres. Finally, we will discuss various applications of the fabricated fibres.

Biography

After obtaining his PhD degrees at the University of Leeds (UK) in 2009, Dr. Jiang joined the group of Prof. Philip Russell's division at the Max-Planck-Institute for the Science of Light (MPL), as the head of the TDSU3: fiber fabrication and glass studio. He studied the ring-cavity fiber laser, mode-locked by saturable absorption based on single-wall carbon nanotubes and infrared optical fibers for chemical sensing during his MSc and PhD. At MPL, he is mainly working on the fabrication of photonic crystal fiber (PCF), made from various glasses (silica and soft glasses), and also on several projects such as supercontinuum generation, photochemistry in hollow core fibers and 3D particle trapping using high NA fibers. Dr. Jiang has a strong publication record in journals such as Nature Photonics, Optica, Progress in Materials Science, Optics Letters, Journal of Lightwave Technology, Optics Express, Inorganic Chemistry, Sensors and Actuators B etc, and serves as reviewers for many journals such as Nature Communications, Optica, Light: Science and Applications, Optics Letters, etc.

- 09:30-10:00, August 8 -

Ultralow loss hollow-core anti-resonant fiber

Wei Ding

Jinan University, China

Abstract

The invention of optical glass fiber in the last century has revolutionized the ways people communicate, generate laser, and sense environment. However, the ever-increasing demands for higher data traffic, higher laser output power, and higher sensitivity to various physical quantities have pushed the performances of optical glass fiber close to its fundamental limits, which originate from the intrinsic properties of glass material itself, i.e., Rayleigh scattering, chromatic dispersion, nonlinearity, and radiation-induced damage. It becomes inevitable to search for disruptive fiber technology and concepts. Hollow-core fiber (HCF), which replaces the glass core with air or vacuum and thus has many unique characteristics, such as low nonlinearity, low dispersion, low latency, potentially low loss, and high radiation hardness, represents such a promising solution to tackle the above problems relevant to fiber materials. How to reduce the loss in HCFs, nowadays, becomes an intense research topic worldwide. In this talk, I will review our efforts in the past 5 years on ultralow loss anti-resonant HCF and its applications. Starting from a simplified model for the confinement loss of light guidance, I will show our state-of-the-art fiber design and fabrication, and preliminary applications in short-range data transmission. Our famed conjoined-tube HCF achieves a minimum loss of 2 dB/km at 1512 nm and a 16 dB/km bandwidth of 335 nm, opening the door for ultralow loss anti-resonant HCF. It also shines new light on conquering the Rayleigh scattering loss limit of silica glass fiber and realizing low-latency fiber communications insensitive to practical environment variations.

Biography

Wei Ding received his PhD degree from Bath University (UK) in 2007, and did postdoc in France and UK before joining Institute of Physics, Chinese Academy of Science (Beijing) in 2011. Now, he is a professor in Institute of Photonics Technology, Jinan University (Guangzhou). He has published more than 40 papers in international journals with H-index of 15 (Web-of-Knowledge). His research interests include micro-structured optical fiber, integrated photonics, optical fiber communications, nonlinear optics, and nanophotonics.

- 11:00-11:30, August 8 -

The linewidth enhancement factor of multimode VCSELs and its impact in multimode fiber links

Adrian A. Juarez

Corning Research and Development Corporation, USA

Abstract

Multimode fibers together with multimode VCSELs are currently used in data centers for short distance optical communications due to its cost effectiveness and power efficiency. As capacity demands rise and the overall throughput through the fiber increases, effects that were not taken into consideration in the past need to be evaluated and its effect understood more carefully. The interaction of chromatic dispersion in single mode fiber and the linewidth enhancement factor has been studied in the past and found relevant for several transmission systems. This effect is studied here numerically, and its impact analyzed for multimode fiber links with relevant systems lengths as found in data center applications. For this purpose, a state of the art multimode VCSEL model was enhanced and matched to a series of measurements performed on a 25G VCSEL and its interaction with multimode fiber studied using PAM4

modulation format. Results show that the interaction of the linewidth enhancement factor of multimode VCSELs with the chromatic dispersion in multimode fibers can have a significant impact on the transmission performance even at short distances. This has also led to the development of a measurement technique which enables the measurement of the linewidth enhancement of the multimode VCSEL for each transverse mode. First results seem to indicate that the linewidth enhancement factor only varies slight between different transverse modes of the multimode VCSEL.

Biography

Dr. -Ing. A. Juarez received his Dipl. -Ing. degree in electrical engineering in 2009 and his PhD in fiber optics communications in 2015 from the Technical University of Berlin (TUB). He then joined Corning Optical Communications in Berlin where he worked until 2018 in topics related to active optical cables and optical short links for data center applications. Since September 2018 he has joined the modeling group in Corning Research & Development Corporation in Corning, NY, USA where he has been investigating multimode VCSELs and their interaction with multimode fiber.

- 11:30-12:00, August 8 -

Advanced optoelectronic and electronic multi-material fiber devices

Wei Yan
Massachusetts Institute of Technology, USA

Abstract

Optoelectronic and electronic systems that can offer performances of planar, rigid wafer-based devices but with the attributes of flexible, bendable, soft, stretchable and wearable are opening a breadth of unique applications. In particular, the recent development of thermal drawing – the same process used to fabricate optical fibers – of different materials with disparate properties into one-dimensional fibers paves a novel way towards advanced optoelectronic and electronic functionalities over unconventional substrates. In this presentation, I will show this approach provides a compelling platform for the production of unconventional optoelectronics and electronics as well as fundamental research in materials science and physics. I will first show how we can fabricate an electrically addressed polycrystalline semiconductor domain with ultra-large grains, controllable crystallization depth as well as preferentially crystallographic orientations in optoelectronic fibers by controlling the nucleation and growth of the semiconductor. These fibers exhibit high performance that is comparable to that of commercial Si devices. By engineering interfacial energy of crystal planes of semiconducting materials in solution, I will then show that we are able to fabricate single-crystal nanowire-based optoelectronic fibers. The resulting nanowire-based fiber devices exhibit an unprecedented combination of excellent optical and optoelectronic properties in terms of light absorption, responsivity, sensitivity and response speed that compare favorably with other reported nanoscale wafer-based devices. We have demonstrated the unique capability of these functional fibers for fluorescent imaging based on a single fiber exhibiting simultaneous efficient optical guidance and excellent photodetecting performance.

Biography

Wei Yan obtained his M.S. degree from Shenyang National Laboratory for Materials Science at the Institute of Metal Research, Chinese Academy of Science in 2013 and Ph.D. degree from the department of Materials Science and Engineering at the Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland, 2017. Currently, he is a postdoctoral fellow at the Research Laboratory of Electronic at the Massachusetts Institute of Technology (MIT), USA. His research interests focus on fiber-shaped flexible and stretchable electronics and optoelectronics for applications in sensing, energy harvesting, robotics, smart textiles, artificial intelligence, healthcare and neuroscience as well as the fundamental study of in-fiber functional materials.

- 13:30-14:00, August 8 -

Highly efficient in-fibre diffraction grating for fiber and free-space interface

Chao Wang
University of Kent, UK

Abstract
Optical diffraction elements (ODEs) are key components for innovative applications based on spectral encoding. Two most recent examples are wavelength-controlled laser beam steering for optical wireless communication and wavelength-to-space mapping for photonic time stretch imaging. Most commonly used ODEs are free-space ruled or holographic diffraction gratings, which however suffer from some inherent drawbacks, such as bulky construction, limited diffraction efficiency (up to 75%) due to the inherent zeroth-order reflection, and high coupling loss between free-space diffraction gratings and optical fibres in the system. In this work, we report the use of a 45° tilted fiber grating (TFG) as a highly efficient, low cost and compact in-fiber diffraction grating device. Compared to conventional free-space diffractive devices, the in-fibre diffraction device provides significant advantages of high diffraction efficiency (99%), compactness, low cost and inherent fiber-compatibility, and holds great promise in fibre and free-space interaction. Its superior performance in beam-steered optical wireless transmission and ultrafast photonic time-stretch imaging is presented with experimental demonstrations.

Biography
Chao Wang received his BEng degree from Tianjin University in 2002, MSc degree in Optics from Nankai University in 2005, and Ph.D degree in Electrical and Computing Engineering from University of Ottawa in 2010. From 2011 to 2012, he was a NSERC Postdoctoral Fellow at the University of California, Los Angeles (UCLA). He is currently a Senior Lecturer (Associate Professor) in the School of Engineering and Digital Arts at the University of Kent, UK, where he first joined as a Lecturer in 2013. His research interests lie in microwave photonics, ultrafast optical imaging, optical communications, and optical sensing. His research activities have been well funded by EU Marie-Curie Actions, the Royal Society, and the Engineering and Physical Sciences Research Council (EPSRC) and Catapult of UK. He was the recipient of Graduate Fellowships from both IEEE Photonics Society (2009) and IEEE MTT Society (2010), Chinese Government Award for Outstanding Self-Financed Students Abroad (2009), NSERC Postdoctoral Fellowship (2011) and EU Marie Curie CIG Award (2014).

- 14:00-14:30, August 8 -

Large nonlinear optical amplification in gases: from sensing to lasing

Fan Yang
EPFL, Switzerland

Abstract
We exploit stimulated Brillouin scattering in gases to achieve unprecedented nonlinear optical amplification. The gain coefficient is 10 times larger than any reported nonlinear gain in gas-filled hollow-core photonic crystal fiber and 6 times larger than the strongest nonlinear gain in standard silica single-mode fiber (SMF). This massive gain enables us to achieve high performance distributed temperature sensing and low threshold Brillouin lasing. For sensing, ~1 cm spatial resolution and 0.3 oC temperature resolution is demonstrated, fully free of strain cross sensitivity, a major impairment in all Brillouin-based sensing systems. Substantially higher performance is obtained by virtue of the higher Brillouin gain, narrower gain linewidth and relaxed optical power restrictions when compared to solid silica SMF. A gas Brillouin laser with 140 mW threshold power is also realized. These systems can be designed to operate at any

SC13

wavelength from vacuum ultraviolet to mid-infrared thanks to the nature of stimulated Brillouin scattering. These open new avenues in gas-based nonlinear optics and distributed fiber sensing, with possibilities of large amplification, new light sources as well as sophisticated all-optical signal processing in hollow-core fibers.

Biography

Fan Yang received his B.Sc. and M. Sc. Degrees from Huazhong University of Science and Technology, and the PhD degree in Electrical Engineering from The Hong Kong Polytechnic University. He is now a postdoctoral researcher in the Group for Fibre Optics (GFO) at École Polytechnique Fédérale de Lausanne (EPFL). His research to date has resulted in more than 20 peer-reviewed journal publications in the fields of gas-based nonlinear optics, laser spectroscopy, photonic crystal fiber and distributed fiber sensing.

- 14:30-15:00, August 8 -

Large-mode-area single-mode Yb^{3+} doped fiber for high power fiber laser

Jinyan Li

Huazhong University of Science and Technology, China

Abstract

Fiber lasers are now associated with high average powers and high beam qualities. Both these characteristics, which required by many industrial, defense and scientific applications, are mainly founded on the large-mode-area single-mode gain fiber. In this report, we have reviewed the fabrication and performance of the Yb^{3+}-doped large-mode-area single-mode fiber. We will focus on the PD and the MI that limit the power stability and beam quality of the high power fiber laser. It is suggested that the core composition, structure design and fiber fabrication are the fundamental ways to improve the performance of Yb^{3+} doped fiber. With the deep research on photo-bleaching, it is now an available solution to mitigate PD. Additionally, we introduce recent advance in ultra-wideband fiber amplification and fiber laser based on mesoporous silica glass in detail.

Biography

Jinyan Li obtained PhD from Shanghai institute of optics and fine mechanics, Chinese Academy of Sciences (CAS) in 2001. He joined in the Wuhan National Laboratory for Optoelectronics since 2008 and promoted as full professor in 2008. He is currently an deputy director of the Laser and THz Performance Laboratory of the Wuhan National Laboratory for Optoelectronics. During the long career on special fiber preparation and its amplification and laser field, he has published more than 100 peer review papers in ACS photonics, nanoscale, Optics express, Optics Letter etc. more than 70 invited talks in domestic and international conferences. As the first contributor, he won 2 provincial second award on technology invention and 1 ministry first awards on science and technology.

- 09:00-09:30, August 9 -

Preparation and application of Yb:YAG crystal derived silica fibers

Zhaojun Liu

Shandong University, China

Abstract

Fiber lasers have a wide range of applications for their excellent performances. We have fabricated a novel Yb:YAG-derived silica fiber (YDSF) using a Yb:YAG crystal as the core material and a high-purity silica tube as the cladding material. Using this approach, the fiber combines some characteristics of YAG crystals and silica glass fibers. It possesses characteristics including high rare-earth doping potential, high thermal conductivity, high SBS threshold,

SC13

and low photodarkening effect. These properties indicate that this kind of fibers have the potential to realize high-power lasers and single-frequency lasers. The fiber was fabricated with a molten-core method. The gain coefficient and transmission loss at 1.06 μm were measured to be 1.7 dB/cm and 0.018 dB/cm, respectively. Using the YDSF, an all-fiber-integrated cladding-pumped laser was demonstrated. With an incident pump power of 28 W, an output power of 6 W was obtained at 1.06 μm. This is the highest power achieved in similar YDSF lasers. The corresponding slope efficiency was 21.7%. In addition, with the distributed Bragg reflection structure, we obtained a single-frequency output with a maximum output power of 110 mW with a slope efficiency of 18.5%. The linewidth was 93 kHz.

Biography

Zhaojun Liu, Doctor of Engineering, Professor, Doctoral Supervisor, School of Information Science and Engineering, Shandong University, Distinguished Young Scholar of Shandong University, Postdoctoral Fellow, Lehigh University, USA. Associate Dean of School of Information Science and Engineering, Shandong University, Deputy Director of Key Laboratory of Laser and Infrared System Integration Technology of the Ministry of Education. He is a review expert for projects such as the National Natural Science Foundation and reviewer of publications such as Opt. Lett., Opt. Express, IEEE Photonics Techno. Lett. The main research directions include fiber material preparation technology, distributed fiber optic sensing technology, single-frequency laser technology, etc.

- 09:30-10:00, August 9 -

New approaches of producing multi-materials, multi-functional fibers—a play around viscosity

Chong Hou

Huazhong University of Science and Technology, China

Abstract

Multi-materials, multi-functional fibers integrate different materials (like metal, semiconductor, insulator, etc.) to perform various functionalities within one fiber. Such fibers would find lots of interesting applications in security, energy, and bio-related areas. Centering to these multi-materials fibers is a fiber fabrication method called “co-draw” in which a macro-scale preform is firstly designed and fabricated, and then heated and get elongated into meters-long fiber. During the thermal drawing process, all the fiber materials get softened and shrunk to a much smaller scale proportionally. In this process one of the fiber materials’ thermal property, i.e. viscosity, plays an important role, as people need to manage it to prevent the complex structure inside the fiber distorted. Study and utilize this thermal property, or work around this thermal limit is of interest both in science and in engineering. Here we demonstrate a few works that explore different possibilities around the viscosity to achieve new materials and new structures inside the fiber. These works (1) uses the viscosity contrast to induce the selective thermal breakup for a ladder-like structure in the fiber, or (2) control the viscosity to get fibers with a surface structure feature down to nanometer scale, or (3) design a chemical reaction to synthesize materials during the fiber production process to overcome the limit of the viscosity restriction. Benefitting from the new materials and the new structures inside the fiber which otherwise will not be normally possible, a fiber device with better performance or more functionalities is thus realized.

Biography

Dr. Chong Hou is a professor in School of Optical and Electrionic Information (SOEI) in Huazhong University of Science and Technology (HUST). His main research interests include multi-material multi-functional fibers and their applications on energy, sensing, healthcare, and environment. He obtained his B.S. (2009) and Ph.D (2016) degree from Peking University and MIT, respectively. He is the recipient of the 1000 Young Award in 2019.

- 10:00-10:30, August 9 -

Distributed fiber-optic acoustic sensing for petroleum geology exploration

Jiasheng Ni
Shandong Province Key Laboratory of Optical Fiber Sensing Technology, China

Abstract
Seismic geophones are widely used to get stratum information in petroleum geophysical exploration. As one of the most advanced sound field detection technology, optical fiber distributed acoustic sensor (DAS) have many superiorities, such as easy deployment, high cost performance ratio, wide range measurement and so on. In this Presentation, DAS technology that using interferometric demodulation is introduced. Principal, demodulation algorithm, and parameter test are researched in detail. Furthermore, a ground geophysical prospecting test is implemented and a very clearly seismic section image is drawn out. Performance and test data of the DAS are discussed in detail. Convenient, large data and big coverage make it potentially better suited for geophysical prospecting applications.

Biography

Jiasheng Ni is associate Professor, director of special fiber research center at the Laser Institute of Shandong Academy of Sciences, of laser Institute of Shandong Academy of Science. From 2014 to 2015, he was a senior visiting scholar at the UNSW, Australia. His current research interests include optical fiber laser and optical fiber sensors.

- 11:00-11:30, August 9 -

Optical microcavity acoustic sensor technology

Ping Lu
Huazhong University of Science and Technology, China

Abstract
Due to the overwhelming advantages compared with traditional electronic sensors, fiber-optic acoustic sensors have arisen enormous interest in multiple disciplines. In this paper, we present the recent research achievements of our group on weak acoustic signal detection technology. The main point of our research is diaphragm based Fabry-Perot acoustic sensors, including gold, aluminium, titanium, graphene and micro-electromechanical systems (MEMS) based silicon nitride diaphragm. These acoustic sensors show high sensitivity and wide detection frequency band. In addition, high precision acoustic signal interrogation technology and sensitivity enhancement technology are also proposed. Moreover, our attention has also been paid on lock-in amplifying technology to extract weak acoustic signal efficiently.

Biography

Ping Lu , Professor ,Ph.D.She graduated from huazhong university of science and technology to obtain a Ph.D in Electronic science and technology, who was promoted to associate professor and professor in 2006 and 2011 respectively , and was engaged in postdoctoral research work in Optical Sciencs Center of University ofArizona during 2009-2010 .Her mainly research work include Fiber sensor, Fiber laser,Fiber optics. She has published more than 50 well-known international journal papers and apply for more than 20 national invention patents.

- 11:30-12:00, August 9 -

Fading elimination in Φ-OTDR with coherent detection

Zinan Wang
University of Electronic Science and Technology of China, China

Abstract

The interference fading, which is detrimental for signal retrieval in phase-sensitive optical time-domain reflectometry (Φ-OTDR). In this talk, we will theoretically describe and experimentally verify how the fading phenomenon in fiber will be suppressed with an arbitrary number of independent probing channels. Furthermore, fading phenomenon is analyzed in frequency domain, and a novel spectrum extraction and remix method is proposed to achieve fading-free operation for Φ-OTDR with heterodyne detection, utilizing single rectangular probe pulse and makes full use of its spectral contents. The operation principle is theoretically analyzed, and it is well confirmed by both simulation and experimental results.

Biography

Zinan Wang received the PhD degree from Beijing University of Posts and Telecommunications, China, in 2009 (During 2007-2009, he was with Alcatel-Lucent Bell Labs as a visiting student). He was with Cornell University, as a postdoctoral research associate during 2009-2010. He joined University of Electronic Science and Technology of China in 2010, and became a full professor since 2015. His research interests include distributed fiber sensing and nonlinear fiber optics. He has published more than 130 papers in international journals and conference proceedings, and he is holding 16 Chinese patents and 2 US patents. He has given more than 18 invited talks at academic conferences, and served as TPC member for a number of conferences. His research was highlighted in 'Optics in 2014' by OSA Optics and Photonics News. He is a recipient of IOP Publishing Top Cited Author Award (China) in 2018. Zinan Wang is an Associate Editor for both IEEE Photonics Technology Letters and IEEE Access, and he is an IEEE & OSA Senior Member.

- 13:30-14:00, August 9 -

Nanocrystal-doped glass and fibers for enhanced laser output

Guoping Dong
South China University of Technology, China

Abstract

Optical glass and fiber working in near/mid-infrared (NIR/MIR) region are extensively investigated owing to their various potential applications. Quantum dot (QD, such as PbS) doped glass with tunable broadband NIR emission and rare-earth-ion (such as Er^{3+}) doped glass ceramics with enhanced NIR/MIR emission are well suitable for the above-mentioned applications. Importantly, the QD/nanocrystal-doped glass fibers are fabricated by the modified fiber-drawing method, which provides an ingenious way to break through the bottleneck problem of uncontrollable rapid growth of nanocrystals existing in traditional fiber-drawing method. Furthermore, thermal and optical properties between fiber core and cladding glass are well matched, which ensure that the structure of the precursor fiber is well preserved during the fiber-drawing process. The excellent spectroscopic characteristics and well-preserved structure indicate that the obtained QD/nanocrystal-doped glass fiber may be a promising gain fiber material. The experimental results also confirm that enhanced single mode laser output are realized in nanocrystal-doped glass fiber.

Biography

Guoping Dong received his PhD degree from Shanghai Institute of Optics and Fine Mechanics, CAS in 2010, where he received the "Chinese Academy of Sciences President Award" in 2010. Since then, he worked in South China University of Technology as a research assistant (2010), associate professor (2011) and full professor (2014). And he has been leading his own research group about the optical functional glass, optical fiber and devices. He has coauthored about 150 peer-reviewed papers with around 4000 citations. He is the author of 1 book chapters and >20 authorized patents. He has been Session Chair/Organizing Committee Member for more than 20 conferences. He was also invited to give ~30 Invited Talks in various conferences, including International Congress on Glass (ICG), ISNOG, GOMD, LTO, IUMRS-ICEM, etc. He has received "Guangdong Natural Science Award (second-class)", "Guangdong Natural Science Foundation for Distinguished Young Scholars", etc. His current research interests are focused on the design, fabrication and photoelectronic properties of novel photonic material and devices.

- 14:00-14:30, August 9 -

Realization of 6 kW single mode fiber laser with LD pumping and high SRS suppression

Shaofeng Guo
Hunan DK Laser Co., Ltd, China

Abstract

A LD-pumped 6 kW Yb-doped single mode fiber laser at 1080 nm has been demonstrated, which represents the highest level of single mode fiber laser in this scheme. Different from the traditional tandem pumping, the fiber laser is directly pumped by 976 nm laser diodes for higher wall-plug efficiency and more compact structure. In this paper, we discuss some methods which are adopted for high stimulated Raman scattering (SRS) suppression in the MOPA system. Numerical simulation is conducted to optimize parameters of the components to balance the requirements of the high power, pump slope efficiency and SRS suppression. Experimentally, based on all fiber construction 6 kW output power with M22 and Raman suppression ration better than -20 dB is obtained. This laser can be widely used in industrial processing, scientific research and other applications with strict demands on beam quality and power level.

Biography

Shaofeng Guo received his Ph.D. degree in Optical Engineering from National University of Defense Technology (NUDT) in 2003, and did post-doctor in Chinese Academy of Science from 2004 to 2006. He visited CREOL in University of Central Florida from 2009 to 2010 then worked in NUDT until 2016 as a professor. Now, he is the CEO of Hunan DK laser company. He has published more than 30 papers in international journals and has more than ten patents. His research interests include high power fiber lasers, fiber components and nonlinear optics.

- 14:30-15:00, August 9 -

Development of ultra-fine-diameter polarization-maintaining fiber and its potential application in miniaturized fiber optic gyroscope

Zhenggang Lian
Yangtze Optical Electronic Co. Ltd., China

Abstract

Fiber optics are small structure that is easy to deploy and install, and has a profound impact in the many field, e.g. telecommunication, laser and sensing. However, considering a wide range of applications, complex structures and more functions will be an important research direction; at the same time, optical devices that tend to be miniaturized

in size. This report introduces the design, development, and strength testing of ultra-fine-diameter polarization-maintaining fibers, focusing on bending loss and strength reliability. The second part is based on the developed ultra-fine diameter fiber, a fiber ring was winded as small as 40 mm diameter, then assembled to a small size fiber optic gyroscope. An opto-electronic sensing capability was demonstrated that combines multi-functions into a two-wheel balance car, include the functions like self-balancing and single line LiDar.

Biography

Zhenggang Lian, obtained bachelor's degree and Ph.D. degree in Electronic Engineering from the University of Nottingham, in 2006 and 2010 respectively. He then worked in the Optoelectronics Research Centre at the University of Southampton; generated more than 40 articles. From the year of 2014, he has been working in Wuhan Yangtze Optical and Electronics Co.; and oversee the R&D department. In 2016, he joint Huazhong University of Science and Technology as part-time professor. He is associate editor of <Optical and Quantum Electronics> and the director of Wuhan Optics Valley Metrology Centre. He led a team to develop new specialty optical fibers and responsible for 10 national research projects. His research interests include design / optimizing specialty optical fibers; the main target application are fiber sensing, fiber laser, and IR transmission. He has achieved a total output value nearly 100 million RMB per year, in industry.

Oral Talks

CIOP2019-2019-000283 (15:00-15:15, August 7)

Q-switched Erbium-doped fiber laser incorporating a hybrid plasmonic microfiber knot resonator

Bingbing Lu[1], Ding Zixuan[2], Mou Chengbo[1*], Fei Xu[2]
1. Shanghai University, China
2. Nanjing University, China

Abstract: A Q-switched Er-doped fiber laser is demonstrated based on hybrid plasmonic microfiber knot resonator (HPMKR). The repetition rate of the Q-switched pulse changes from 1.93 kHz to 11.73 kHz by increasing the pump power.

CIOP2019-2019-000317 (15:15-15:30, August 7)

Ionization-induced adiabatic soliton compression in gas-filled photonic crystal fibers

Zhiyuan Huang, Yifei Chen, Fei Yu, Ding Wang, Yuxin Leng
Shanghai Institute of Optics and Fine Mechanics, CAS, China

Abstract: We experimentally report the generation of soliton-plasma-driven blueshifting solitons whose wavelengths can be continuously tuned over 300 nm through ionization-induced adiabatic soliton compression in He-filled photonic crystal fibers.

CIOP2019-2019-000303 (17:00-17:15, August 7)

The study of broadband OAM mode converter based on helical long period fiber grating in dispersion turning point

Kaili Ren, Jihong Liu, Minhui Cheng
Xi'an University of Posts and Telecommunications, School of Electronic Engineering, China

Abstract: Based on the phase matching turning point in helical long-period fiber grating, a broadband orbital angular momentum modulator with a bandwidth up to 100 nm and a uniquely effective coupling mode is proposed and investigated.

CIOP2019-2019-000175 (17:15-17:30, August 7)

Ultra-low-modal-crosstalk double-ring-core FMF for weakly-coupled MDM transmission

Lei Shen, Lei Zhang, Jie Luo, Rui Zhang
Yangtze Optical Fibre and Cable Joint Stock Limited Company, China

Abstract: We design and fabricate a weakly-coupled ring-core 6-mode fiber with a minimum Δneff of 1.49×10^{-3}, based on which 71-km WDM-MDM transmission through 6-modes and 4 wavelengths with OOK modulation and MIMO-free direct detection is experimentally demonstrated.

CIOP2019-2019-000216 (10:00-10:15, August 8)

Investigation of whispering gallery modes in a liquid-filled hollow glass microsphere

Bojian Shi, Weiqiang Ding
Department of Physics, Harbin Institute of Technology, China

Abstract: We investigated the hollow whispering gallery mode microcavity, in which the WGM resonance position is transferred with changes in the core refractive index.

CIOP2019-2019-000306 (10:15-10:30, August 8)

The cabling and splicing performance of terrestrial G.654.E fiber

Peng Li
Yangtze Optical Fibre and Cable Joint Stock Limited Company, China

Abstract: The terrestrial G.654.E cable performances in the long term high temperature and the long low temperature are investigated.Splicing parameters ofoptical fusion splicer are researched to get smaller splicing loss for the G.654.E fiber.

SC13

CIOP2019-2019-000064 (15:00-15:15, August 8)

A novel chalcohalide glass fiber with high nonlinearity but low material zero-dispersion via extrusion

Zheming Zhao[1*], Xunsi Wang[2], Jingfei Shen[1]
1. Jiaxing University, China
2. Ningbo University, China

Abstract: We developed a novel approach to peel off the bad surfacelayer of ChH glass rodsby the extrusion method and prepared a robust, high nonlinear chalcohalidestep-index fiber with an ultra-low material ZDW

CIOP2019-2019-000208 (15:15-15:30, August 8)

Theoretical investigation of the fast light at double Brillouin gain lines in an optical fiber

Wenhao Guo, Shanglin Hou, Jingli Lei, Daobin Wang, Xiaoxiao Li, Dongming Wu
Lanzhou University of Technology, China

Abstract: Through the numerically simulated the SBS fast light of dual-pump broadband Brillouin gain spectrum by changing the frequency separation. The fast light can be generated between the double gain lines as d from 1 to 5.25.

CIOP2019-2019-000192 (15:00-15:15, August 9)

Ultrasensitive elliptic microfiber based Sagnac interferometer operating at group birefringence turning point

Zihao Yuan, Tiansheng Huang, Yuchen Ge, Li-Peng Sun, Jie Li, Linghao Cheng, Bai-Ou Guan
Institute of Photonics Technology, Jinan University, Guangzhou 510632, China

Abstract: This work focuses on the demanding optical fiber gas sensors and we demonstrate an ultrasensitive elliptic microfiber based Sagnac interferometer operating at group birefringence turning point, which have a good performance in gas detection.

CIOP2019-2019-000020 (15:15-15:30, August 9)

Researches on phase mask method-based phase-shifted fiber grating fabrication and sensing properties

Danqing Yang
Xi'an Shiyou University, China

Abstract: In this paper, a simple phase-shifted fiber grating (PSFG) inscription technique based on screening method was demonstrated, in which a standard single-mode fiber (SMF) was irradiated by 193 nm excimer laser beam (ELB) via phase mask (PM). During the inscription processes, a small segment of filament with the diameter of 1mm was perpendicularly inserted in the exposure area to cover the SMF before the ELB was irradiated into the SMF, thus the PSFG will be inscribed.

SC14 Biophotonics and Optofluidics

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Advances in integrated multimodality intravascular imaging for assessing and characterizing atherosclerotic plaques (Tutorial)

Zhongping Chen
University of California, Irvine, USA

Abstract
Atherosclerosis is one of the major causes of morbidity and mortality. This presentation reports on the development of integrated multiple modality intravascular imaging techniques for the identification and evaluation of vulnerable plaques. The integrated imaging technology combines the high-resolution capabilities of optical coherence tomography (OCT), deep penetration depth of intravascular ultrasound (IVUS), molecular sensitivity of fluorescence and photoacoustic (PA) imaging, and mechanical contrast of phase-resolved acoustic radiation force optical coherence elastography (ARF-OCE) to characterize plaques. In vitro images of pathologic human coronary arteries, as well as in vivo images of normal rabbit abdominal aorta, were obtained using the integrated probe, which demonstrated the feasibility of the integrated system in intravascular imaging and its potential in the detection of vulnerable atherosclerotic plaques. The presentation will discuss advances made thus far, as well as the challenges that remain to translate this technology from the bench to clinical bedside.

Biography
Dr. Zhongping Chen is a Professor of Biomedical Engineering and Director of the OCT Laboratory at the University of California, Irvine. He is a Co-founder and Chairman of OCT Medical Imaging Inc. Dr. Chen received his B.S. degree in Applied Physics from Shanghai Jiao Tong University in 1982, his M. S. degree in Electrical Engineering in 1987, and his Ph.D. degree in Applied Physics from Cornell University in 1993. Dr. Chen's research group has pioneered the development of functional optical coherence tomography (OCT), including Doppler OCT, phase resolved OCT, and optical coherence elastography. He has published more than 280 peer-reviewed papers and review articles and holds a number of patents in the fields of biomaterials, biosensors, and biomedical imaging. Dr. Chen is a Fellow of the American Institute of Medical and Biological Engineering (AIMBE), a Fellow of SPIE, and a Fellow of the Optical Society of America.

- 14:15-14:45, August 7 -

Nucleic acid based bioassays with active centrifugal microfluidics

Ho-Pui HO
The Chinese University of Hong Kong, Hong Kong, China

Abstract
The next generation of healthcare infrastructure is destined to be highly personalised, which relies on accurate analysis of health-related medical data. Rapid low-cost point-of-care bio-detection devices therefore have a significant role for data collection. The lab-on-a-chip (LoC) approach, which brings together the benefits of miniaturisation due to microfluidics and integrated smart electronics for bioassay applications, is certainly the direction to go for. In this presentation, we report the use of centrifugal force the realisation of LoC. We have developed a so-called lab-on-a-disc

(LOAD) system, capable of conducting sample-to-answer bioassays at point-of-care level. Centrifugal forces generated by spinning a sample disc have been conveniently used for the actuation of multiple fluidic samples and reagents in a highly parallel and controllable manner. We have developed a wireless power coupling scheme for driving the active devices in the disc platform. Real-time data transfer is achieved with the use of a wireless communication port. This active LOAD device is capable of performing a series of sample processing steps, including transfer of samples and reagents between microchambers, cell lysis, temperature cycling for DNA amplification and detection through monitoring of fluorescence. As demonstration experiments, we report successful screening of drug allergy genetic markers from blood samples and detection of infectious diseases.

Biography

Ho-Pui HO (Aaron) received his BEng and PhD in Electrical and Electronic Engineering from the University of Nottingham. Currently a professor in the Department of Biomedical Engineering, The Chinese University of Hong Kong. Started as a compound semiconductor materials scientist, his current academic interests focus on nano-sized semiconductor materials for photonic and sensor applications, optical instrumentation, surface plasmon resonance biosensors, lab-on-a-chip and biophotonics. He has published over 300 peer-reviewed articles, 32 Chinese and 6 US patents. He is a Fellow of SPIE.

- 14:45-15:15, August 7 -

Deep-learning assisted stimulated Raman histology

Minbiao Ji
Fudan University, China

Abstract

Stimulated Raman scattering (SRS) microscopy is an emerging label-free imaging technique. It is a nonlinear version of Raman scattering, with the advantages of high chemical selectivity and rapid imaging. We developed dual-phase parallel imaging technique for real-time two color SRS imaging, which provides a key advance for intraoperative virtual histology. We further extend our study to image various human diseases, including pancreatic, laryngeal and brain cancers. Furthermore, we have developed a deep-learning based algorithm to classify lesion and non-lesion tissues, which could aid rapid, intraoperative diagnosis.

Biography

Dr. Minbiao Ji received B.S. degree in Physics from the Peking University, Beijing, in 2001. He received his Ph.D degree in Physics at Stanford University, in 2011. His research was focused on using ultrafast laser spectroscopy to study various chemical dynamics, including hydrogen-bond dynamics in water, and transient dynamics of carriers and enzyme molecules. Afterwards, he joined the research group of Prof. Sunney Xie at Harvard University as a postdoctoral research fellow, where he learnt the technique of coherent Raman scattering microscopy and applied it to various biomedical researches. Minbiao Ji is currently a Professor in the Department of Physics in Fudan University, Shanghai, where he won the “Thousand Youth Talent Plan” in 2015. His current research is focused on developing novel nonlinear optical spectroscopy and microscopy tools to study biomedical and material sciences.

- 16:00-16:30, August 7 -

Biomedical photonics: from imaging to theranostic applications

Junle Qu
Shenzhen University, China

Abstract

Biomedical photonics, which involves a fusion of photonics and biomedicine, deals with interaction between light and biological matter. The use of photonics for optical diagnostics, as well as for light-activated and light-guided therapy, has an increasing impact on health care in recent years. The challenges for future development of optical diagnostics and therapy include limited penetration depth, diffraction limited spatial resolution for optical imaging, as well as the complicated mechanism of light-tissue interaction on a broad range of length scale. In addition, the use of light for therapy and treatment, e.g, in photodynamic therapy (PDT), is limited by the penetration and is increasingly dependent on combining different imaging modalities with light-activated therapies, in particular drug-free light treatment. In this talk, I will first present our recent work on biomedical optical imaging, including multimodal, NIR & Short wave IR, as well as superresolution optical imaging. Then, I will discuss the ideas to expand the scope of conventional PDT by using nonlinear photon upconversion of the NIR light and demonstrate how the nonlinear interactions of NIR light can open a new avenue for transformational advances in PDT. I will also show that direct irradiation of cells with low level NIR light can cause reactive oxygen species (ROS) generation, changes in lipid metabolism and lipid droplet formation, membrane depolarization and Ca^{2+} influx. These can all result in cancer cell apoptosis and death, providing basis for development of drug-free PDT of type I. In the future, the theranostic approach can be developed combining type I and type II PDT pathways and involving nonlinear optical imaging.

Biography

Junle Qu graduated from the Department of Electronic Engineering, Xi'an Jiaotong University with a BE degree in 1992. He graduated from Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences with a Ph.D. degree in 1998. From 2001 to 2003, he was working as a postdoctoral fellow in the School of Optometry at Indiana University in USA. Since 2003, he has been working in the Institute of Optoelectronics and the College of Optoelectronic Engineering, Shenzhen University. He is currently a Professor of Optical Engineering at Shenzhen University. His research interests include nonlinear optical microscopy, fluorescence lifetime imaging, super resolution optical imaging and their applications in biomedicine, imaging guided optical therapy. He has published more than 200 papers in peer reviewed journals such as Nature Photonics, Nature Communications, Chemical Society Reviews, Advanced Materials, Chem, Optics Letters etc. He is the Fellow of SPIE and the director of Biomedical Photonics Committee of Chinese Optical Society. He serves in the editorial boards of JIOHS, Frontiers of Optoelectronics etc.

- 16:30-17:00, August 7 -

High speed two-photon Bessel light-sheet microscope for neural imaging

Jun Ding
Stanford University, USA

Abstract

Studying neural activities in brain requires rapid volumetric imaging in deep tissue. Conventional two-photon microscopy has a decent penetration depth in the scattered brain tissue, but its sequential point-scanning method limits the imaging volume and speed. We developed a multi-modality two-photon Bessel light sheet microscope that enables large field of view light-sheet imaging and high-speed 3D projection imaging for neural activities. The microscope uses a Bessel beam to illumination a 250-μm-wdie field of view. It has two distinct imaging mode: the light-

SC14

sheet scanning mode and the projection mode. The light-sheet scanning mode enables sub-micron 3D imaging over the entire field of view. Structured illumination could be combined to reject the scattered emission and enhance image clarity on fine neural structure in deep brain tissue layers. The projection mode uses the two-photon Bessel beam to scan across tissue at up to 100 volumes per second. It captures dual-view projection images with two objectives oriented at 90-degree angle. Neural activities are imaged in two orthogonal projections simultaneously and analyzed in 3D at the millisecond timescale.

Biography

Dr. Jun Ding obtained his B.S. degree from Department of Biology, East China Normal University in 1998, and Ph.D. degree in Neuroscience from Northwestern University in 2002. After his postdoctoral training at Harvard Medical School, he joined faculty at Department of Neurosurgery, Stanford University School of Medicine in 2012. The Ding laboratory studies the neural mechanisms of movement control. The Ding lab uses a multidisciplinary approach, including combined physiology and 2-photon imaging, to study neural circuits ex vivo and in vivo.

- 08:30-09:15, August 8 -

Near-Infrared organic semiconducting optical platform for theranostic application (Tutorial)

Quli Fan

Nanjing University of Posts & Telecommunications, China

Abstract

Near-infrared (650-1700 nm) optical platform with spatiotenporal control, minimal invasiveness, deep tissue penetration and fine spatial resolution is a promising tool for precise understanding and theranostic of diseases. We synthesized many near-infrared absorption/fluorescence materials with excellently optoelectronic and biochemical performance, and polish them into smart and biocompatible optics based-theranostic probes for advanced molecular imaging and enhanced therapy. Including three major research interests. Nonlinear optical platform: Developing nonlinear optical absorption materials with simple structure yet unprecedentedly high two-photon absorption cross-section used to detect pathological-parameter and implement target-specific-activitable photodynamic therapy. Photoacoustic imaging platform: We developed endogenic and biodegradable organic materials as nano-photoacoustic probes with strong near-infrared absorption and good biocompatibility for brain tumor and pathological-parameter imaging, monitoring thrombolysis and photothermal therapy. NIR-II (1000-1700 nm) fluorescence imaging platform: To solve the lack of target-specific NIR-II fluorescence probes, a generic activitable probe design strategy using bio-erasable intermolecular donor-acceptor interaction was firstly developed to provide guidelines to design activatable NIR-II fluorescence probe for target-specific imaging. Furthermore, the concept of multi-pathological-parameter cooperatively activatable NIR-II fluorescence probe was proposed, implementing ultra-high target-specific imaging. Our works offer many opportunities to construct near-infrared optical platform for precise theranostic.

Biography

Dr. Fan obtained his Ph.D. degree from National University of Singapore (NUS) in 2003. He joined the Institute of Advanced Materials at Fudan University in 2003. In 2006, he moved to Nanjing University of Posts & Telecommunications and then was promoted to full professor in 2007. From 2012 to 2014, he came to Stanford University as a visiting scholar to explore the potential applications of organic semiconducting materials in theranostics. Currently, his research interests mainly focused on the development of organic semiconducting materials for theranostic applications including photoacoustic imaging, photodynamic therapy, and photothermal therapy. To date, Dr. Fan has published more than 120 journal papers with citation over 4000 and H-index of 46.

- 09:15-09:45, August 8 -

Turning the tide on upconversion cross-relaxation via energy transition engineering

Timothy Tan
Nanyang Technological University, Singapore

Abstract

Cross-relaxation in lanthanide nanoparticles has always been deemed deleterious in upconversion emissions, especially so for lanthanide ions with multiple energy states. Such ions, when placed within close proximity, encourage cross relaxation energy transfer leading to loss in upconversion quantum yield. In this talk, I will show that cross-relaxation may not always be undesirable in upconversion processes. First of all, I will share some of our understanding of cross-relaxation processes, and through this understanding, we turn the tide around and exploit cross-relaxation for tuning single upconversion emission. We also learn ways to overcome its deleterious effects through a nanostructuring technique and achieve 808 nm near-infrared activated photodynamic therapy. Finally, I will showcase putting cross-relaxation into good use in one of the highest photothermal efficiency attained in tumor photothermal therapy with simultaneously photoacoustic imaging, and a potentially disruptive technology for skin phototherapy.

Biography

Dr Timothy Tan obtained his Ph.D in Chemical Engineering from the University of New South Wales, Australia. He is interested in the engineering, manipulation and interrogation of nano-biophotonic systems, with an ultimate goal of enhancing biological and chemical functions. His group has developed novel upconversion nanotheranostics suitable for photodynamic and photothermal theray, photoacoustic imaging and skin photomedicine, with potential application in eczema and carcinoma phototherapy. His group has also patented an electrostatic tunable hydrogel delivery platform which has demonstrated effective siRNA delivery, cell internalization and gene knockdown for scar reduction in rabbit eye models post glaucoma filtration surgery. Dr Tan has published more than 95 peer-reviewed papers and obtained/applied for 8 patents. His work has garnered more 5000 citations with a H-index of 43. His recent awards include Singapore President's Public Administration Award 2015 and Young Investigator Award in "International Symposium of Materials on Regenerative Medicine 2012".

- 09:45-10:15, August 8 -

Emerging two-dimensional monoelemental materials (Xenes) for biophotoincs applications

Han Zhang
Shenzhen University, China

Abstract

Emergence of novel two-dimensional (2D) monoelemental materials (Xenes) has shown remarkable potential for technological applications, as well as a plethora of unexplored fundamental science. Xenes (e.g., borophene, silicene, germanene, stanene, phosphorene, arsenene, antimonene, bismuthene, and tellurene) are of particular interest, as they are the most chemically tractable material for synthetic exploration. The excellent physical, chemical, electronic and optical properties regard Xenes as promising agents for biosensors, bio-imaging, therapeutics delivery, theranostics, as well as other new bio-applications. In this talk, we first discuss the general properties of Xenes and provide the summary and classification of Xenes according to their bulk properties. The synthesis and modification methods of Xenes are then presented. Furthermore, the representative Xenes nanoplatforms for various Biophotonics applications are elaborated. We also propose the optimization approaches for performance improvement of Xenes for Biophotonics applications. Finally, the research progress, challenges and perspectives for future development of Xenes in Biophotonics are discussed.

Biography

Prof. Han Zhang was born in Wuhan, China, in 1984. He received his BS degree from Wuhan University in 2006 and PhD from Nanyang Technological University in 2010. He is currently a director of the Shenzhen Key Laboratory of 2D Materials and Devices, and the Shenzhen Engineering Laboratory of Phosphorene and Optoelectronics, Shenzhen University. To date, he has published over 203 scientific publications and 38 patents. His current research focus is the ultrafast and nonlinear photonics of two-dimensional materials. His publications have received >20000 citations, with an H-index of 70. He was also selected as the highly cited researcher by Clarivate Analytics at 2018 and has been awarded/enrolled with 'the Second Prize of Natural Science Award, Ministry of Education (Rank the second)' and 'China's Top 10 Optical Breakthroughs', 'NSFC Key Project' and 'NSFC outstanding young scholar fund' etc.

- 11:00-11:30, August 8 -

Deep brain Calcium recording in behaving mice

Ling Fu

Huazhong University of Science and Technology, China

Abstract

Neuronal calcium transients are reflection of neuronal action potential firing. The microscopy should be able to catch the dynamic process of calcium signal transients with a good temporal and spatial resolution for deep brain. Here, we developed a multi-channel fiber photometry system for recording neural activities in several brain areas of an animal or in different animals. With this system, we simultaneously acquired calcium signals from the bilateral barrel cortices of a head-restrained mouse or from the orbitofrontal cortices of three freely moving mice. Results about visual cue-dependent memory circuit for place navigation in hippocampus of mice will be also presented. In addition, a GRIN lens based confocal microscope is also developed to detect the specific cell type calcium signal of deep brain area with single cell resolution. The activity signals of neurons have been efficiently recorded in orbitofrontal cortices, hippocampus, and striatum nucleus in head-fixed mice. In sum, relaying the deep brain calcium signals to the surface with optical fibers is an efficient approach to extend the in vivo optical detection methods. The methods we developed are suitable for neural circuitry investigations, and finally facilitate the finding of new treatments of psychiatric diseases.

Biography

Dr. Ling Fu is a professor in Britton Chance Center for Biomedical Photonics in Wuhan National Laboratory for Optoelectronics (WNLO), and the Executive Dean for School of Engineering Sciences in Huazhong University of Science and Technology (HUST) in China. Her research interest is optical microscopy and its applications to biomedicine. Nonlinear optical microscopy based on multiphoton absorption and higher harmonic generation has provided spectacular sights into visualization of cellular events within live tissue. Her group aims to develop real-time nonlinear optical imaging approaches to monitor how molecules work and cells interact in their natural environment. Her research focuses on the multicolor multiphoton microscopy for in vivo immunology, and confocal/ multiphoton microendoscopy for neuron imaging. Dr. Ling Fu serves as an assistant editor in Journal of Innovative Optical Health Sciences, and an editorial board member for Scientific Reports, Chinese Optical Letters, Neurophotonics. She was an International Council member of Optical Society of America (OSA), one of program chairs for 100th Annual Meeting of OSA. She is a senior member of Chinese Optical Society.

- 11:30-12:00, August 8 -

Multiscale molecular dynamics using plasmonic nanoaperture arrays

Donghyun Kim
Yonsei University, South Korea

Abstract

Optical molecular imaging and sensing techniques based on light localization are explored. The creation of locally amplified electromagnetic near-fields on surface plasmon-enhanced metallic nanoarray structures has been investigated in many studies because of the potential for extreme light confinement to improve molecular detection sensitivity and resolving power for imaging processes that would be typically impossible to observe under the diffraction limit. By colocalization of light-matter distribution using plasmonic nanoaperture arrays, it was shown that improvement of detection sensitivity by several orders of magnitude would be plausible. For imaging, although many emerging microscopy approaches have been highly successful to produce super-resolved images beyond imagination, we explore alternative techniques based on plasmonic nanoarrays by which achievable resolution may be customized to fit specific imaging needs. Feasibility studies on multiscale dynamics of molecular complexes such as internalization of virus particles, sliding microtubules, intracellular mitochondrial movement, and bacterial motility on random and periodic plasmonic nanoaperture patterns performed. Enhancement of axial resolution for the detection of intracellular protein distribution is reported by extraordinary light transmission using linearly graded plasmonic nanoapertures. To be also described here is switching-based light localization to circumvent the diffraction limit of far-field optics under the Rayleigh criterion, thereby implement full-field super-resolution microscopy. Localization switching can also be used to improve image resolution of label-free surface plasmon microscopy which suffers from plasmon scattering in a conventional set-up. Improvement of surface coverage of localized fields is discussed using random nanocomposite islands for light switching.

Biography

Dr. Donghyun Kim received B. S. with summa cum laude and M. S. from Seoul National University both in electronics engineering. He graduated from Massachusetts Institute Technology in 2001 with Ph. D. in electrical engineering in the area of novel multi-dimensional display technologies and smart optical filters. He worked on next generation fiber-optic access communication systems at Corning Inc. as a senior research scientist and then investigated cellular biophotonic sensors for in vitro cell culture devices at Cornell University, Ithaca, NY, as a postdoctoral fellow. Since 2004, He has been leading Biophotonics Engineering Laboratory of Yonsei University, Seoul, Korea. The main theme of his research has been focused on nanophotonic technology and applications in biomedical engineering based on plasmonic techniques. He has published more than 100 peer-reviewed journal and conference papers on nano/biophotonics, many of which were the results of collaboration with researchers of diverse backgrounds across the world and also holds 30 international patents. In recognition of the research achievements, He was awarded a Korean Research Foundation Young Investigator Award in 2005 and LG Scholar Fellowship in 2009. He has organized many local and international conferences in the field of nano/biophotonics including Asian and Pacific Rim Symposium on Biophotonics, Surface Plasmon Photonics 2011, and SPIE Global Congress on Nanosystems in Engineering and Medicine 2012.

- 13:30-14:00, August 8 -

Optical mapping of brain activation and connectivity: from cognition, psychiatric disorders to neurological disorders

Zhen Yuan
University of Macau, Macau, China

Abstract
To date, the neural mechanism underlying brain cognition and various psychiatric and neurological disorders remains yet unclear and is still under extensive investigations. One aim of our present work is to use optical neuroimaging techniques to identify the brain activation patterns and networks associated with various cognition functions such as the deception, language and translation, executive functions, emotion, intelligence and mathematics. In addition, we will also discuss our recent attempts at using fNIRS brain imaging in various clinical applications such as in drug/ food/ gambling addiction and down syndrome. Our pilot fNIRS neuroimaging results exhibit that both the altered brain networks and hemodynamic/neural changes in the cortex are able to reveal the complex neural mechanism associated with brain cognition and diseases.

Biography
Dr. Yuan is an associate professor with the Faculty of Health Sciences at University of Macau (UM). Right now, he is also serving as the acting Dean of the Center for Cognition and Brain Sciences at UM. Before joined UM, he had worked as an assistant professor with the Arizona State University and research assistant professor in Biomedical Engineering Dept. with the University of Florida. His academic investigations focus on cutting-edge research and development in laser, ultrasound and EEG/fMRI-related biomedical technologies as well as their clinical/pre-clinical applications in neuroimaging and neurosciences, and molecular imaging and cancer. He has achieved national and international recognition through more than 150 SCI publications in high ranked journals in his field. He is the editorial board member of Quantitative Imaging in Medicine and Surgery, associate editor of BMC Medical Imaging, and associate editor of Frontiers in Human Neuroscience. He is a senior member of OSA and senior member of SPIE.

- 14:00-14:30, August 8 -

Noninvasive monitoring of nanoparticle clearance and aggregation in blood circulation by in vivo flow cytometry

Xunbin Wei
Shanghai Jiao Tong University, China

Abstract
Nanoparticles have been widely used in biomedical research as drug carriers or imaging agents for living animals. Blood circulation is crucial for the delivery of nanoparticles, which enter the bloodstream through injection, inhalation, or dermal exposure. However, the clearance kinetics of nanoparticles in blood circulation has been poorly studied, mainly because of the limitations of conventional detection methods, such as insufficient blood sample volumes or low spatial-temporal resolution. In this work, we monitored the dynamics of nanoparticle concentration and formation of nanoparticle aggregates in the bloodstream in live animals using in vivo flow cytometry. The results indicated that nanoparticles in smaller size could stay longer in the bloodstream. PEG-modification could prolong circulating time and reduce the formation of aggregates in the blood circulation. Our work shows that IVFC can be a powerful tool for pharmacokinetic studies of nanoparticles and other drug carriers, assessing cell-targeting efficiency, as well as potentially measuring cardiac output and hepatic function in vivo.

Biography

Prof. Wei obtained his BS in Physics from University of Science and Technology of China in 1993. He received his Ph.D. in Biophysics from University of California at Irvine in 1999. He had been a Postdoc fellow at Harvard Medical School, and a faculty member at Wellman Center for Photomedicine, MGH. Dr. Wei was a professor at Department of Chemistry in Fudan University from 2006 to 2010. He joined Shanghai Jiao Tong University (SJTU) in 2011 and currently is the head of the Optical Molecular Imaging Laboratory and distinguished professor in School of Biomedical Engineering. Prof. Wei has authored and co-authored more than 80 papers in peer reviewed scientific journals, including Nature, PNAS, and Nature Communications. Dr. Wei received the National Outstanding Young Scientific Investigator Award in 2014. Currently he is an SPIE Fellow and Associate Editor of Cytometry Part A (IF=3.71). His research interests include early detection of cancer and treatment of Alzheimer's disease by optical methods.

- 14:30-15:00, August 8 -

Photoacoustic imaging technology and clinical translation

Sihua Yang
South China Normal University, China

Abstract

This talk presented the new progress in photoacoustic imaging towards the clinical translation. A toward clinically-used photoacoustic dermoscope (PAD) assembled by a multiscale confocal opto-sono objective, was developed for label-free imaging anatomy of human skin with endogenous chromophores. The newly-developed opto-sono objective can effectively coordinate the spatial resolution and penetration depth in the visualization of the skin delamination and chromophore structures up to reticular dermis depth, with lateral resolution from 1.5 μm to 104 μm and axial resolution from 34 μm to 57 μm. The PAD allows us to achieve multilayered skin histology implicated in the diagnosis or staging of pigmentary and vascular skin diseases, which is a promising technique for non-invasive observation of human tissue structure and skin disease detection.

Biography

Sihua Yang received his doctoral degree in Optics in 2009 at South China Normal University. Now he is Professor, the Vice Dean of College of Biophotonics, Institute of Life Science, South China Normal University. He has published more than 80 peer-reviewed journal papers, including Journal of the American College of Cardiology, Small, Biomaterials, Optics Letter, Optics Express, Appl Phys Lett and so on. He got the" Sylvia Sorkin Greenfield Award" of American Association of Physicists in Medicine (AAPM) in 2008, and the Natural Science Award of Guangdong Province in 2008 and 2013. His main interests in research include Photoacoustic microscopy imaging and clinical applications, multi-modality imaging of photoacoustics, ultrasound and fluorescence, ultrashort microwave-induced thermoacoustic imaging.

- 08:30-09:00, August 9 -

FDISCO: advanced solvent-based clearing method for imaging whole organs

Dan Zhu
Huazhong University of Science and Technology, China

Abstract

Various optical clearing methods have emerged as powerful tools for deep biological imaging. Organic solvent-based clearing methods, such as three-dimensional imaging of solvent-cleared organs (3DISCO), present the advantages of high clearing efficiency and size reduction for panoptic imaging of large samples such as whole organs, and even whole

SC14

bodies. However, 3DISCO results in a rapid quenching of endogenous fluorescence, which has impeded its application. Here, we propose an advanced method named FDISCO to overcome this limitation. FDISCO can effectively preserve the fluorescence of various fluorescent probes, and can achieve a long storage time of months while retaining potent clearing capability. We used FDISCO for high-resolution imaging and reconstruction of neuronal and vascular networks. Moreover, FDISCO is compatible with labelling by multiple viruses and enables fine visualization of neurons with weak fluorescence labelling in the whole brain. FDISCO represents an effective alternative to the three-dimensional mapping of whole organs and can be extensively used in biomedical studies.

Biography

Dan Zhu is a Distinguished Professor, SPIE Fellow, Deputy-Director, Wuhan National Laboratory for Optoelectronics, Wuhan & Deputy-Director, Key Lab for Biomedical Photonics, Ministry of Education, Huazhong University of Science and Technology, Wuhan, P. R. China. She has been focusing on tissue optical imaging, from intro to in vivo, and holds more than 150 papers in the field of biomedical photonics. She is the Vice-President & Secretary General, Biomedical Photonics Committee of Chinese Optical Society, P. R. China, and also severs as Guest Editor or Editor member for various international Journals, including Biomedical Optics Express, Journal of Biomedical Optics, Scientific Reports, Journal of Innovative Optics Health and Science, Frontiers of Optoelectronics, Laser & Photonics in Medicine, et al.

- 09:00-09:30, August 9 -

Full-color structured illumination optical sectioning microscopy

Ming Lei

Xi'an Institute of Optics and Precision Mechanics, CAS and Xi'an Jiaotong University, China

Abstract

High resolution volumetric imaging technology has found a number of applications in many biological fields. However, the existing volumetric imaging tools are often time-consuming to use on large-scale specimens, such as centimeter-sized insects. In addition, most volumetric imaging systems discard the natural color information of the specimens. To surmount these limitations, we present a structured illumination-based approach capable of delivering a large field-of-view three-dimensional images. With this approach, full-color volumetric images and 3D morphological data in size range of typical insect samples can be obtained. This method provides a very promising approach that can be used to support many different types of entomological investigations.

Biography

Dr. Ming Lei is now working as a full professor in Xi'an Jiaotong University and Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences. He was trained as a postdoctoral research fellow in the Dept. of Chemistry, University of Konstanz (2008-2010). He received his Ph. D. degree in Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences in 2007. He received B. E. degree in School of Physics and Optoelectronic Engineering, XiDian University in 2000. His current research focused on super-resolution microscopy and optical trapping technologies. He has published more than 100 research papers and holds 12 patents.

- 09:30-10:00, August 9 -

Multifunctional mesoporous silica nanocarriers

Wenfei Dong
Suzhou Institute of Biomedical Engineering and Technology, CAS, China

Abstract

Owing to large surface area, high pore volume, tunable pore size, abundant surface chemistry, and acceptable biocompatibility, mesoporous silica nanoparticles (MSNs) are considered as promising candidates for cancer diagnosis and therapy. However, the clinical translation and commercialization of MSNs is still a long way because of their lower therapeutic efficacy. In this talk, I will update the recent progress on MSN-based nanocarrier systems in my group. Firstly, we had developed novel biodegradable MSNs in response to the tumor microenvironment, which can solve their problem of severe side effects and lower efficacy of delivery of biomolecules in tumor therapy. Secondly, we had developed the novel cell membrane-cloaked MSNs for targeted and safe tumor therapy. Thirdly, we had fabricated Janus metal- MSNs as novel multifunctional platform with the integration of targeted, efficient, and safe cancer theranostics, solved the drawback of considerable interference of each part in traditional core-shell MSNs. In the end, we hope the above achievements can be utilized for accelerating the clinical translation of MSNs.

Biography

Prof. Dr. rer. nat. Wen-Fei Dong received his master degree in 1999 from Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Jilin, China and his Ph.D. degree in 2004 from Department of interfaces, Max-Planck-Institute of Colloids and Interfaces, Golm, Potsdam, Germany. His Ph.D. thesis supervisor is Prof. Dr. Helmuth Möhwald. From 2006 to 2008, he joined a group of Prof. Kataoka Kazunori in University of Tokyo as a JSPS postdoctoral fellow. From 2009 to 2012, he moved to Key Laboratory on Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University as an Associate Professor. After 2013, he is appointed as the professor in Suzhou Institute of Biomedical Engineering and Technology, Chinese Academy of Sciences. His recent research projects especially focus on the development of novel nanoprobes, multifunctional nanocarriers and next-generation biomedical devices for liquid biopsy. He has co-authored over 110 publications including reviewing articles and book chapters.

- 10:00-10:30, August 9 -

Tumor microenvironment monitoring based on optical methods

Liwei Liu
Shenzhen University, China

Abstract

Label-free non-invasive optical imaging method have made tremendous inroads toward elucidating pathways in tumor microenvironment. However, their wide application is hindered by the limited discrimination in the sub-millimeter field of view and the lack of uniform pathological criteria. In this work, we introduce different contrastive optical method such as nonlinear optical, fluorescence lifetime imaging microscope (FLIM) to offer cellular-scale observation for primary and metastatic tumors as a reference for the tumor therapy and tumor pathology. our study will offer the potential to translate this method into routine clinical use.

Biography

Liwei Liu received BSc, MSc and Ph.D. degrees from Changchun University of Science and Technology, now she is a full professor in Shenzhen University, she has award National Science Foundation for Distinguished Young Scholars in 2017. She has published over 60 scientific papers in peer-reviewed journals, her research interests cover mainly optics, nanophotonic and biophotonic, and biological sensors.

- 11:00-11:30, August 9 -

Multiscale photoacoustic microscopy

Lei Xi

Southern University of Science and Technology, China

Abstract

Photoacoustic microscopy (PAM), benefiting from rich optical contrast, scalable acoustic resolution and deep penetration depth, is of great importance for the fields of biology and medicine. The introduction of new scanning devices/mechanisms and fast pulsed lasers enables high spatiotemporal resolution and compact configuration. However, limited by the size and performance of reported optical/acoustic scanners, existing PAMs are bulky, heavy, and suffer from low imaging quality/speed. In this talk, I will present a multiscale photoacoustic microscopic platform consisting of large-field-of-view PAM, portable PAM, handheld PAM and endoscopic PAM, which are capable of meeting various requirements of both fundamental and clinical studies..

Biography

Lei Xi received his bachelor degree from Huazhong University of Science and Technology, Wuhan, China (2007) in optics, and finished his doctoral and post-doctoral training in the Department of Biomedical Engineering at the University of Florida, Gainesville, USA, in 2012 and 2014, respectively. Then, he worked at the University of Electronic Science and Technology of China (UESTC) from 2014 to 2018 as a professor. Now, he join the Department of Biomedical Engineering at the Southern University of Science and Technology (SUSTech). He is hosting the multifunctional optical imaging lab (www.mfoil.org) in SUSTech and focusing on developing novel optical imaging techniques for different biomedical and clinical studies.

- 13:30-14:00, August 9 -

New up conversion nanoparticles for fluorescence based bioassays and bioimaging

Yong Zhang

National University of Singapore, Singapore

Abstract

Traditional fluorophores including fluorescent dyes/proteins and quantum dots (QDs) have been widely used for various imaging and detection applications. These are based on 'downconversion fluorescence', converting high energy photons (UV or visible) to low energy photons (visible to NIR). Upconversion nanoparticles (UCNPs) present a new technology for sensitive imaging and detection in various fields. Unlike traditional fluorophores, UCNPs emit detectable high energy fluorescence in the UV/visible/NIR range upon irradiation with NIR light based on a process termed 'upconversion'. They can be used for ultrasensitive interference-free biodetection/imaging because most biomolecules do not have this upconversion property. The major advantages of this approach include but are not limited to: multi-color, low background autofluorescence, single wavelength excitation, good photostability, and spectral unmixing.

Biography

Yong Zhang is a Provost Chair Professor in Department of Biomedical Engineering, National University of Singapore (NUS), and senior faculty member of NUS Graduate School for Integrative Sciences and Engineering (NGS). His current research interests include nanobiophotonics, nanomedicine, and microfluidic devices. He has authored over 300 peer-reviewed research papers in international journals such as Nature Medicine, Nature Communications, Nature Protocols, and PNAS, and has delivered more than 40 Plenary/keynote/invited talks in prestigious international conferences. He has won numerous research awards such as IES Prestigious Engineering Achievement Award and NUS Young Investigator Award. He is a Fellow of Royal Society of Chemistry (FRSC) and a Highly Cited Researcher amongst the World's Most Influential Scientific Minds named by Clarivate Analytics.

- 14:00-14:30, August 9 -

Biomedical photoacoustic tomography and microscopy: from technology to applications

Chao Tian
University of Science and Technology of China, China

Abstract

Based on the energy conversion of light into sound, photoacoustic imaging is an emerging noninvasive biomedical imaging technique and has experienced explosive developments in the past two decades. As a hybrid imaging technique, photoacoustic imaging possesses distinguished optical absorption contrast as in optical imaging and superb spatial resolution as in ultrasound imaging. It can visualize biological samples at scales from organelles, cells, tissues, organs to small-animal whole body and has found unique applications in a range of biomedical fields. In this talk, I will present our most recent progress in photoacoustic imaging, including photoacoustic tomography and photoacoustic microscopy. In photoacoustic tomography, I will present our efforts in the development of a high-performance, real-time photoacoustic scanner and its applications in the sentinel lymph node identification in vivo. Results reveal that the detector view angle, element number, center frequency, bandwidth, aperture size, focusing, orientation error, and scan step angle error all have significant impacts on the imaging performance of the scanner. The developed scanner can be used in practical scenarios and produce real-time high-performance imaging. In photoacoustic microscopy, I will report our work in single cell and single vessel imaging. Results show that optical-resolution photoacoustic microscopy can not only achieve high-resolution, high-sensitivity single cell imaging but also can visualize blood vessels architecture of the retina and choroid in living rabbits without any labeling. The work advances both the technology and applications of photoacoustic imaging in biomedicine.

SC14

Biography

Dr. Chao Tian received the B.S. degree in Electrical Engineering and the Ph.D. degree in Optical Engineering from Zhejiang University, Hangzhou, China. He then worked as a Post-Doctoral Research Fellow in biomedical photoacoustic imaging with the Department of Biomedical Engineering at the University of Michigan, Ann Arbor. He has authored over 30 peer-reviewed journal articles and six inventions, and is the awardees of the “One Hundred Talents Program” by the Chinese Academy of Science (CAS) and Anhui Province, China. Dr. Tian is currently a professor at the School of Engineering Science, University of Science and Technology of China (USTC). His research interests mainly focus on photoacoustic imaging and its biomedical applications.

- 14:30-15:00, August 9 -

Near infrared emitting nanoformulations for optical bioimaging and imaging guided drug delivery

Tymish Y. Ohulchanskyy
Shenzhen University, China

Abstract

Due to the ability of near-infrared (NIR) light to penetrate deeper into biological tissues, NIR luminescence imaging is emerging as a powerful yet feasible biomedical imaging technique, allowing for imaging guided surgery, therapy and drug delivery Over the last several years, we have been developing nanomaterials as NIR emitting probes for bioimaging. A nanochemistry approach allows us to combine imaging and therapeutic agents and fabricate nanoparticles as targeted, imaging guided drug delivery nanovehicles. Light excitation plays a key role in the functionality of these photoactive nanoplatforms, which can be tuned and optimized through control of the excitation dynamics and electronic processes within nanoparticles. The talk will provide examples of the nanoformulations, where electronic processes have been orchestrated by us to enhance imaging and therapeutic functionalities. The developed

nanostructures include liposomal and polymeric nanoparticles, near-infrared fluorescent organic dyes, rare-ion doped nanophosphors, as well as their hybrids. While possessing the optical imaging contrast functionality, the NIR emitting nanoplatforms can be also garnished with other medical imaging modalities, enabling the integration of cellular, tissue and whole body imaging and allowing us to employ a single nanoformulation for multiple imaging techniques. The talk will demonstrate examples of applications of nanoparticles as multimodal imaging guided therapeutic agents and conclude with a discussion on the challenges and opportunities in the field.

Biography

Tymish Y. Ohulchanskyy holds his B.S./M.S. (Physics) and Ph.D. (Optics and Laser Physics) degrees from Taras Shevchenko National University of Kyiv (Kyiv, Ukraine). After obtaining Ph.D. in 2001, Dr. Ohulchanskyy has joined the University at Buffalo (UB, Buffalo, NY, USA) where he advanced to the position of Deputy Director at the UB's Institute for Lasers, Photonics and Biophotonics. Since 2016, Dr. Ohulchanskyy occupies the Distinguished Professor position in the College of Physics and Optoelectronic Engineering of Shenzhen University, Shenzhen, Guangdong, China. Prof. Ohulchanskyy's main research interest is in biophotonics, with focus on nanoformulations for optical/multimodal bioimaging and photoinduced therapy; he is also interested in physical mechanisms of phototherapy. He has published more than 130 articles in peer-reviewed journals (>12000 citations, h-index of 48, according to Google Scholar) and has a number of patents and patent applications. Prof. Ohulchanskyy is a member of SPIE and American Chemical Society (ACS), he serves on editorial boards of several journals.

- 16:00-16:30, August 9 -

Extracting molecular and vascular information with multi-scale photoacoustic imaging

Chengbo Liu

Shenzhen Institutes of Advanced Technology, CAS, China

Abstract

The diseased or disordered state of biological system often manifests as the vascular or molecular abnormity. This talk will focus on the vascular and molecular information acquisition based on multi-scale photoacoustic imaging technology including both photoacoustic microscopy (PAM) and computed tomography (PACT). Besides the application studies, the talk will also cover research progress on technology and instrumentation development in photoacoustic imaging. In specific, in PACT, a novel principle named wavefront fast marching was applied to improve the resolution, and a new optical and acoustic coupling method was developed to improve the sensitivity. In PAM, novel multi-scale and multi-modality imaging designs were proposed to achieve mighty information acquisition in different regimes, and a new motion correction method was developed to conquer the motion artifacts by heart beat and breathing. Based on the above technology innovations, the sensitivity, resolution, and speed of photoacoustic imaging have been improved. The technology innovations were further applied to image tumor boundary, monitor tumor metastasis, and diagnose vascular plaques, as well as applied to brain imaging and study of tumor theranostic mechanisms.

Biography

Chengbo Liu received both his Ph.D and Bachelor degree from Xi'an Jiaotong University, each in 2012 in Biophysics and 2007 in Biomedical Engineering. Now he is an associate professor at Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, working on multi-scale photoacoustic imaging technology, instrumentation and translational research. He has published more than 50 journal papers, and applied for more than 30 patents. He is currently a member of SPIE, OSA and IEEE, and serves as routine reviewer for more than 20 journals such as Laser & Photonics Review, Nano Letters, IEEE TMI.

- 16:30-17:00, August 9 -

Near infrared-optogenetic manipulation of the C. elegans motor circuit by upconversion nanoparticles

Yan Zhang
Huazhong University of Science and Technology, China

Abstract

Optogenetics become a powerful tool to decode the circuit mechanisms that underlie the physiological and pathological states of the brain. A technical limitation for optogenetics is the lack of optical transparency of most living tissues. All currently developed genetic light sensors are activated by visible light, whose tissue penetration is limited due to tissues' high light absorption and scattering. Near infrared light (NIR) pentrates tissue deeply, but its application to motor behavior stimlation has been limited by the lack of known gentic NIR light responsive sensors. We designed and synthesized lanthanide doped upconversion nanoparticles (UCNPs) that effectively convert 808 nm NIR ligth to visible light eissions and they are compatible with light-active proteins; as such, it can be used in optogenetic manipulation of the motor behavior in C.elegans. The UCNPs effectively activates Chrimosn-expressing, inhibitory GABAergic motor neurons, leading to reudced action potential firing in the body wall muscle and resulting in locomotion inhibition. The UCNPs also activates the excitatory DVC interneuron, leading to potentiated muscle action potential bursts and active reversal location. Importantly, UCNPs exhibit negligible toxicity in neural development, growth and reproduction. This study shows that UCNPs provide a useful integrated optogenetic toolset, which may have wide applications in other experimental system.

Biography

Zhang Yan, an Associate Professor from College of Life Science & Technology, Huazhong University of Science & Technology. She obtained her Ph.D degree from School of Chemical and Biomedical Engineering at Nanyang Technological University, Singapore in 2012. She did her post-doctoral training at the same school, where she conducted detailed research on the development of inorganic nanoparticles for cancer theranostics. Her current research interests focus on - Design and engineering of nanoparticles for early cancer diagnosis; - Design and manipulation of multifunctional inorganic nanoparticles for phototherapy; - Upconverting fluoresencet nanoparticles for optogenetics. She aims to integrate fundamental understanding of cellular and molecular microenvironment with engineering advances in the design of biocompatible inorganic nanomaterial and drug delivery system for more effective treatment for cancer and neuron diseases.

Oral Talks

CIOP2019-2019-000006 (15:15-15:30, August 7)

Cytobiology and histopathology studies via confocal raman spectral imaging

Shuang Wang
Institute of Photonics and Photon-Technology, Northwest University, Xi'an, Shaanxi, China

Abstract: It presented our cytobiologic and spectropathologic studies by using confocal Raman spectral imaging with its multivariate analytical method. Inverse spatially offset Raman spectroscopy was also presented for overcoming the detection limitation of traditional Raman method.

CIOP2019-2019-000052 (17:00-17:15, August 7)

Optimized detector angle for improving signal-to-noise ratio of pinhole X-ray fluorescence computed tomography

Jing Guo[1], Peng Feng[1,2*], Luzhen De[1], Yan Luo[1], Peng He[1,2*]
1. Key Laboratory of Optoelectronics Technology & System, Chongqing University, Ministry of Education, China
2. ICT-NDT Engineering Research Center, Chongqing University, Ministry of Education, China

Abstract: For pinhole XFCT, comparing the correlation between S/N and detector angles in terms of tube voltage, GNPs concentration and insert diameter demonstrated that, for most circumstances, 120° have a higher S/N than 60°, 90°.

CIOP2019-2019-000081 (17:15-17:30, August 7)

Analysis of negativity artifacts in back-projection based photoacoustic tomography

Kang Shen, Chao Tian
University of Science and Technology of China, China

Abstract: We analyze the presence of negativity artifacts in back-projection based photoacoustic tomography and studied major contributing factors. Two methods are used to mitigate the artifacts and their performance is compared.

CIOP2019-2019-000069 (10:15-10:30, August 8)

Research on zoom prism-coupled OI-RD system

Bilin Ge
Fudan University, China

Abstract: The research established a software-controlled automatic zoom prism-coupled oblique incident reflectance difference (OI-RD) system, laid the foundation for constructing a surface plasmon resonance enhanced prism-coupled OI-RD system.

CIOP2019-2019-000516 (15:00-15:15, August 8)

Generating new cross relaxation pathways by coating prussian blue on $NaNdF_4$ to fabricate enhanced photothermal agents

Zhongzheng Yu, Timothy Thatt Yang Tan
School of Chemical and Biomedical Engineering, Nanyang Technological University, Singapore

Abstract: Generating new cross relaxation pathways between existing photothermal agents is proposed to contribute to the enhancement of photothermal conversion efficiency and the development of photoacoustic imaging and photothermal therapy.

CIOP2019-2019-000121 (15:15-15:30, August 8)

On-disc ratio-adjustable droplet fusion for solution-based material synthesis

Yuye Wang, Tiankai Zhang, Ho-Pui Ho
1. The Chinese University of Hong Kong, Hong Kong, China

Abstract: We report a novel scheme for ratio-adjustable droplet fusion in a lab-on-a-disc platform. The device is capable of performing droplet-based chemical synthesis experiments with various ratios of the mixing components.

CIOP2019-2019-000228 (11:30-11:45, August 9)

Optofluidic laser sensor for Copper ion detection

Zhen Sun, Qi-Yu Bo, Run-Jia Liu, Li-Peng Sun, Wei Wang, Bai-Ou Guan
Institute of Photonics Technology, Jinan University, China

Abstract: Optofluidic laser is a new method of measuring biochemical changes. In this work, We use optofluidic laser system to detect the fluorescent products generated by the combination of a novel probe and copper ions to achieve the purpose of detecting copper ions.

CIOP2019-2019-000259 (11:45-12:00, August 9)

Co-encapsulating photosensitizers and biomedical imaging regents in nanoliposomes for bioimaging guided photodynamic therapy of cancer

Hao Xu, Tymish Y. Ohulchanskyy, Junle Qu
Shenzhen University, China

Abstract: In our research, photosensitizers (PSs) and biomedical imaging contrast regents (ICR) were co-encapsulated in nanoliposomes (NL). The mutual influences of PSs and ICR were evaluated and application of these PSs and ICR co-encapsulating NL in cancer theranostics that combines CT, fluorescence and photoacoustic (PA) imaging with photodynamic therapy was examined.

CIOP2019-2019-000403 (15:00-15:15, August 9)

A multi-functional platform for single cell manipulation, lysis and detection using optothermal effect

Yuanyuan Wei, Hengji Cong, Ho-Pui Ho
The Chinese University of Hong Kong, Hong Kong, China

Abstract: We herein report a multi-functional platform with a laser source for both cell manipulation and nucleic acid amplification, which offers an attractive and highly versatile approach for on-site single cell analysis systems.

CIOP2019-2019-000060 (15:15-15:30, August 9)

Ease of photodynamic therapy resistance of cancer with Bcl-2 inhibitor uploaded upconversion nanophotosdensitizers

Geyu Lu, Liu Xiaomin, Xianggui Kong
Jilin University, China

Abstract: Our results indicate that the ABT737@ZnPc-UCNPs can significantly potentiate PDT efficiency through preventing tumor cells evasion of apoptosis internally and making the tumor microenvironment susceptible to oxidative stimuli externally, which offers a potentially new adjuvant intervention strategy to improve PDT effect.

CIOP2019-2019-000527 (17:00-17:15, August 9)

An immunoturbidimetric assay for specific proteins identification from whole blood based on multi-layered centrifugal microfluidic chip

Jiachen Yang, Kangkang Liu, Minghao Yang, Guanghui Wang
College of Engineering and Applied Sciences, Nanjing University, China

Abstract: We proposed an immunoturbidimetric assay system based on multi-layered centrifugal microfluidics for specific proteins identification from whole blood. Itwas demonstrated to have good accuracy and high repeatability, providinga sample-to-answer solution.

SC15 Optical Sensors, and Systems

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Few mode fiber & fiber laser sensors (Tutorial)

Byoung Yoon Kim
KAIST, South Korea

Abstract

Most of highly sensitive optical fiber sensors are in the form of interferometers. Typical fiber interferometers consist of multiple strand of optical fibers and a few discrete components. Much simpler forms of interferometers are possible using different guided modes in a single strand of optical fiber. In this tutorial, different ways of utilizing modes in few mode fibers and fiber lasers for optical sensing are described. Interference between different spatial and polarization modes in few mode fibers as well as the interference between longitudinal modes in fiber lasers are utilized in the presented examples. The basic principles and enabling devices for the in-line fiber optic sensors will be discussed

Biography

Byoung Yoon Kim is Professor Emeritus of Physics at KAIST. He previously served as Vice President of Research at KAIST and founding Director of the Institute for Startup KAIST. He earned his PhD in applied physics from and held a faculty position at Stanford University before he moved to KAIST in 1990. His research focus has been with fiber-optic devices for sensors and communications. His research work includes the use of guided modes in few mode fibers as independent information channels, fiber lasers as sensors and all-fiber acousto-optic gratings for mode coupling and modulation. He founded FiberPro, Inc. that develops and manufactures fiber-based components and instruments. He later founded Novera Optics, Inc. in Silicon Valley to commercialize dynamic optical amplifiers and WDM passive optical network subsystems. He is a Fellow of IEEE, OSA, Optical Society of Korea, and a member of the Korean Academy of Science and Technology. He served as President of Optical Society of Korea, Board member of OSA and IEEE Photonics Society and Vice President of ICO.

- 14:15-14:45, August 7 -

Real time interrogation of identical weak FBG array sensors

Chang-Seok Kim
Pusan National University, South Korea

Abstract

We demonstrate a novel interrogation system for an identical weak fiber Bragg grating (FBG) array sensors based on an active mode locking laser cavity. The system can successfully and efficiently interrogate over multiple series of identical center wavelength FBGs by detecting their mode-locked frequencies. The results confirm the large capacity over 31, high interrogation speed over 5 kHz, high signal-to-noise ratio over 25 dB, and high linearity of R2 = 0.9998 of the proposed interrogator configuration.

Biography

Chang-Seok Kim obtained his Ph.D. in 2004 from the Department of Electrical and Computer Engineering, Johns Hopkins University, USA, for research in the area of fiber optic devices and fiber laser systems, after finishing his Master degree in 1999 from Gwangju

Institute of Science and Technology (GIST) for the research with fiber Bragg grating (FBG) sensors with specialty fibers. Subsequently, he held a one-year postdoctoral fellowship at the Beckman Laser Institute and Medical Clinic, University of California at Irvine, USA, for research in the area of fiber lasers for biomedical sensing and imaging. He returned to the Department of Optics and Mechatronics Engineering, Pusan National University as a faculty member in 2005 and is now a Professor. His research interests are the applications of wavelength tunable fiber laser including FBG sensor interrogations, optical frequency domain reflectometry (OFDR) sensor interrogations, and optical coherence tomography (OCT) imaging instruments, and system integrations for fiber sensor and biomedical imaging applications. His work has led to over 250 publications, including journal/conference papers and patents.

- 14:45-15:15, August 7 -

Off-axis fiber optic interferometry for nanoscale resolution

Nan-Kuang Chen
Liaocheng University, China

Abstract

Optical interferometry is featured with a high spatial resolution of down to half wavelength based on on-axis or paraxial configurations. Usually, the C-band wavelengths are capable of providing spatial resolution of around 750 nm and which is obviously insufficient for the advanced fiber-optic developments in nanoscale applications. In contrast, off-axis optical interferometry is now proposed to substantially improve the spatial resolution down to 4 nm when the C-band lightsource from superluminescent diodes is used. The off-axis lights generating from the hollow core silica tubing, spliced with a singlemode fiber, are focused and projected to different points in space to form successive foci. The propagating high order modes are deflected by fiber lens and the corresponding foci are densely spaced near fiber lens. The narrowest spacing between adjacent foci can be down to 4 nm and this is helpful to discriminate the MHz supersonic signals with extremely low amplitude under noncontact situation for high frequency acoustic sensing applications. The precision displacement sensing with nanometers resolution can also be achieved. This off-axis fiber optic interferometry is advantageous to develop molecular microsensing with high accuracy.

Biography

Nan-Kuang Chen received the B. Sc. and M. Eng. degrees from the National Tsing Hua University, Taiwan, the Ph. D. degree from National Chiao Tung University, Taiwan. Starting from Jan 2018, he joined Liaocheng University, China. He has also been invited to be a Ph. D. Student co-supervisor for IIT, Dhanbad in India since 2016, an SPIE (the international society for optics and photonics) Travelling Lecturer in 2015 and 2017. He has authored and co-authored more than 220 international SCI journal and conference articles. He has delivered 35 invited talks and 1 keynote talk in international conferences. He holds 14 Taiwan patents, 12 US patents, 1 Korea patent, and 4 PRC patents.

- 16:00-16:30, August 7 -

Rotation measurements with a passive resonant gyroscope based on hollow-core Kagome fiber

Fabien Bretenaker
Laboratoire Aimé Cotton, France

Abstract

We present our efforts to build a passive resonant gyro based on hollow-core optical fiber. We considered different kinds of hollow-core fibers, based either on photonic bandgap guiding mechanism or on so-called inhibited coupling

mechanism, also called Kagome fibers. We tested these fibers to build passive ring resonators, and ended up performing rotation measurements using a cavity based on Kagome fiber. Two types of configurations were considered. In the first one, the counter propagating beams resonate on the same cavity mode. This leads to observation of a so-called locking zone that prevents measuring rotation rates below roughly 0.5°/S. In the second configuration, the counter propagating beams resonate on two different cavity modes. This leads to rotation rate measurements much reaching an angular random walk as small as 0.004°/h1/2 and a bias stability of 0.45 °/h over 0.5 s of integration time. We will describe the possible sources of drifts and the solutions we consider to circumvent them.

Biography

Fabien Bretenaker graduated from Ecole Polytechnique, France, in 1988. He received his PhD degree from University of Rennes, Rennes, France, in 1992 while working on ring laser gyroscopes for Sagem. He joined the Centre National de la Recherche Scientifique, Rennes, in 1994 and worked in Rennes until 2002 on laser physics and nonlinear optics. In 2003, he joined the Laboratoire Aimé Cotton, Orsay, France, working on nonlinear optics, laser physics, quantum optics, and microwave photonics. Fabien Bretenaker is also part-time professor at Ecole Polytechnique, Palaiseau, France, adjunct professor at Ecole Normale Supérieure Paris-Saclay, Cachan, France, and adjunct professor at Raman Research Institute, Bangalore, India. He is the author of about 200 papers in peer-reviewed journals, 8 patents, and 3 books

16:30-17:00, August 7

Distributed acoustic sensing system based on ultra-weak fiber Bragg grating array

Minghong Yang
Wuhan University of Technology, China

Abstract

A distributed acoustic sensing system based on broadband weak fiber Bragg grating array which is capable of quantifying multiple dynamic strain perturbations is introduced. The technique is based on measuring the phase of the interference signals between two adjacent weak FBGs. Phase, amplitude, frequency response and location information can be directly obtained at the same time by using the passive 3×3 coupler demodulation technique. The experimental results and field test show that this system can demodulate vibration signals with different frequencies.

Biography

Minghong Yang received PhD in physical electronics from Huazhong University of Science and Technology in 2003. From July 2003 to December 2005, he was with the Fraunhofer Institute for Applied Optics and Precision Mechanics in Jena, Germany as post-doctoral visiting scholar, after that he worked in the Berlin University of Technology, Germany as research fellow. Since 2009, he has been a research faculty member in the National Engineering Laboratory for Optical Fiber Sensing Technology, Wuhan University of Technology, China. In Feb.- Sept. 2013, he was senior visiting professor at the Virginia Tech, USA, and he was also invited to the Friedrich-Schiller University Jena, Germany as guest professor at the Abbe School for Photonics in 2014. Minghong Yang is a Fellow of IET, a senior member of IEEE, a TPC member of the international conferences of optical fiber sensors. He is serving as associate editor for IEEE Sensors Journal. His research interests include optical fiber sensors, thin film sensors.

- 08:30-09:00, August 8 -

Optical fibre sensing revised: past present and future

Gilberto Brambilla
University of Southampton, UK

Abstract

Optical fibre sensors have found a variety of applications, from gyroscopes, to structural health monitoring, from distributed sensing to biomedical. Consequently, they represent a continuously expanding market expected to pass 6 billion dollars within the next decade. In this presentation, I will review the most successful point and distributed optical fibre sensing technologies, and discuss how current research in optical fibre materials, geometries, guidance and related devices can affect the development of future sensors and sensing architectures. New photonic technologies with significant potential include: new dopants (Gd, Bi), microstructured / hollow-core fibres, multicore and multimode devices, and femtosecond laser writing. These have the potential to improve the performance of gyroscopes, quasi-distributed and distributed sensing, providing a significant improvement, possibly of few orders of magnitude, in sensitivity, dynamic range and spatial resolution.

Biography

Gilberto Brambilla is a professor at the Optoelectronics Research Centre (ORC), where he has been continuously employed since 2002, and the Deputy Director and General Manager of The Future Photonics Hub, where he has responsibility for the research platforms. Until 2015 he has been the Director of the EPSRC Centre for Innovative Manufacturing in Photonics. He obtained his MSc (Engineering – Nuclear Materials) with honours from Politecnico di Milano (Italy) and his PhD degree in Optoelectronics from the ORC in 2002. In 2007 he was awarded the prestigious Research Fellowship from the Royal Society, renewed in 2012. His research interests include: optical fibre sensors (point and distributed), optical fibre devices and fs lasers. He has published ~400 papers in international scientific journals/conferences, authored seven patents and given more than 30 plenary/keynote/invited talks over all five continents.

SC15

09:00-09:30, August 8

Development of polymer coating on optical fiber for sensing applications

Chan Chi Chiu
Shenzhen Technology University, China

Abstract

Polymers have received a great attention in the field of sensor technology in recent years. They offer numerous advantages for sensor technology as they can be deposited on various types of substrates and their effects can be matched up to that silicon in microsensors. To exhibit desired sensing behaviors, the chemical/physical properties of the polymers can be tailored by incorporating charge or neutral particles into polymeric matrix, side-chains or on its surface region. The functionalized sensing polymers (sheet or film form) are utilized as an integral part of solid-state sensing devices for the measurement of various quantities such as mechanical quantities (force, strain, deformation, ect), acoustic quantities (ultrasound, microphone, hydrophone, etc), temperature, relative humidity, chemical and biology (DNA and immunosensors). Due to the fast development of human and environmental-friendly smart materials in recent years, natural polymers have attracted a great interest in sensing technology. This is largely due to the interest in the intrinsic properties of these natural polymers. For instance, natural polymers are naturally sourced, with no

reliance on oil for production and are recyclable. They do not contain toxic monomers in their base backbone, so some natural polymers are even approved for food product packaging and pharmaceutical use. On top of that, they can be processed at room temperatures and pressures result in only water as a by-product from the solidification process. Among most of the polymers used in sensing applications, chitosan a natural biopolymer, has attracted a significant amount of interest. In this presentation, we explore the possibilities of integrating chitosan with silica optical fiber for different kinds of sensing applications.

Biography

Ir. Prof. Dr. Chan Chi Chiu received the BEng. (1st Honors.) and Ph.D from Department of Electrical Engineering, the Hong Kong Polytechnic University in 1996 and 2000 respectively. From 2000 to 2003, he was a Postdoctoral Fellow in the Department of Electrical Engineering of the Hong Kong Polytechnic University. He was an Assistant Professor in School of Electrical and Electronics Engineering, Nanyang Technological University Singapore and was promoted to Tenured Associate Professor in School of Chemical and Biomedical Engineering, Nanyang Technological University Singapore in 2003 and 2010 respectively. Currently, he is a Distinguished Professor in Sino-German College of Intelligent Manufacturing, Shenzhen Technology University, China started from 2017. His research areas are optical fiber sensing system, fiber Bragg grating device, fiber optics chemical sensors, fiber optics biosensors, and smart structures. His accomplishment in these areas is demonstrated in his 170 SCI journal publications and 5 patents. His research works have been cited about 2500 times and H-index of about 30. He was appointed as Associate Editors of IEEE Sensors Journal and Journal of Sensors. He is an IEEE Senior Member, IES Senior Member, OSA Life Member and SPIE Life Member. Recently, he has been awarded Shenzhen Overseas High-Caliber Personnel (Level B), Pengcheng Distinguished Scholar, Fellow of Hong Kong Institution of Engineers (FHKIE) and Fellow of Society of Operation Engineers (FSOE), UK.

- 09:30-10:00, August 8 -

Chaotic brillouin optical correlation domain analysis

Mingjiang Zhang

Taiyuan University of Technology, China

Abstract

Chaotic Brillouin sensing technology is a particularly competitive method that enables both high spatial resolution and large measurement range in distributed fiber sensing system. Recent progresses in high-resolution chaotic-BOCDA system are reported. The utilization of chaotic laser ensures a sole narrow correlation peak existing within the entire fiber, whose width only depends on chaotic signal bandwidth. Firstly, the experimental results demonstrated a 4-cm spatial resolution over a 906-m measurement range, with the analysis of the signal-to-noise ratio. To improve the performance of C-BOCDA, a modified system with suppressed time delay signature (TDS), which would contribute an additional noise mechanism, has successfully extended the sensing range to 3.2 km by optimizing the injection current and feedback strength of the external cavity semiconductor laser. However, the Brillouin background noise structure induced by the residual side peaks near the main peak gradually accumulates along with the increasing of sensing distance. The time-gated scheme is introduced to suppress the off-peak SBS amplifications and a large enhancement of the measurement range has been obtained, which achieved a 9 cm spatial resolution over a 10.2 km-long test fiber. Further, a millimeter-level-spatial-resolution BOCDA based on a broadband chaotic laser, where the CP width is compressed to be extremely narrow, has been proposed and experimentally demonstrated. The distributed tensile strain sensing along a 165-m long FUT was verified with an ultra-high spatial resolution of 3.5 mm. To the best of our knowledge, the proposed system is a broadband-source optical sensing system with the highest reported spatial resolution.

Biography

Mingjiang Zhang received a Ph.D. degree in Optics Engineering, Tianjin University, China, in 2011. He worked as a visiting scholar in University of Ottawa (Canada) in 2015. He received the Sanjin scholar and the Outstanding Innovative Teams of Higher Learning Institutions of Shanxi in 2016, among other honors. He is a member of the youth editorial board from Chinese Laser Press and an external Accelink expert of national-recognized enterprise technology center. He is currently a full professor of College of Physics and Optoelectronics, Taiyuan University of Technology. His research interests include the development of advanced photonic integrated chaotic laser, distributed optical fiber sensing technology and applications. Prof. Zhang is an author or coauthor of more than 100 international journal and conference papers, and he has authored more than 50 patents. He has given more than 10 invited talks at international and national conferences. He presided over 10 national and provincial projects in recent years, including the national major scientific instruments development project 'Photonic integrated broadband chaotic signal generator'.

- 11:00-11:30, August 8 -

Fastest-ever distributed Brillouin sensing using glass and plastic optical fibers

Yosuke Mizuno

Tokyo Institute of Technology, Japan

Abstract

We review the recent advances of specially configured Brillouin optical correlation-domain reflectometry for real-time distributed strain and temperature measurement with inherent single-end accessibility. Technical details and the latest findings of this configuration are presented. Specifically, we demonstrate the detection of a shortest-ever hot spot using a "beyond-nominal-resolution" effect, loss-insensitive operation using a trench-index-type fiber, and stable operation using a polarization-maintaining fiber. We also present highly sensitive temperature measurement using a plastic optical fiber. If time permits, we will also present the measurement results using a silica fiber embedded in a composite structure and prove the practical usefulness of this system. We finally discuss the future prospects of this sensing technique.

Biography

Yosuke Mizuno received the B.E., M.E., and Dr.Eng. degrees in electronic engineering from the University of Tokyo in 2005, 2007, and 2010, respectively. From 2007 to 2010, he worked on Brillouin optical correlation-domain reflectometry for his Dr.Eng. degree. From 2010 to 2012, as a JSPS Research Fellow (PD), he worked on polymer optics at Tokyo Institute of Technology, Japan. In 2011, he was a Research Associate of BAM, Federal Institute for Materials Research and Testing, Germany. Since 2012, he has been an Assistant Professor at Tokyo Institute of Technology, where he is active in fiber-optic sensing, polymer optics, and ultrasonics. He has authored >140 refereed journal papers and has given >20 invited talks at international conferences including OFS-23, APOS 2016, and OFS-25. He is a senior member of the IEEE Photonics Society, and a member of the Japan Society of Applied Physics (JSAP), the Optical Society of Japan (OSJ), and the Institute of Electronics, Information, and Communication Engineers (IEICE) of Japan.

- 11:30-12:00, August 8 -

Sensors and devices based on suspended-core fibers and photonic microcells

Chao Wang

Wuhan University, China

Abstract

The optical fibers with suspended-core structures present attractive optical and mechanical properties, such as strong

SC15

evanescent and mode fields, contamination-free light-matter interaction regions, robust and flexible structures. These suspended-core fibers (SCFs) have found lots of applications in physical, chemical and biological parameters or substances sensing, opto-mechanical, interferometric and nonlinear optical devices. This report reviews recent development of SCF sensors and devices briefly, and introduces our works on a locally post-processed SCF, i.e. suspended-core photonic microcell (SC-PMC). The fabrication, structures and properties of various SC-PMCs are summarized firstly. Then a series of applications of the SC-PMCs are introduced. Based on a three-hole SC-PMC filled with laser dye Rhodamine 6G, a fiber gain cell was demonstrated. Bragg and long period gratings were inscribed inside the pure silica SC-PMCs and tested comprehensively. Birefringent interferometer based on a four-hole SC-PMC and its sensing applications are exhibited. Micro-cantilever were fabricated inside a six-hole SC-PMC by femtosecond laser micromachining. The in-fiber cantilever is useful in sensing acceleration and vibration. Finally, the future trends of the development of SCF and SC-PMC are discussed.

Biography

Chao Wang received bachelor degree in Optical Information Science & Technology, master degree in Optical Engineering from School of Optical & Electronic Information, Huazhong University of Science and Technology respectively in 2002 and 2005, and Ph.D. degree from Department of Electrical Engineering, the Hong Kong Polytechnic University in 2013. He was employed as a Postdoctoral Fellow / Research Associate at the Hong Kong Polytechnic University from 2013 to 2015. He is currently an Associate Professor at the School of Electrical Engineering and Automation, Wuhan University. He has published more than 50 journal and conference papers. He is mainly engaged in the research of micro-structured optical fiber sensors and devices, gas and liquid detection techniques, condition monitoring in electrical power system.

- 13:30-14:00, August 8 -

Suppression of systematic errors in optical correlation-domain distributed Brillouin sensors

Kwang-Yong Song
Chung-Ang University, South Korea

Abstract

Brillouin optical correlation domain analysis (BOCDA) and reflectometry (BOCDR) are well-established methods for the measurement of Brillouin frequency distribution, where direct modulation of a distributed feedback laser diode (DFB-LD) is generally adopted to implement a frequency-modulated continuous-wave (FMCW) light source. Recently it has been reported that a phase delay occurring between the amplitude and frequency variations, called AM-FM phase delay, in the output of the modulated DFB-LD can cause considerable errors in the Brillouin frequency measured by a BOCDA or BOCDR system. The error induced by the AM-FM phase delay is systematic since it cannot be suppressed by averaging process while constantly distorts the distribution map of Brillouin frequency. In this talk the theoretical and experimental analysis on the effects of the AM-FM phase delay in the correlation-domain Brillouin sensors will be presented as the first part. In the second part experimental results on the suppression of the systematic errors caused by the AM-FM phase delay will be presented, using an injection-locked DFB-LD as a light source of the BOCDA system. Our results show that the injection locking not only reduces the depth of amplitude modulation, but also keeps a specific phase delay at a wide range of modulation frequency. In test measurements the systematic errors are reduced by more than 70% on average using the slave LD as a common light source of BOCDA system.

Biography

Kwang Yong Song received the Ph. D degree in Physics from Korea Advanced Institute of Science and Technology (KAIST) in 2003. He worked as a post-doctoral researcher in Nanophotonics and Metrology Laboratory of Ecole Polytechnique Federale de Lausanne (EPFL) where he conducted researches on distributed Brillouin sensors and a pioneering work on Brillouin slow light. In 2005 he joined in the Dept. of Electronic Engineering in the University of Tokyo as a research fellow. In 2007 he moved to Chung-Ang University in South Korea where he currently works as a full professor in Dept. of Physics. His research area includes distributed fiber sensors based on Brillouin scatterings, applications of Brillouin dynamic gratings and nonlinear optical phenomena in few-mode fibers. Prof. Song is an author or coauthor of more than 160 international journal and coference papers.

- 14:00-14:30, August 8 -

Infrared photoacoustic and photothermal trace gas detection

Wei Ren

The Chinese University of Hong Kong, Hong Kong, China

Abstract

Photoacoustic spectroscopy (PAS) and photothermal spectroscopy (PTS) are two highly sensitive methods for chemical analysis by detecting the absorption induced acoustic wave and refractive index change, respectively. This talk will present two recent technical advancements of fiber-laser intracavity photoacoustic spectroscopy (FLI-PAS) and mid-infrared PTS using hollow-core negative curvature fibers. These sensors are demonstrated for sensitive detection of C_2H_2, CO, and N_2O with ppm to ppb sensitivity, providing new opportunities for fiber-based chemical analysis and laser spectroscopy.

Biography

Dr. Wei Ren received his B.S. and M.S. degrees from the Department of Precision Instrument at Tsinghua University, and Ph.D. degree in Mechanical Engineering from Stanford University. He is now the assistant professor in the Department of Mechanical and Automation Engineering at the Chinese University of Hong Kong. His research to date has resulted in more than 60 peer-reviewed journal publications in the fields of optical sensing, laser spectroscopy, and combustion diagnostics. He is currently the associate editor of the Springer journal Applied Physics B.

- 14:30-15:00, August 8 -

Embedded optical micro/nanofibers and related applications

Lei Zhang

Zhejiang University, China

Abstract

Optical microfibers and nanofibers (MNFs) have been emerging as a promising candidate for assembling compact and sensitive sensors with fast response, high flexibility and low optical power consumption. Note that most of the previously reported evanescent wave sensors used MNFs suspended in air or mounted in a bulky volume flow chamber, thus, surface contamination and environmental factors are likely to affect the stability of these sensors. To address these issues, one can integrate MNFs with a microfluidic chip or embedding MNFs into low refractive index polymer. We found that microfluidic chip does not only provide natural protection of the MNF, but also delivery of micro/nanoliter sample solution for the MNF. By embedding an MNF in to a microfluidic chip or flexible polymer, I will demonstrate a femtoliter-scale optical nanofiber sensor, a humidity sensor, and an optical skin sensor. The embedded structure can provide a number of attractive advantages for assembling compact and robust sensing system. The sensors shown here may open up new opportunities for single molecule analysis, highly stable gas sensing, and tactile sensing.

SC15

Biography

Dr. Lei Zhang is an Associate Professor in College of Optical Science and Engineering, Zhejiang University. He obtained his PhD in analytical chemistry from Zhejiang University in 2006. After years post-doctoral employments in Zhejiang University, he jointed College of Optical Science and Engineering, Zhejiang University in 2008. His research focuses on optical micro/nanofiber sensors, optofluidics, microfluidics, and wearable devices. Prof. Zhang has more than 30 scientific publications in peer-reviewed journals and international conferences.

- 08:30-09:00, August 9 -

Fiber optic nerve systems based on brillouin optical correlation domain technologies - from basic principle to recent achievement

Kazuo Hotate

Toyota Technological Institute, Japan

Abstract

Distributed fiber optic strain and/or temperature sensing based on Brillouin optical correlation domain technologies are discussed, as fiber optic nerve systems for structural health monitoring. In these systems, interference nature of continuous lighwave is synthesized to realize position selective measurement. This is called "Synthesis of Optical Coherence Function (SOCF)," whose principle is discussed in the first part of this talk. By using SOCF, distribution of stimulated or spontaneous Brillouin scattering is measured along a fiber, with system configuration, respectively, called Brillouin Optical Correlation Domain Analysis (BOCDA) or Brillouin Optical Correlation Domain Reflectometry (BOCDR). Strain and temperature discriminative distributed measurement has also been demonstrated utilizing Brillouin Dynamic Grating (BDG), whose system is called BDG-BOCDA. In the second part of this talk, recent progresses in BOCDA, BOCDR, and BDG-BOCDA are discussed, showing equipments for practical use, ultimate performances, and improvement in spatial resolution, respectively.

SC15

Biography

Kazuo Hotate received B.E., M.E., and Dr. Eng. degrees in electronics from the University of Tokyo, in 1974, 1976, and 1979, respectively. In 1979, he joined the University of Tokyo, and became Professor in 1993. He served as Dean of Graduate School & Faculty of Engineering, Director General of Division of University Corporate Relations, and Executive Vice President of the University of Tokyo. After his retirement from the University in 2017, he has been working in Toyota Technological Institute, as Vice President and Professor. He has been engaged in measurement and analysis of optical fiber characteristics and optical fiber sensors. He has authored or co-authored several books on optical fibers, and more than 450 journal papers and international conference presentations. Prof. Hotate is Fellow of IEEE, IEICE, SICE, and JSAP. He received academic awards, such as OFS Life-time Achievement Award, SPIE DSS Life-time Achievement Award, Ichimura Prize, IEICE Achievement Award, SICE Hasunuma Prize, and JSAP Takuma Prize. He was a Board of Governors member of IEEE Photonics Society. He served as Associate Editor of Journal of Lightwave Technologies, TPC Chair for 13th International Conference on Optical Fiber Sensors, and General Chair for OFS-16.

- 09:00-09:30, August 9 -

Monitoring on tendon force distribution in prestressed structures by brillouin-based optical fiber sensor

Michio Imai

Kajima Technical Research Institute, Japan

Abstract

For prestressed concrete structures, it is quite important to apply and to maintain a required loading force to a tendon.

Such as a load cell, the existing sensors can measure the force only at the specific location of the tendon. These sensors can detect a variation in the loaded force, but cannot detect the location of anomaly. In order to monitor the force along the tendon, an optical fiber sensor is embedded along a strand. Distributed strain information by Brillouin-based sensor can determine the force along the whole length of the optical fiber embedded-strand. Because of its long lifetime, the strand can be expected to contribute to not only construction but also maintenance. The authors have developed two types of optical fiber embedded-strand, i.e., for bonded and unbonded tendon, and experimentally investigated the basic performance of the strands in laboratory, and applied them to a prestressed concrete bridge under construction. When the strand is gradually tentioned by a jack, the force distribution along the tendon is successfully measured in-situ. The measurement can reveal the friction loss and the anchoring loss, also it can be confirmed that the loaded force is more than the designed force. Afterwards, the force has been periodically monitored, and the measurement after a year of the completion of the construction shows that force variation has never occurred along the entire length of the tendon.

Biography

Senior Research Engineer, Kajima Technical Research Institute, Tokyo, Japan. I'm engaged in advanced measurement and survey technologies as a researcher of the core division of research and development at Kajima Corporation, Japan's leading contractor in the construction industry. Currently, my research is focusing on an optical fiber sensor based on the unique method for structural health monitoring. Ph. D. in Structural Engineering, May., 2009 Civil and Environmental Engineering Department, University of California, Irvine "Damage Assessment of Civil Engineering Structures using Distributed Optical Fiber Sensor." Advisor: Professor Maria Q. Feng

- 09:30-10:00, August 9 -

Improvement of signal processing of passive resonant fiber optic gyroscope

Huilian Ma

Zhejiang University, China

Abstract

We present a reciprocal modulation technique to suppress the laser frequency noise in the resonant fiber optic gyroscope. The sensing element is a hybrid single-polarization fiber ring resonator with a length of 28 m, a finesse of 14.7 and a diameter of 12 cm. The laser is modulated first and divided into the clockwise and the counterclockwise propagating beams and then modulated by two additional phase modulators for carrier suppression to reduce the backscattering noise. After delicate adjustment of the modulation frequency, the angle random walk of 0.007°/√h and the bias stability of 0.1°/h over 40 s of integration time are achieved.

Biography

Professor Huilian Ma received the Ph.D. degree in Electronic and Science Technology from Zhejiang University, China in 2002. Since 2002, she has been with Zhejiang University and has engaged in the research of resonant optical gyroscopes. She was a visiting scholar of Laboratory of Hotate and He in the University of Tokyo, Japan from 2007 to 2009. She has authored and coauthored more than 80 refereed journal papers and international conference presentations and she is holding more than 20 Chinese patents. She has given more than 10 invited talks at the international and domestic conferences including IEEE Photonics Conference (IPC), Conference on Lasers and Electro-Optics Pacific Rim (CLEO-PR), and OptoElectronics and Communications Conference (OECC). Her research on resonant optical gyroscopes covers a variety of areas including low-loss silica waveguide ring resonators, high-Q fiber ring resonators, optical noises suppression, and low-noise signal processing.

Oral Talks

CIOP2019-2019-000529 (15:15-15:30, August 7)

Mapping dynamical magnetic responses of ultra-thin micron-size superconducting films using nitrogen-vacancy centers in diamond

Ying Xu, Chuanshan Tian
Fudan University, China

Abstract: We report here an imaging method that employed NV- centers in diamond as sensor capable of mapping out the microwave magnetic field distribution on an ultrathin superconducting film of micron size

CIOP2019-2019-000311 (17:00-17:15, August 7)

Perimeter monitoring of urban buried pipeline subject to third-party intrusion based on fiber optic sensing and convolutional neural network

Renzhu Peng, Zelong Liu, Suzhen Li
Tongji University, China

Abstract: A real-time surveillance system based on convolutional neural network (CNN) and phase-sensitive optical time-domain reflectometry(ϕ-OTDR) is built to prevent the urban buried pipeline from third-party interference.

CIOP2019-2019-000178 (17:15-17:30, August 7)

Broadband cavity-enhanced spectroscopic multigas sensor using a 1650 nm light emitting diode

Kaiyuan Zheng[1], Chuantao Zheng[1*], Ningning Ma[1], Zidi Liu[1], Yang Yue[1], Yu Zhang[1], Yiding Wang[1], Tittel Frank[2]
1. Jilin University, China
2. Rice University, USA

Abstract: A near-infrared broadband cavity-enhanced sensor system was demonstrated for the first time using an energy-efficient light emitting diode (LED) with a central emission wavelength at 1650 nm and a light power of ~16 mW.

CIOP2019-2019-000227 (10:00-10:15, August 8)

Static strain sensing with temperature-effect compensated by dual-comb spectroscopy with FBG sensors

Ruixue Zhang, Zebin Zhu, Guanhao Wu
Tsinghua University, China

Abstract: To precisely characterize the optical response of the fiber Bragg grating (FBG) when strain is applied, dual-comb spectroscopy (DCS) is used to realize pure strain sensing with temperature–induced frequency shift compensated.

CIOP2019-2019-000224 (10:15-10:30, August 8)

Simultaneous Measurement of Strain and Torsion based on a seven-core fiber Mach-Zehnder Interferometer

Fan Zhang
Guangxi Normal University, China

Abstract: In this paper, we have proposed and demonstrated a torsion sensor based on MZI. The sensors can simultaneous measurement strain and torsion.

CIOP2019-2019-000281 (12:00-12:15, August 8)

Detection of prostate specific antigen using arc-induced long-period microfiber gratings

Peng Xiao, Kaqiang Li, Wenhua Huang, Li-Peng Sun, Jie Li, Linghao Cheng, Bai-Ou Guan
Institute of Photonics Technology, Jinan University, China

Abstract: In this work, we report a microfiber long period grating biosensor for detection of prostate specific antigen (PSA), which was fabricated using an arc discharge method. The sensor presents a log-linear response to concentration range from 1 ng/ml to 500 ng/ml.

CIOP2019-2019-000285 (15:00-15:15, August 8)

Fiber optic surface plasmon resonance technology for detection mercury Ion

Huizhen Yuan, Hsuwen Chu, Xuhui Zhang, Wei Peng

College of Physics and Optoelectronics Engineering, Dalian University of Technology, China

Abstract: In this paper, a method of detecting mercury ion (Hg^{2+}) concentration in water samples by using Thymine-1-aceticAcid(T-COOH) functionalized Au nanoparticles enhanced fiber optic SPR sensor is proposed.

CIOP2019-2019-000305 (15:15-15:30, August 8)

Assessment of monitoring dimension difference of fish swimming behavior based on NIR sensor

Kai Lin

Beijing Research Center for Information Technology in Agriculture, China

Abstract: This paper aim was to systematically evaluate whether and to which extent 3D has a higher precision of quantifying swimming activities, and 2D data whether may challenge experimental validity based on NIR sensor.

CIOP2019-2019-000019 (15:30-15:45, August 8)

Light addressable potentiometric sensor phase rapid detection method based on orthogonal detection

Xiaoguang Yan, Dong Chen, Xingyuan Tong

Xi'an University of Posts and Telecommunications, China

Abstract: The phase detection method of Light-addressable potentiometric sensor (LAPS) can realize accurate detection under the weak light intensity. Now available phase detection method has high algorithm complexity and is difficult to achieve. Aiming at this practical problem, a phase detection method based on orthogonal detection is proposed.

CIOP2019-2019-000377 (10:00-10:15, August 9)

Design and detection experiment of a portable platelet aggregation instrument

Xiechen Huang[1,2], Jiangyun Wang[2], Ming Yu[1], Hui Lin[1,3*]

1. Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China
2. China University of Petroleum (Beijing), China
3. Shenzhen Key Laboratory of Precision Engineering, China

Abstract: This paper mainly introduces the design and detection experiment of a new portable platelet aggregation detector, and makes an investigation of the data

SC16 Atomic Physics, Quantum Photonics, and Quantum Information

Tutorial & Invited Talks

- 13:30-14:15, August 7 -

Atom-photon quantum interface (Tutorial)

Shengwang Du
The Hong Kong University of Science and Technology, Hong Kong, China

Abstract
The atom-photon quantum interface, interconnecting long-lived matter states and flying photon modes, plays an important role in many quantum systems involving atom-photon interactions. However strong nonlinear atom-photon interaction on atomic resonance in a single-photon level often is accompanied with loss. In this talk I will review the recent progress in lossless on-resonance nonlinear atom-photon interfaces based on electromagnetically induced transparency, and the applications in narrowband entangled photon pair generation, photonic quantum memory, mirrorless optical parametric oscillation, and nontraditional quantum heat engine.

Biography
Shengwang Du, Professor of Physics in The Hong Kong University of Science and Technology. Prof Du's experimental research mainly focuses on atomic, molecular, and optical (AMO) physics. On the fundamental side, his group is exploring the field of quantum optics and probing the quantum nature of light quanta with cold atoms. Prof. Du is also interested in developing applied optical microscopy tools for nano-micro material and cell bioimaging. Prof. Du is a Fellow of The Optical Society (OSA).

SC16

- 14:15-14:45, August 7 -

Recent progress in the optical studies of single perovskite nanocrystals

Xiaoyong Wang
Nanjing University, China

Abstract
Semiconductor perovskite nanocrystals (NCs) have just emerged as a novel type of semiconductor nanostructure capable of emitting single photons without the influence of dark-exciton emission. Moreover, the suppressions of both the photoluminescence (PL) blinking and spectral diffusion effects were successfully demonstrated in single perovskite NCs. In this talk, we will show our recent progress made on the optical studies of single perovskite $CsPbI_3$ NCs at the cryogenic temperature, focusing mainly on the bright-exciton fine-structure splitting (FSS), coherent optical property and the electrical manipulation. First, the bright-exciton FSS is manifested as either a doublet or a triplet PL peak, which should correspond to the weak and strong quantum confinement in a single CsPbI3 NC according to our experimental and theoretical investigations. Second, the first-order photon correlation and PL excitation measurements are performed on single $CsPbI_3$ NCs, which allow us to further realize the quantum interference measurement to yield an exciton dephasing time of about 10 ps. Third, strong quantum-confined Stark effect is observed in single $CsPbI_3$ NCs upon being biased by an external electrical field, with the FSS value being greatly reduced to signify potential emission of polarization-entangled photon pairs. The above achievements will surely advance single perovskite NCs into the quantum information regime, opening up an alternative yet prospective research direction beyond their traditional applications such as in optoelectronic devices and bioimaging.

Biography

Dr. Xiaoyong Wang obtained his bachelor's and master's degrees of optical engineering from Tianjing University, China, and his doctoral degree in physics from University of Arkansas at Fayetteville, US. After doing his postdoctoral researches from University of Texas at Austin and University of Rochester in the US, Dr. Xiaoyong Wang took a full professor position in the School of Physics at Nanjing University, China, and is now the chair for the department of optical science.

- 14:45-15:15, August 7 -

Recent progress in telecom wavelengths solid-state quantum emitters from InP-based photonic structures

Mohamed Benyoucef
University of Kassel, Germany

Abstract

Solid state semiconductor quantum dots (QDs) embedded in microcavities emitting at optical fiber communication wavelengths, particularly in the telecom C-band, which offers the lowest attenuation losses in silica fibers have a lot of potential as a single photon source platform due to their various advantages of favorable manipulation and integration with various photonic elements. Cavity QED platform consisting of QDs in photonic crystals (PhCs) emitting at the telecom wavelengths are also considered as highly attractive for future applications in the solid-state quantum information processing. Here, we report our recent progress in telecom wavelengths single-photon emitters from single InP-based QDs. Low QD density is obtained by careful control of the QD growth using a special growth technique and temperature processing. These QDs proved to have a nearly perfect single-photon emission and good coherence properties with clear signature of Rabi oscillations and large g-factors. Low-temperature single-dot spectroscopy exhibits sharp excitonic emission lines from single QDs and vanishing fine-structure splittings. The fabrication of InP-based PhC microcavities embedded with QDs is discussed. The influence of geometrical parameters on the quality factor enhancement, light out-coupling and the mode profiles of InP-PhC cavities are investigated. Suitable PhC are designed using finite difference time domain (FDTD) simulations. Sharp cavity modes with high quality factors are presented.

Biography

Mohamed Benyoucef has received his PhD from the University of Bristol, United Kingdom and Habilitation from the University of Kassel, Germany. He is the Head of Nano Optics and Photonics Group, at University of Kassel and a member of the Centre of Interdisciplinary Nanostructure Science and Technology (CINSaT). He is actively involved in research network related to quantum communication and quantum technology. His research focuses on the development of novel and advanced quantum nanoarchitectures fabricated on Si, GaAs, and InP substrates using molecular beam epitaxy system and study their specific aspects of quantum optics using various spectroscopic techniques. Integration of III-V semiconductor light sources in silicon and processing of nanostructured surfaces for optical devices, which open new perspectives in photonics and quantum information technology.

- 16:00-16:30, August 7 -

Experimental test of error-tradeoff uncertainty relation with continuous variables

Xiaolong Su
Shanxi University, China

Abstract

Heisenberg's uncertainty relation is one of basic principle in quantum mechanics, which gives a fundamental limitation for joint measurements of two incompatible quantum observables. We experimentally test the error-tradeoff uncertainty relation by using a continuous-variable Einstein-Podolsky-Rosen (EPR) entangled state. We also experimentally test the error-disturbance uncertainty relation for different Gaussian states by using a heterodyne measurement system. Our experimental results demonstrate that Heisenberg's error-tradeoff uncertainty relation is violated in some cases, while the Ozawa's and Brainciard's error-tradeoff uncertainty relation for continuous variables are valid. Our work is helpful not only in understanding fundamentals of physical measurement but also in developing continuous variable quantum information technology.

Biography

Xiaolong Su is currently a professor at State Key Laboratory of Quantum Optics and Quantum Optics Devices, Institute of Opto-electronics, Shanxi University. His research interest is focused on quantum information with continuous variables and hybrid quantum information processing. He has published over 50 papers on scientific journals, including Nature Communications, Phys. Rev. Lett., et. al. He is the winner of National Science Fund for Excellent Young Scholars in 2015 and Youth Sanjin Scholar in Shanxi Provience.

- 16:30-17:00, August 7 -

Experimental investigation of the Einstein-Podolsky-Rosen steering

Jinshi Xu

University of Science and Technology of China, China

Abstract

Einstein-Podolsky-Rosen (EPR) steering describes the ability of one observer to nonlocally steer the other observer's state through local measurement. EPR steering stands between entanglement and Bell nonlocality in the hierarchy, which provides a novel insight into quantum nonlocality. In this report, I will introduce our recent works on the experimental investigation of EPR steering. Based on the All-Versus-Nothing proof, we demonstrate an EPR steering game. We then provide a necessary and sufficient condition for EPR steering and clearly demonstrate the distinguished one-way EPR steering. We further implement the task of subchannel discrimination where the probabilities of correct discrimination are clearly enhanced by exploiting steerable states. Our woks provide a particularly strong perspective for understanding EPR steering and have potential applications in asymmetric quantum information processing.

Biography

Jin-Shi Xu received his Ph.D. degree in optics from University of Science and Technology of China (USTC) in 2009. He became a professor in USTC since 2016. He was awarded the national best PhD thesis prize in 2011 and Wang Daheng optics prize in 2015. He was supported by the National Science Fund for Distinguished Young Scholars. His current research interests include linear optical quantum simulation, spin-photon interface and fundamental quantum physics.

- 08:30-09:15, August 8 -

Quantum light source engineering towards "quantum supremacy" (Tutorial)

Chaoyang Lu

University of Science and Technology of China, China

Abstract

Quantum computers can in principle solve certain problems faster than classical computers. Despite substantial progress in the past decades, building quantum machines that can actually outperform classical computers for some

specific tasks—a milestone termed as "quantum supremacy"—remained challenging. Boson sampling has been considered as a strong candidate to demonstrate the "quantum supremacy". The challenge for realizing a large-scale boson sampling mainly lies in the lack of perfect quantum light sources. To this end, using single semiconductor quantum dot deterministically coupled to elliptical micropillars, we produced polarized single photons with near-unity purity, indistinguishability for 1000 photons, and high extraction efficiency—all combined in a single device compatibly and simultaneously [PRL 116, 020401 (2016)]. We built boson sampling machines with increasingly large number of photons to race against classical computers [Nature Photonics 11, 365 (2017)]. We also developed SPDC entangled two-photon source with simultaneously a collection efficiency of 97% and an indistinguishability of 96% between independent photons [PRL 121, 250505 (2018)]. The probabilistic nature of SPDC could be overcome using cascaded transition of a single quantum dot embedded in a broadband microcavity [PRL 122, 113602 (2019)].

Biography

Chao-Yang Lu obtained his Bachelor's degree from the University of Science and Technology of China in 2004, and obtained his PhD in Physics from the Cavendish Laboratory, University of Cambridge in 2011. Shortly after being a Fellow of Churchill College, he returned to China and is currently a Professor of Physics at the University of Science and Technology of China, where he focuses on research on scalable quantum photonics, quantum computation, and quantum foundations. He published more than 70 articles in Reviews of Modern Physics, Science, Nature, Nature research journals, PNAS and PRL, with 8000 citations. His work on quantum teleportation was selected as by IOP Physics World as "Breakthrough of the Year 2015". His work on single-photon source and boson sampling was selected by Optical Society of American as one of "Optics in 2016" and one of "Optics in 2017". He has been awarded Young Qianren Talent, Hong Kong Qiushi Outstanding Young Scholars, National Natural Science Fund for Exceptional Young Scholars, First-Class National Natural Science Prize, Nature's "Science Star of China", OSA Fellow, China's Youth Wusi Medal, Fresnel Prize from the European Physical Society, TR35 China, AAAS Cleveland Prize, and Huangkun Prize on Semiconductor Physics from the Chinese Physical Society.

- 09:15-09:45, August 8 -

Integrated quantum dot single photon sources on Si

Yasutomo Ota

The University of Tokyo, Japan

Abstract

In this talk, we will review our recent efforts on hybrid integration of quantum dot single photon sources on silicon photonics circuits, as a first step toward large scale photonic quantum information processors. We employed transfer printing for assembling the III-V semiconductor based emitters on the CMOS-processed photonic chips. The pick-and-place assembly process enables placing pre-selected quantum-dot single photon guns on desired positions in the circuits. This may allow for overcoming the difficulties in the heterogeneous integration process associated with the inherit randomness in emission wavelengths and positions of self-assembled quantum dots. We will also show that the integrated quantum dot emitter can couple to the underlying silicon waveguide with a theoretical efficiency close to unity. The use of a carefully-designed photonic crystal nanobeam cavity is the key to achieve this high efficiency. Experimentally, we observed a high coupling efficiency over 70%. Another interesting topic to be discussed is the realization of a quantum-dot-based cavity quantum electrodynamics system on a silicon chip, which was in strong coupling regime and exhibited an anti-crossing between the quantum dot and cavity mode.

Biography

Yasutomo Ota received a B.E. (2006) in Mechanical Engineering from Osaka Prefecture University and a M.E (2008) and a Ph.D. (2011) in Electrical Engineering from The University of Tokyo. He joined Institute for Nano Quantum Information Electronics, The University of Tokyo as a project assistant professor in 2011 and has been a project associate professor since 2016. His research interest lies in, but not limited to light-matter interactions in photonic nanostructures.

- 09:45-10:15, August 8 -

Multiplexed light-matter interface at telecom band based on cryogenically cooled Erbium doped fibre

Qiang Zhou
University of Electronic Science and Technology of China, China

Abstract
Distributing quantum information using photons through quantum channels is essential for building future quantum networks. The scalability needed for such quantum networks can be realized by employing photonic quantum bits (qubits) that are multiplexed into time and/or frequency, and light-matter interfaces that are able to store and process such qubits with large time-bandwidth product and multimode capacities. Despite important progress in developing such devices, the demonstration of these capabilities using nonclassical light remains challenging. Here, employing the atomic frequency comb quantum memory protocol in a cryogenically cooled (800 mK) erbium-doped optical fibre, we report the quantum storage of heralded single photons at a telecom-wavelength (1.53 mm) with a time-bandwidth product approaching 800. Furthermore, we demonstrate frequency-multimode storage and memory-based spectral-temporal photon manipulation. Notably, our demonstrations rely on fully integrated quantum technologies operating at telecommunication wavelengths. With improved storage efficiency (by cooling the erbium-doped optical fibre to 10 mK), our light-matter interface would become a useful quantum device in future quantum networks.

Biography
Dr. Qiang Zhou is a professor at the University of Electronic Science and Technology, with research interests in quantum information technologies, quantum internet, light-matter interface, quantum devices, nonlinear optics, nano-photonics and quantum photonics. He received the B.S. degree from University of Electronic Science and Technology in Optoelectronic Information and the Ph.D. degree from Tsinghua University in Electronic Science and Technology. He was awarded the 2011-Tsinghua outstanding doctoral thesis prize for his work in fibre based quantum light source. He has authored more than 50 papers in referred journals and conferences. He presented more than 10 talks (including 5 invited talks) in international conferences. He is a principal investigator for National Key R&D Program of China.

- 11:00-11:30, August 8 -

Nanocontrolled quantum dot scanner as quantum light source and near field probe

Xuewen Chen
Huazhong University of Science and Technology, China

Abstract
Absorption, emission from matter and scattering of light comprise the majority of optical phenomena in our world. Single quantum emitters are elementary sources of light and also most sensitive probes of optical fields and material boundaries. Among various kinds of nanoscopic emitters, colloidal quantum dots (QDs) have gained great attention due to intense broad-band absorption, tunable narrow-band emission, solution processibility, and compatibility with photonic structures. In this presentation, on nano-controlled coupling of one colloidal quantum dot to a dielectric nanotip for single-mode outcoupling of the single photons We show in-situ deciphering the charging status, and precisely assessing the absorption cross section for neutral, positively-charged, and negatively-charged single core/shell CdSe/CdS QD. We demonstrate three-dimensional manipulation of the QD towards precise integration of nanophotonic structures and near-field imaging.

Biography

Prof. Xue-Wen Chen graduated with Bachelor (2003) in Chu Kochen Honors College and Ph.D. (2008) in Optics both from Zhejiang University, China. He was a Postdoctoral fellow at the Laboratory for Physical Chemistry, Swiss Federal Institute of Technology Zurich (ETH Zurich) and a research scientist at the Max-Planck Institute for the Science of Light (MPL, Germany). In June 2014, He accepted the national “Thousand Plan (Youth)” award from China and joined the School of Physics Huazhong University of Science and Technology (HUST) as professor. His research interests include experimental and theoretical studies of solid-state quantum optics and photonics at the nanometer scale.

- 11:30-12:00, August 8 -

Quantifying the mesoscopic nature of the Einstein-Podolsky-Rosen nonlocality

Qiongyi He
Peking University, China

Abstract

Evidence for Bell’s nonlocality is so far mainly restricted to microscopic systems, where the elements of reality that are negated predetermine results of measurements to within one spin unit. Any observed nonlocal effect (or lack of classical predetermination) is then limited to no more than the difference of a single photon or electron being detected or not (at a given detector). In this paper, we analyze experiments that report Einstein-Podolsky-Rosen (EPR) steering form of nonlocality for mesoscopic photonic or Bose-Einstein condensate (BEC) systems. Using an EPR steering parameter, we show how the EPR nonlocalities involved can be quantified for four-mode states, to give evidence of nonlocal effects corresponding to a two-mode number difference of 105 photons, or of several tens of atoms (at a given site). We also show how the variance criterion of Duan-Giedke-Cirac and Zoller for EPR entanglement can be used to determine a lower bound on the number of particles in a pure two-mode EPR entangled or steerable state, and apply to experiments.

Biography

Dr. Qiongyi He is a “Talent-100” Professor at Peking University. She joined the faculty of Institute of Modern Optics at Peking University in January 2012, after carrying postdoctoral at University of Queensland and Swinburne University of Technology in Australia, undertaking Australian Postdoctoral Fellowship (APD) and Discovery Early Career Research Award (DECRA). She received the “Excellent Young Scholar Award” granted by National Natural Science Foundation of China (NSFC) and “The Changjiang (Yangtze River) Youth Scholar Award” selected by Ministry of Education of China in 2017. Her research interests lie in the fields of theory and applications of general quantum correlations for quantum information science.

- 13:30-14:00, August 8 -

Quantum coherence resource theory and its application

Guoyong Xiang
University of Science and Technology of China, China

Abstract

Entanglement is explored within the framework of quantum resource theories, which can also be used to investigate other non-classical features of quantum mechanics in a systematic way. A concept underlying many facets of non-classicality, including entanglement, is the superposition principle. Since a quantum system naturally decoheres in the presence of unavoidable interactions between the system and its environment, superposition is itself a resource, which

is studied in the recently developed resource theory of quantum coherence. In this talk, I will review the experimental progress in measurement of quantum coherence, interconversion between quantum coherence and quantum correlation, and the applications of quantum coherence resource theory.

Biography

Dr. Guoyong xiang, professor of physics, have received his Ph.D. degree from University of Science and Technology of China (USTC) in 2005. Dr. Xiang is an experimental physicist and his research interest is focused on quantum information, quantum precision measurement and fundamental problems of quantum mechanics. Dr. Xiang was supported by National Natural Science Foundation--Outstanding Youth Foundation.

- 14:00-14:30, August 8 -

Research of ultrahighly-sensitive phodiodes

Xia Guo

Beijing University of Posts and Telecommunications, China

Abstract

Ultrahighly-sensitive photodetectors are desirable for optoelectronics. In this paper, three types of ultrahighly-sensitive photodetectors are developed. First is transfer-free graphene/Cu_2O quantum dot photodetector. Graphene attracts great attention due to its outstanding electrical, optical and mechanical properties, which make it appealing in optoelectronics and photodetection applications. An internal current gain mechanism is proposed based on a 2D/0D photodetection system. Carrier density in the 2D material can be amplified by Fermi level modulation when a 0D quantum dot absorbs photons. An ultrahigh responsivity over 1010 A W^{-1} and fW light detectivity at room temperature are achieved by a transfer-free hybrid graphene/Cu_2O quantum dot photodetector. In order to verify the internal current gain mechanism, ultrahigh sensitivity of ~109 A W^{-1} is also achieved in graphene/GaN quantum dot photodetector system. The third type of ultrahighly-sensitive photodetector is conventional avalanche photodiode operating in the Geiger mode, which is also called single-photon avalanche diode (SPAD), with the single photon sensitivity. We solved the confliction between photon detection efficiency and timing jitter, which is ~20% and ~22ps, respectively.

Biography

Professor Xia Guo is from Beijing University of Posts and Telecommunications. Her research interest is mainly the development of semiconductor optoelectronic devices, including single photon avalache photodiodes, vertical-cavity surface-emitting diodes, and light-emitting diodes. She has presided over more than 20 scientific research projects, such as the key projects of the National Natural Science Foundation and the national key R&D projects. She has published more than 100 SCI papers in academic journals.

- 14:30-15:00, August 8 -

High dimensional linear transformation from orbital angular momentum states to spatially coherent states

Xue Feng

Tsinghua University, China

Abstract

Linear operations on an N-dimensional vector are a powerful tool both for quantum optics and for classical optical information processing. Based on orbital angular momentum (OAM) states, the concepts of “quasi-angle” state and

"quasi-OAM" state are introduced to form the high-dimensional optical Hilbert space and a linear states transformation method have been proposed. Furthermore, we have proposed and demonstrated a non-cascaded approach to perform arbitrary unitary and non-unitary linear operations for N-dimensional phase-coherent spatial modes. Our approach is a simple, fixed, error-tolerant and scalable scheme based on meticulously designed phase gratings. According to experimental results, the unitary transformation matrix has been realized with dimensionalities ranging from 7 to 24 with corresponding fidelities from 95.1% to 82.1%. Besides the unitary operations, non-unitary operators can also be implemented. As a concrete example, a 4×16 matrix is presented for the state tomography of a 4-level quantum system, with a fidelity of 94.9%.

Biography

Dr. Xue Feng received his BS, MS and PhD degrees from Tsinghua University in 1999, 2002 and 2005, respectively. Since 2005, he has been a faculty in Department of Electronic Engineering, Tsinghua University, Beijing, China. Dr. Xue Feng has published more than 150 papers on academic journals and conferences with topics of optoelectronic devices. From 2009, he is dedicated to the integrated optoelectronic devices with nano/micro structures. The main research interests include integrated photonic orbital angular momentum emitter, new photonic functional devices and photonic integrated circuit.

- 15:00-15:30, August 8 -

Photonic spin-orbit coupling in optical microcavities

Feng Li
Xi'an Jiaotong University, China

Abstract

Fabry-Perrot (FP) microcavities with metal or DBR (distributed Bragg reflector)-coated mirrors provide an excellent platform for investigating the collective behavior of confined 2-dimensional photons and polaritons. The TE-TM mode splitting in such cavities acts as an effective magnetic field, leading to photonic spin-orbit (SO) coupling effect that the pseudospin of cavity photons changes anisotropically with their momenta. Such mechanism has led to interesting observations including optical spin-Hall effect, magnetic-monopole-like half solitons, spinor condensate with half-quantum circulation, and polaritonic topological insulators. In this paper, we report the SO coupling effect in an open-access microcavity consisting of planar and concave DBR-coated cavity mirrors separated by a micro-sized gap. A combination of the SO coupling and the lateral photonic potential gives rise to new eigenstates of spin vortices and optical Skyrmions. We show that those states provide vector vortex beam lasing with ultrasmall mode volume, whose pseudospin features can be tuned by varying the cavity length. Furthermore, by incorporating optically-active organic microcrystals inside the FP microcavity, we show the direct measurement of pseudospin-dependent Berry curvature and quantum metric in geometrically nontrivial bands preserving time reversal symmetry. These studies show promising applications in high-efficiency quantum light sources and pseudo-spin mediated topological photonic devices.

Biography

Feng Li got his bachelor's and master's degree at Tianjin University in China in 2006 and 2008. He got his PhD at CNRS and the University of Nice Sophia-Antipolis in France in 2013, supported by the European Marie-Curie ITN project CLERMONT4. Then he worked as a research associate at the University of Sheffield in UK from January 2014 to May 2017. Feng Li joined Xi'an Jiaotong University (China) as a professor in June 2017, with main research interest in light-matter interaction in microcavities and nanostructures.

- 08:45-09:15, August 9 -

Extreme nonlinear photoemission from carbon nanotubes

Qing Dai
National Center for Nanoscience and Technology, China

Abstract
Controlling electron motion by strong electromagnetic field, occurring on the attosecond (10-18 seconds) timescale, is the heart of "lightwave electronics". Until so far, various light-field driven effect has been explored, such as sub-optical-cycle photoemission from metal tips, interband tunneling in dielectrics and semiconductors, and high harmonic generation from bulky or two dimensional crystals. However, much less is known about light-field driven effect from one dimensional quantum confined electronic states. Among various one dimensional nanomaterials, Carbon nanotube is a promising platform to achieve light-field driven electron dynamics, because their wide bandwidth light field enhancement and high damage threshold. Here, we show that the photoemission yield induced from carbon nanotubes by intense laser pulses exhibited 20 power law of the laser intensity. The photoemission in such regime induced by few-cycle laser pulses can be sensitively modulated by the carrier-envelope phase, with a total current modulation contrast up to 100%, indicating an access into deep light-field driven regime. We expect these results to provide design philosophy for light-wave electronics.

Biography
Dr. Qing Dai is a professor in Nanophotonics at National Center for Nanoscience and Technology (NCNST), China. He is a cofounder and director of the Division of Nanophotonics at NCNST. His current research focuses on Nanophotonics, including high quality nanomaterials and nanostructures design and fabrication; plasmonic properties and surface enhanced spectroscopy; high spatial nearfield optical characterization and ultrafast electron emission. He has published over 60 peer-reviewed papers in reputed international journals, including Nature Communications and Advanced Materials. He is a regular reviewer of various high-impact journals such as Nature Materials, Advanced Materials, Nanoscale, ACS Nano and Nano Letters.

- 09:15-09:45, August 9 -

Quantum entanglement with photonic orbital angular momentum

Xilin Wang
Nanjing University, China

Abstract
Orbital angular momentum (OAM) arising from the helical phase structure of a photon could be used to encode a qubit or a qudit. It plays an important role for the photonic quantum information processing since it could result in some unique functions such as entanglement with high momentum and in high dimension. In this talk, I will start with a brief introduction to OAM and a short review of the recent advances in OAM application in quantum information processing. Then, I will in particular talk about our work of applications of quantum entanglement with OAM. By simultaneously manipulating OAM and Spin angular momentum (SAM), we implemented the first quantum teleportation of multiple DoFs of a single photon [Nature 518, 516-519 (2015)]. Then, together with the high-brightness photon entanglement source for ten-photon entanglement [Phys. Rev. Lett. 117, 210502 (2016)], we successfully demonstrated the 18-qubit entanglement with six photons' three degrees of freedom including SAM, OAM and path [Phys. Rev. Lett. 120, 260502 (2018)].

Biography

Xi-Lin Wang now is a professor at Nanjing University. His research interest focus on quantum optics and quantum information with orbital angular momentum. His contribution as the main author include: the first quantum teleportation with multiple degrees of freedom, which was elected as “Breakthrough of the Year 2015” by IOP Physics World; the first ten-photon entanglement, refreshing the world record; and the first 18-qubit entanglement with six photons’ three degrees of freedom, which was reported by Phys. Org. with a title of “18-qubit entanglement sets new record”. He has so far published 30 articles in peer-reviewed journals, including 1 in Nature, 10 in Physical Review Letters, and his publications have attracted more than 1200 SCI citations.

Oral Talks

CIOP2019-2019-000067 (15:15-15:30, August 7)

Multi-bit quantum digital signature based on quantum temporal ghost imaging

Xin Yao, Zhang Wei
Tsinghua University, China

Abstract: Based on the temporal ghost imaging with security test, we propose and demonstrate a multi-bit quantum digital signature scheme, in which a multi-bit message can be signed at a time.

CIOP2019-2019-000101 (17:00-17:15, August 7)

Generation of adjustable biphoton frequency comb and its spatial quantum beating

Rong Xue[1], Yidong Huang[1,2], Wei Zhang[1,2*]
1. Beijing Innovation Center for Future Chips, Electronic Engineering Department, Tsinghua University, China
2. Beijing Academy of Quantum Information Sciences, China

Abstract: We realize a biphoton frequency comb through vector spontaneous four wave mixing processes. Comb-like fringes with a series of dips of spatial quantum beating show the biphoton frequency comb is adjustable by the pulse shaper.

CIOP2019-2019-000055 (17:15-17:30, August 7)

Quantum Photonic Justification of Refraction for development of atto-second optical switches

Hassan Kaatuzian
Professor of Electrical Engineering, Iran

Abstract: In this paper, we use Quantum- Photonic (Q.P.) theoretical analysis to describe why refraction occurs. Quantum Photonics, is an authentic concept based on Bohm theory.

SC16

CIOP2019-2019-000112 (10:15-10:30, August 8)

Single photon detectors based on periodically poled lithium niobate waveguides

MIngyang Zheng[1], Fei Ma[1], Longyue Liang[1], Quan Yao[1], Xiuping Xie[1], Qiang Zhang[1,2]
1. Jinan institute of quantum technology, China
2. University of Science and Technology of China, China

Abstract: Up-conversion single photon detectorbased on frequency mixing, operatingin the near infrared band,has extensive applicationsin quantum secret key distribution, optical time domain reflectometer, infrared single photon imaging, quantum lidar and so on.

CIOP2019-2019-000159 (09:45-10:00, August 9)

Design of single photon spectrum analyzer based on silicon waveguide integrated superconducting nanowire single photon detectors

Lingjie Yu, Jingyuan Zheng, Wei Zhang, Yidong Huang
Beijing Innovation Center for Future Chips, Electronic Engineering Department, Tsinghua University, China

Abstract: Feasibility of the combination of SNSPDs and silicon shallow-ridge waveguides is demonstrated by sample fabrication and measurement. Based on it, a design of silicon based single photon spectrum analyzer is proposed.

CIOP2019-2019-000240 (10:00-10:15, August 9)

Scalable multipartite EPR steering via a quantum frequency comb

Yin Cai

Xi'an Jiaotong University, China

Abstract: We present experimental generations of multipartite EPR steering using an intrinsic multimode quantum resource with optical frequency combs and a pulse shaped homodyne detection apparatus.

CIOP2019-2019-000294 (10:15-10:30, August 9)

On-chip polarization independent quantum interference device

Feng Yu[1], Li-Cheng Wang[1], Chen Yang[2], Zhen-Nan Tian[1*]

1. Jilin University, China

2. University of Science and Technology of China, China

Abstract: Ultra-low birefringence single-mode optical waveguides and polarization-independent quantum unit interference devices were fabricated in Corning glass by optical field shaping technology, which provided high performance basic devices for polarization-coded optical quantum chips.

Best Student Papers Competition

CIOP2019-2019-000059 (13:30-13:45, August 7)

Rabi-like oscillation of photonic topological valley Hall edge states

Hua Zhong[2], Yaroslav V. Kartashov[1], Yiqi Zhang[2*], Zhigang Chen[3]
1. Institute of Spectroscopy, Russian Academy of Science, Russia
2. Xi'an Jiao Tong University, China
3. Nankai University, China

Abstract: We investigate Rabi-like oscillations of topological valley Hall edge states by introducing two zigzag domain walls in an inversion-symmetry-breaking honeycomb photonic lattice. Such resonant oscillations are stimulated by weak periodic modulation of the lattice depth along the propagation direction that does not affect the overall symmetry and the band topology of the lattice.

CIOP2019-2019-000073 (13:45-14:00, August 7)

White beam lasing from a hybrid micro-cavity with slab–capillary mode coupling

Hailang Dai, Zhuangqi Cao, Xianfeng Chen
Shanghai Jiao Tong University, China

Abstract: White and tunable lasing over the full range of visible colors has been achieved through controlled injection of different dye solutions into the metal-cladded capillaries of the micro-cavity.

CIOP2019-2019-000083 (14:00-14:15, August 7)

Multidimensional quantum linear operations with simple and non-cascaded structure

Shikang Li, Xue Feng[*], Yidong Huang
Department of Electronic Engineering Tsinghua University, China

Abstract: We propose and demonstrate a distinctive implementation for universal quantum linear operators with dimension up to 15×15. Quantum projective measurements and quantum state tomography are performed with fidelity up to 96.7% and 90.8%.

CIOP2019-2019-000108 (14:15-14:30, August 7)

Energy-time entanglement-based dispersive optics quantum key distribution networks

Xu Liu[1], Xin Yao[1], Wei Zhang[1,2*], Yidong Huang[1,2]
1. Beijing Innovation Center for Future Chips, Electronic Engineering Department, Tsinghua University, China
2. Beijing Academy of Quantum Information Sciences, Beijing, China

Abstract: An energy-time entanglement-based dispersive optics quantum key distribution (DO-QKD) is demonstrated over optical fibers of 20 km. Based on this, a fully connected all passive wavelength division multiplexing quantum access optical network is also constructed.

CIOP2019-2019-000174 (14:30-14:45, August 7)

Bright-dark pulse pair and soliton bunch generation from mode-locked erbium-doped fiber laser with GIMF-SIMF-GIMF as a saturated absorber

Zhiming Zou, Yong Yao[*], Jie Shi, Qianchao Wu, Chonghao Wu
Harbin Institute of Technology (Shenzhen), China

Abstract: Multiple sets of soliton bunches in different pump power and dual-wavelength bright-dark pulse pair generation from all fiber mode-locked erbium-doped fiber laser with GIMF-SIMF-GIMF as a saturated absorber.

CIOP2019-2019-000191 (14:45-15:00, August 7)

Femtosecond mode-lock fiber laser with GIMF-SIMF-GIMF structure as the saturable absorber

Jie Shi, Zhiming Zou, Yong Yao*

Harbin Institute of Technology (Shenzhen), China

Abstract: A femtosecond mode-lock all-fiber laser based on the nonlinear multimode interference (NL-MMI) effect is demonstrated. The saturable absorber (SA) in this laser is a graded-index multimode fiber-step index multimode fiber-graded-index multimode fiber (GIMF-SIMF-GIMF) structure. Through finely adjust the polarization controller (PC) to a certain state, the laser will output a mode-lock pulse.

CIOP2019-2019-000234 (15:00-15:15, August 7)

Effect of laser energy and polarization on RF emission characteristics of laser induced air plasma

Xingsheng Wang

Changchun University of Science and Technology, China

Abstract: Radio frequency emissions in the range of 30-800 MHz from laser induced air plasma by a nanosecond laser were investigated. The RF emissions from air plasma induced by different laser energies and polarization were obtained.

CIOP2019-2019-000237 (15:15-15:30, August 7)

All-inorganic transparent hybrid materials for dynamic filtering of optical radiation

Xu Feng[1], Zhuo Shi[1], Jianrong Qiu[2], Shifeng Zhou[1*]

1. School of Materials Science and Engineering, South China University of Technology, China
2. College of Optical Science and Engineering, Zhejiang University, China

Abstract: Nonlinear optical limiting material lies at the core of the dynamic laser protection system. Here, we present a new strategy to improve the nonlinear optical limiting performance of the photonic glass by topological engineering.

CIOP2019-2019-000250 (16:00-16:15, August 7)

A 3-D printed saturable absorber for femtosecond mode-locking of a fiber laser at a 1.9 μm wavelength

Jinho Lee, Woo Guido, Ju Han Lee*

University of Seoul, Korea

Abstract: We demonstrate the fabrication of a saturable absorber (SA) suitable for operation at 1.9-μm wavelengths using the 3-D printing technology. Using the SA within a thulium-holmium-codoped fiber cavity, 924-fs pulses were readily obtained.

CIOP2019-2019-000291 (16:15-16:30, August 7)

A parallel timing synchronization architecture for all-digital coherent receiver

Yunpeng Zhang[1,2], Chaolei Yue[1,2], Ren Zhu[1], Xia Hou[1], Weibiao Chen[1,2*]

1. Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China
2. University of Chinese Academy of Sciences, China

Abstract: A parallel timing recovery method for all-digital coherent receivers is proposed. Symbol synchronization is achieved through the adjusting of frame structure in of the interpolator. Compared with its serial equivalent, there is almost no degradation in performance.

BEST

CIOP2019-2019-000365 (16:30-16:45, August 7)

Multicolor two-photon microscopy by phase-shaping selective excitation using broadband fiber-continuum

Xinyuan Huang[1,2], Zhongyun Chen[1,2], Ling Fu[1,2*]

1. Britton Chance Center for Biomedical Photonics, Wuhan National Laboratory for Optoelectronics-Huazhong University of Science and Technology, Wuhan, Hubei 430074, China

2. Moe Key Laboratory for Biomedical Photonics, School of Engineering Sciences, Huazhong University of Science and Technology, Wuhan, Hubei 430074, China

Abstract: We present an imaging strategy for multicolor TPEF microscopy combining super continuum, selective excitation and linear unmixing which shows potential to promote multicolor two-photon fluorescence microscopy in the application for in vivo imaging.

CIOP2019-2019-000408 (16:45-17:00, August 7)

Molybdenum disulfide based thermo-optic phase shifter on a silicon nitride waveguide with low power consumption

Nan Tang[1], Qiang Zhao[2*], Linpeng Gu[1], Zhiwen Li[1], Jianlin Zhao[1], Xuetao Gan[1*]

1. MOE Key Laboratory of Material Physics and Chemistry under Extraordinary Conditions, and Shaanxi Key Laboratory of Optical Information Technology, School of Science, Northwestern Polytechnical University, Xi'an 710072, China

2. Qian Xuesen Laboratory of Space Technology, China Academy of Space Technology, Beijing 100094, China

Abstract: Here, we propose and demonstrate a thermo-optic phase shifter with molybdenum disulfide (MoS_2) micro-heater on a SiN waveguide. The proposed MoS_2 microheater is a promising integration platform for various thermo-optic on-chip applications.

CIOP2019-2019-000514 (17:00-17:15, August 7)

Three-dimensional holographic optical tweezers based on a new arbitrary-plane Gerchberg-Saxton algorithm

Yanan Cai, Yansheng Liang, Zhaojun Wang, Shaohui Yan, Baoli Yao

State Key Laboratory of Transient Optics and Photonics, China

Abstract: We proposed an arbitrary-plane Gerchberg-Saxton algorithm for fast generation of 3D multi-focus and realized three-dimensional multi-trap array in real time.

CIOP2019-2019-000569 (17:15-17:30, August 7)

Capacity increase in single sideband direct detection system with probabilistic shaping

Lei Zhang[1], Mingxuan Jiang[2], Fan Zhang[2]

1. State Key Laboratory of Advanced Optical Communication Systems and Networks School of Electronics Engineering and Computer Science, China

2. Peking University, No.5 Yiheyuan Road Haidian District, Beijing, P.R.China, China

Abstract: This article studies the limit shaping gain of probabilistic shaping technique under Gaussian channel and discusses the implementation of probabilistic shaping in single sideband direct detection system.

Posters

SC1 Light-Matter Interactions

CIOP2019-2019-000008

Theoretical calculation and experimental verification of Z increment in laser metal direct manufacturing

Youbin Lai
College of Engineering, Shenyang Agricultural University, China

Abstract: In order to improve the quality of laser metal direct manufacturing parts, the Z increment mathematical model was established, and the optimal Z increment was solved theoretically.

CIOP2019-2019-000046

Tilt interferometer for detecting gravitational wave signals at high frequencies

Shenghua Yu
National Astronomical Observatories, Chinese Academy of Sciences, China

Abstract: A tilt interferometer is realized in a single arm optical cavity to detect high frequency GW signal. Theoretical analysis and some preliminary experimental results indicate that the tilt interferometer can reach a moderate high sensitivity.

CIOP2019-2019-000065

Combustion wave of monocrystalline silicon induced by millisecond laser

Ming Guo[1*], Yongxiang Zhang[2*], Wenying Zhang[1], Chunyan Xu[1]
1. Jilin Engineering Normal University, China
2. College of Optical and Electronical Information, Changchun University of Science and Technology, China

Abstract: Analysis combustion wave state of monocrystalline silicon induced by millisecond pulse laser using optical shadow imaging method, Study influence from different laser energy density and the number of pluses to expansion rate and expansion distance.

CIOP2019-2019-000070

Centrosymmetric cladding-waveguide-arrays directly written by femtosecond laser in $LiNbO_3$ crystals

Bin Zhang
Shandong University, China

Abstract: We report on the fabrication of two types of centrosymmetric waveguide arrays (1D and 2D waveguide array) in $LiNbO_3$ crystals by femtosecond laser direct writing.

CIOP2019-2019-000103

The impact of radio-frequency magnetic field on atomic magnetometer

Yangying Fu, Jie Yuan
National University of Defense Technology, China

Abstract: We study the impact of radio-frequency magnetic field on the atomic magnetometer both in theory and experiments. Through optimizing the radio-frequency magnetic field size, the magnetometer sensitivity is significantly improved.

CIOP2019-2019-000106

Controlling EPR correlations via a coherent signal injection

Jingyan Li, Qingping Hu, Qing Ye, Yanqin Ren
School of Electronic and Electrical Engineering, Wuhan Textile University, China

Abstract: The flexibility and easy controllability of EPR correlations is of great importance in the quantum system, which makes it is an attractive candidate for experimental investigation and future technological use.

CIOP2019-2019-000118

Efficient quasi-phase-matching second-harmonic Generation from cladding waveguides in PPSLT crystal by femtosecond laser writing

Lingqi Li
Shandong University, JINAN, China

Abstract: We demonstrate second harmonic generations in quasi phase-matched cladding waveguide in PPSLT fabricated by direct femtosecond laser writing. A normalized conversion efficiency of 6.15%/ (W cm^2) is obtained, corresponding to maximum conversion efficiency of 54.3%

CIOP2019-2019-000164

Femtosecond laser microfabrication of three-dimensional integration microfluidic chips

Chao Shan[1,2], Chengjun Zhang[2,3], Qing Yang[2,3], Hao Bian[1,2], Xun Hou[1], Feng Chen[1,2]
1. School of Electronics & Information Engineering, Xi'an Jiaotong University, China
2. International Joint Research Laboratory for Micro/Nano Manufacturing and Measurement Technologies, China
3. School of Mechanical Engineering, Xi'an Jiaotong University, China

Abstract: Aims at developing a new method of integrately fabricating PCR microfluidic chip by femtosecond laser, which will supply an effective route to solve the fabrication of widely applicable 3D microfluidic chip with hybrid integrated complex structures.

CIOP2019-2019-000211

Three-dimensional polarization tracking model of interactions between light and scattering media

Yahong Li[1*], Yu Zhao[2], Jinkui Chu[1], Yuegang Fu[2], Peter J. Bryanston-cross[3]
1. School of Mechanical Engineering, Dalian University of Technology, China
2. School of Opto-Electronic Engineering, Changchun University of Science and Technology, China
3. School of Engineering, University of Warwick, United Kingdom

Abstract: Using the present polarization track Monte Carlo program, a 3D polarization tracking model of interactions between light and scattering media is proposed to preciously calculate the polarization transformation effect of multiple scattering events.

CIOP2019-2019-000226

Self-organized periodic crystallization in unconventional glass: induced by ultrafast laser and optical attenuation application in the broadband near-infrared region

Bo Zhang, Jianrong Qiu
Zhejiang University, China

Abstract: Self-organized nanogratings with periodically assembled crystalline and amorphous phases are induced by ultrafast laser. Heat accumulation and the Ta_2O_5 content strongly contribute to nanograting formation. The fabricated structures exhibit a broadband attenuation effect in near-infrared region.

CIOP2019-2019-000232

Interlaced scanning by laser ultrasonic for defects imaging of train rail surface

Yue-hong Zhang, Lin Luo, Yu Zhang, Xiao-rong Gao
Abstract: School of Physical Science and Technology, Southwest Jiaotong University, China

In this paper, the technique of laser ultrasonic rapid detection of rail surface defects is studied. An interlaced laser ultrasonic inspection scheme is designed to obtain a complete rail surface inspection image.

CIOP2019-2019-000233

Investigation of cavity confinement enhancing effect in femtosecond laser induced breakdown spectroscopy

Shangyong Zhao
Changchun University of Science and Technology, China

Abstract: The physical mechanism of cavity confinement enhancing effect of plasma emission intensity, plasma temperature and electron density by using femtosecond laser induced breakdown spectroscopy is discussed.

CIOP2019-2019-000256

Finite simulation of weld inspection using time-of-flight diffraction method based on laser ultrasonic

Jin Yang
Southwest Jiaotong University, China

Abstract: This paper combines TOFD method with laser ultrasonic to detect weld defect. The defect detection process was simulated by finite element method, and the influence of different factors on the echo signal was analyzed.

CIOP2019-2019-000260

Raman spectral properties of fenbendazole molecules

Shuai Lian
Changchun University of Science and Technology, China

Abstract: Study on molecular vibration information and enhanced activity spectrum of fenbendazole by density functional theory and Raman spectroscopy

CIOP2019-2019-000276

Polarization evolution and propagation properties of the circular Airy vector vortex beams

Xiaoyan Yu, Jin Zhang, Yuqing Chen
School of Electronic and Communication Engineering, Guiyang University, China

Abstract: The circular Airy vector vortex beams generated and modulated by the dielectric metasurface is investigated theoretically. We would like to build the intrinsic connection between the vector vortex light field and the Pancharatnam-Berry phase.

CIOP2019-2019-000322

Mechanisms of ablation on Ti-6Al-4V surface irradiated by a single pulse laser

Yong Yang[1,2,3], Tao Zhang[5], Wenhui Fan[1,4*], Guanghua Cheng[1*], Jinhai Si[5]
1. Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China
2. School of Electronics and Information Engineering, Xi'an Jiaotong University, China
3. University of Chinese Academy of Sciences, China
4. Collaborative Innovation Center of Extreme Optics, Shanxi University, China
5. Shaanxi Fast Automotive Transmission Engineering Research Institute, China

Abstract: We discuss the mechanisms of ablation on Ti-6Al-4V surface irradiated by various laser duration based on microstructure characters and temperature on surface. We find that there are different ablation mechanisms under various laser durations.

CIOP2019-2019-000325

Formation of deep-subwavelength structures on organic materials by femtosecond laser ablation

Zhen-Ze Li, Lei Wang
State Key Laboratory of Integrated Optoeletronics, Jilin University, China

Abstract: The formation mechanisms of the laser induced deep-subwavelength structures on organic materials have been systematically studied in this work. It has been found that materials with π-bonds and benzene rings were most susceptible to the formation of the deep-subwavelength structures. Based on a laser-induced surface plasmonic model, the period of regular patterns was estimated and was in a good accordance with experimental results.

CIOP2019-2019-000354

Effects of light intensity and photoperiod on the growth rate of barley grass

Maoke Wan
Ocean University of China, China

Abstract: Using LED light sources that have determined the intensity ratio of red and blue light to explore the effects of different light intensities and photoperiod on the growth rate of barley grass.

CIOP2019-2019-000357

High-performance Al nanostructures in the UV region

Jie Zheng, Zhilin Yang
Department of Physics, Collaborative Innovation Center for Optoelectronic Semiconductors and Efficient Devices, Jiujiang Research Institute, Xiamen University, China

Abstract: Recently, a plenty of research area has been shifting to aluminum (Al)-based nanostructures due to the capacity of supporting the surface plasmon resonance (SPR) spanning from the ultraviolet (UV) to near-infrared (NIR) wavelength and being abundant in the earth.

CIOP2019-2019-000366

The effect of electrode separations on laser triggered discharge plasma

Zhuo Xie[1*], Jiazhi Wu[1], Jingquan Lin[1], Toshihisa Tomie[1,2]
1. School of Science, Changchun University of Science and Technology, China
2. Nanoelectronics Research Institute, National Institute of Advanced Industrial Science and Technology (AIST), Japan

Abstract: The pinch plasma was generated by laser triggered discharge plasma. The better pinch plasma was formed when the electrode separation is 5mm, and the zipper effected observed for electrode separation of 9mm.

CIOP2019-2019-000501

Electron density analysis of plasma produced by laser irradiation of silicon nitride ceramics

Pengcheng Cai, Shuang Li, Hongxing Cai
College of Science, Changchun University of Science and Technology, China

Abstract: The Si_3N_4 ceramics were irradiated by laser, and the FWHM parameters of the lines were obtained by Lorentz and Gauss fitting. The effects of different line broadening on electron density under different energies were studied.

CIOP2019-2019-000512

Spiral spectrum of anomalous vortex beams propagating through weak turbulent atmosphere

Fang Li
Beijing University of Civil Engineering and Architecture, China

Abstract: We study the spiral spectrum of anomalous vortex beams in weak turbulent atmosphere. It is found that the spiral spectrum of anomalous vortex beams is less affected by turbulence than that of Laguerre-Gaussian beams.

CIOP2019-2019-000583

Optical trapping and manipulation of Mie particles with Hollow-Gaussian beam

Ziyu Zhao
Xi'an Shiyou University, School of Science, China

Abstract: In this paper we calculate the scattering fields, radiation forces and torque of Mie-particle induced by Hollow-Gaussian beams using the paraxial approximation method and arbitrary beam theory.

CIOP2019-2019-000586

Controlling two-dimensional periodic surface structure formation on 4H-SiC crystal with three time-delayed femtosecond laser beams of different linear polarizations

Wanlin He
Xi'an Shiyou University, China

Abstract: The fabrication of subwavelength two-dimensional (2D) structures on semiconductor is of paramount importance to modern nanophotonics. Here we report a method to fabricate 2D micro-island structures on 4H-SiC crystal surfaces under the irradiation of three temporally delayed pulses.

SC2 Plasmonics and Metamaterials

CIOP2019-2019-000010

Terahertz slow light at plasmon-induced transparency windows in symmetry broken meta-molecules

Zhenyu Zhao

Shanghai Normal University, China

Abstract: By introduction of symmetric breaking, a broadband PIT window is achieved via near-field coupled dimer MM, while a localized slow light effect is achieved via conductively coupled dimer and trimer MM.

CIOP2019-2019-000038

Multimetallic nanostructures for energy conversion, plasmonic photocatalysis, and photothermal catalysis

Yun Chen, Ningning Wang, Yu Huang

Hunan University, China

Abstract: To fully exploit each function of the constituent materials, a numerical study on the optimal design of the hybrid nanostructures is presented in this work.

CIOP2019-2019-000053

Redshift gap and polarization selectivity in one-dimensional photonic crystal composed of alternative hyperbolic metamaterials and dielectrics

Feng Wu[1], Guang Lu[2], Haitao Jiang[1*], Minjia Zheng[2], Chaoxin Chen[2], Guiqiang Du[2], Hong Chen[1]

1. Tongji University, China

2. Shandong University at Weihai, China

Abstract: We realize redshift bandgap for TM polarization and blueshift bandgap for TE polarization in one-dimensional photonic crystal containing layered hyperbolic metamaterials. The edges of such bandgap can be utilized in high-efficiency wide-angle polarization selection.

CIOP2019-2019-000072

Quantum sensing based on strong photon-emitter coupling

Zhiyuan Qian, Ying Gu

School of Physics, Peking University, China

Abstract: Based on strong photon-emitter coupling of nanogap plasmon system, we propose the quantum plasmon sensing, where Rabi splitting is utilized to detect slight change of environment permittivity at the nanoscale.

CIOP2019-2019-000075

Strong purcell effect for terahertz magnetic dipole emission with spoof plasmonic structure

Hong-Wei Wu

Anhui University of Science and Technology, China

Abstract: In this context, we investigate the enhancement of magnetic dipole emission by putting a magnetic dipole at the hollow of spoof plasmonic structure. The results indicate that the Purcell factor can be more than 103 for magnetic dipole emission, which is one order of magnitude larger than the hollow bare silicon cylinder case.

CIOP2019-2019-000110

Design and analysis of a broadband nanoantenna for energy harvesting

Lu Zhu, Yue Jin, Kangkang Li, Huan Liu, Yuanyuan Liu
School of Information Engineering, East China Jiaotong University, China

Abstract: In this paper, we propose a broadband nanoantenna for solar energy harvesting, whose elements compose of dual triangles, a hexagonal pillar and a ring column. The optical characteristics are analyzed numerically by the three-dimensional finite-difference time-domain (FDTD) method.

CIOP2019-2019-000115

Ultraviolet to near infrared titanium nitride broadband plasmonic absorber

Huixuan Gao, Wei Peng, Wenli Cui, Shuwen Chu, Li Yu, Xiong Yang, Zhenguo Jing
Dalian University of Technology, China

Abstract: We theoretically design and numerically verify a broadband plasmonic absorber that works continuously in ultraviolet to near-infrared region, the absorber can achieve a continuous absorption of more than 90% from wavelength 200 to 1200 nm.

CIOP2019-2019-000254

Ag nanoparticles locally enhanced high performance coupled plasmon waveguide resonance biosensor

Ruikang Guo, Xiongdong Jiang, Wei Li, JImin Wang
University of Electronic Science and Technology of China, China

Abstract: Ag Nanoparticles Locally Enhanced High Performance Coupled Plasmon Waveguide Resonance Biosensor, Ag nanoparticles indeed greatly enhance the penetration depth and figure of merit of the sensor.

CIOP2019-2019-000315

Sensing application of metamaterial perfect absorber based on nanodisk array

Shuwen Chu, Huizhen Yuan, Xuhui Zhang, Huixuan Gao, Li Yu, Wei Peng
School of Physics, Dalian University of Technology, China

Abstract: We propose a dual-channel perfect absorber based on Au nanodisk array that has a wide angular range absorption characteristic in the visible region, which realizes dual-resonance sensing measurements.

CIOP2019-2019-000324

Plasmonic narrow-band perfect absorber for near-infrared biosensing application

Li Yu, Huixuan Gao, Shuwen Chu, Qiao Wang, Wei Peng
DLUT, China

Abstract: We have numerically investigated a perfect narrowband absorber based on the MMDM structure and obtain a nearly perfect absorption of over 99% with an ultra-narrow band of 4nm. The structure shows good sensing performance with S=1208 nm/RIU and FOM=302, which has great potential as a biosensor.

CIOP2019-2019-000359

Enhanced second harmonic generation from strongly coupled collective surface plasmon resonances in the array of hybrid nanocavities

Shen Shaoxin[1*], Yang Weimin[2], Zhou Yongliang[3], Han Junbo[4], Yang Zhilin[2*]
1. College of Information Science and Engineering, Fujian Provincial Key laboratory of Light Propagation and Transformation, Huaqiao University, China
2. Department of Physics, Collaborative Innovation Center for Optoelectronic Semiconductors and Efficient Devices, Xiamen University, China

3. State Key Laboratory of Physical Chemistry of Solid Surfaces, Xiamen University, China
4. Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology, China

Abstract: Plasmon-enhanced second harmonic generation (PESHG) in metal-based nanostructures have attracted extensive attentions due to its widely applications ranging from quantum information processing, ultrasensitive spatial resolution, nonlinear metasurfaces, and nanoscale light-source application with a reliable fabrication technology.

CIOP2019-2019-000368

Broadband directional scattering and controllable hot spot distribution in single core-shell nanoparticle

Chen Yan[1], Chen Shu[2], Yang Zhilin[1*]
1. Department of Physics, Collaborative Innovation Center for Optoelectronic Semiconductors and Efficient Devices, Jiujiang Research Institute, Xiamen University, China
2. CIC nanoGUNE, Spain

Abstract: Efficient manipulate of light scattering pattern at sub-wavelength scales plays a critical role for various applications. Directional scattering is a special light scattering pattern, which may offer new opportunities for nanoantennas, sensing, photovoltaic devices and many other interdisciplinary researches.

CIOP2019-2019-000369

Chiral exceptional points in graphene metasurface

Jinyang Li
Huazhong University of Science and Technology, China

Abstract: We investigate the exceptional points (EPs) in chiral metasurface composed of graphene strips. The EPs emerge as two eigenvalues of transmission matrix coalesce, which relates to completely left- or right-handed circularly polarized output.

CIOP2019-2019-000399

Large-bending-angle 100%-efficiency metasurfaces designed with a top-down approach

Zhening Fang
Fudan University, China

Abstract: We establish a top-down approach to design large-bending-angle high-efficiency metasurfaces, using multiple high order surface waves as auxiliary fields to match the required boundary conditions.

CIOP2019-2019-000506

Polarization-independent plasmonic color filter with metallic disk arrays structure

Yuting Yang
Guilin University of Electronic Technology, China

Abstract: We propose a polarization-independent ultra-thin plasmonic color filter based on a metal disk arrays structure on a substrate-free dielectric film waveguide. The filter consists of a waveguide layer (Si_3N_4), a buffer layer (MgF_2) and a nanodisk (Al). The transmission efficiency of the filter is more than 65%.

CIOP2019-2019-000518

Strong localization of surface plasmon polaritons with engineered disorder

Bo Xiong
Nanjing University, China

Abstract: In this work, we experimentally demonstrate for the first time strong localization of surface plasmon polaritons (SPPs) at the visible regime in metallic nanogratings with short-range correlated disorder."

CIOP2019-2019-000540

Enhanced Raman scattering from gold nanorods vertical array deposited with single layer graphene

Zhu Lu[1], Xing Zhao[1], Yi Cao[1], Qingyan Han[1], Yongkai Wang[1], Jianxia Qi[2], Jun Dong[1*]

1. School of Electronic Engineering, Xi'an University of Posts and Telecommunications, China
2. School of Science, Xi'an University of Posts and Telecommunications, China

Abstract: A complex nanostructure, consisting of gold nanorods vertical array (GNRs-VA) and graphene hybrid substrate (G/GNRs-VA), was fabricated with self-assembly and wet-etching method, which demonstrated high performance in surface-enhanced Raman scattering (SERS).

CIOP2019-2019-000544

A simply method for fabrication of Vertical Arrays of Gold Nanorods as surface enhanced Raman spectroscopy substrates

Rui Wang[1], Xing Zhao[1], Zhongyu Wang[1], Yongkai Wang[1], Jianxia Qi[2], Jun Dong[1*]

1. School of Electronic Engineering, Xi'an University of Posts and Telecommunications, China
2. School of Science, Xi'an University of Posts and Telecommunications, China

Abstract: In this paper, we use the evaporation self-assembly method to prepare the vertical array structure of gold nanorods, and then adjust the morphology of the substrate by changing the soaking time in the target molecule solution, and study the effects of self-assembled metal nanostructure substrates on surface-enhanced Raman scattering (SERS) of target molecules.

CIOP2019-2019-000548

Plasmonic properties of AuSi and its nanostructures

Yang Pang, Zhiqiang Yang, Kang Du, Wending Zhang, Ting Mei

Northwestern Polytechnical University, China

Abstract: We studied plasmonic properties of AuSi and the designed nanostructures. With enhanced absorption and formation of Schottky barrier Si, AuSi is potentially a good material candidate for Si-based hot-electron infrared photodetector.

CIOP2019-2019-000559

Regulation infrared and terahertz plasmon based on graphene nanoribbons

Han Jing[1,2], Yang Suying[3], Gao Yang[1*], Gao Yachen[1*]

1. College of Electronic Engineering, Heilongjiang University, China
2. College of Science, Heilongjiang Institute of Technology, China
3. Physics group, Chaoyang Medical School, China

Abstract: This paper proposes a simple method of depositing single-stranded graphene ribbonsof different widths on a dielectric substrate to introduce discontinuities on the nanoscale, enhancing and effectively controlling the interaction of graphene with light.

CIOP2019-2019-000577

Interaction properties between different modes of localized and propagating surface plasmons in a dimer nanoparticle array

Qilin Ma[1,2,3,] Guangqiang Liu[4*], Yiqing Chen[3*]

1. South China Normal Univ, Sch Informat & Optoelect Sci & Engn, Guangzhou Key Lab Special Fiber Photon Devices, Guangzhou 510006, Guangdong., China
2. National Center for International Research on Green Optoelectronics, South China Normal University, guangzhou 510006, China
3. Hefei University of Technology, School of Materials Science and Engineering, Hefei, Anhui, China

4. Qufu Normal University, School of Physics and Engineering, Qufu, Shandong, China

Abstract: the research based on surface plasmons is receiving more and more attention, so that we study the interaction properties between different modes of localized and propagating surface plasmons, to get further study of the surface plasmons.

CIOP2019-2019-000579

Theoretical modelling of periodic graphene structures

Suwan Kang, Weihua Wang

School of Physical Science and Technology, China University of Mining and Technology, China

Abstract: We propose a simple theoretical model to compute the electromagnetic wave scattering problems in the periodic graphene structures in a highly efficient way.

CIOP2019-2019-000580

Mechanically tunable band-pass filter based on metamaterials

Hongmei Ye, Xiaopeng Shen

School of Physical Science and Technology, China University of Mining and Technology, Xuzhou 221000, China

Abstract: We demonstrate a mechanically tunable metamaterial BPF. By means of mechanically shifting one of the metamaterials layers with cross-shaped slots and changing the incident angle, the BPF can achieve a very broad operation bandwidth.

CIOP2019-2019-000581

Shape effects on graphene magnetoplasmons

Nanfang Jiao, Weihua Wang

School of Physical Science and Technology, China University of Mining and Technology, Xuzhou, China

Abstract: We have studied the magnetoplasmonic properties in graphene regular polygons, we examine the magnetoplasmons in the shapes without rotational symmetry, such as rectangles, where the symmetry of the splitting breaks as well.

CIOP2019-2019-000791

Tunable infrared photodetector based on graphene plasmons controlled by ferroelectric domains

Guo Junxiong, Li Shangdong, Ke Yizhen, Mao Linna, Huang Wen, Zhang Xiaosheng

University of Electronic Science and Technology of China, China

Abstract: An infrared photodetector based on graphene plasmons controlled by the ferroelectric domains was demonstrated. The designed photodetector features a tunable absorption peak in the range from 6 μm to 20 μm and significantly enhanced photo-responsivity.

SC3 Ultrafast and Nonlinear Phenomena

CIOP2019-2019-000314

Extended filamentation of temporally chirped femtosecond Bessel beam in fused silica

Junwei Chang[1*], Lanzhi Zhang[1], Tingting Xi[2], Zuoqiang Hao[1,3]
1. School of Science, Changchun University of Science and Technology, Changchun, China
2. School of Physical Sciences, University of Chinese Academy of Sciences, Beijing, China
3. School of Physics and Electronics, Shandong Normal University, Jinan, China

Abstract: We demonstrate the extension of the filamentation in fused silica with uniform intensity can be realized by adjusting the energy and temporally chirp of the laser pulse.

CIOP2019-2019-000318

Sharp narrowband spectral peaks modulated by plasma-driven blueshifting soliton

Yifei Chen, Zhiyuan Huang, Fei Yu, Ding Wang, Yuxin Leng[*], Zhizhan Xu[*]
Shanghai Institute of Optics and Fine Mechanics, CAS, China, China

Abstract: We theoretically and experimentally investigate the influence of plasma-driven wavelength-tunable blueshifting soliton on emission of sharp narrowband spectral peaks in a gas-filled single-ring photonic crystal fiber.

CIOP2019-2019-000499

Method for realizing controllable high voltage in femtosecond laser guided high voltage discharge experiment

Yiming Guo
Center for Atmospheric Optics, Hefei Institute of Material Science, Chinese Academy of Sciences, China

Abstract: Introducing a controller to generate PWM, the controllable high voltage is obtained by controlling the high voltage with PWM, then analyzing the specific influence of the controllable high voltage with different electrical parameters on the high voltage discharge induced by femtosecond laser.

CIOP2019-2019-000503

Watt-level All-fiber mid-infrared supercontiuum generation in step-index As_2S_3 fiber pumped by a thulium-doped fiber Amplifier

Peilong Yang[*], Kai Xia, Bin Yan
Ningbo University, China

Abstract: An all-fiber, watt- level supercontinuum source covering 2 to 3.6 μm has been demonstrated in a single-mode step-index As_2S_3 chalcogenide glass fiber. This fiber was pumped by a pulsed thulium-doped fiber MOPA system, central wavelength at 2.1μm, pulse duration of 1.5ns, and pulse peak power of 6kW. We also measured the output power stability of this system, the fluctuation range from 10~30mW by an uninterrupted running of 2 hours, and the measured beam quality also very high.

CIOP2019-2019-000519

Study of the third-order nonlinear optical properties of Fe_2O_3 nanoparticles using the femtosecond intensity scan technique

Shijia Hua, Kang Du, Heng Wang, Xiaoqi Cui, Wending Zhang, Ting Mei*

Northwestern Polytechnical University, China

Abstract: The third-order optical nonlinearity of Fe_2O_3 nanoparticles in the form of 38μm-thick Fe_2O_3-PVA film studied using femtosecond intensity scan (fs I-scan) technique shows stronger two-photon absorption and self-focusing than ever reported.

CIOP2019-2019-000547

Arbitrary free spectral range control of optical frequency combs through four-wave mixing

Tianwen Han

Wuhan National Laboratory for Optoelectronics and School of Physics, China

Abstract: By mixing the periodic pulse trainwith a linearly chirped pump in HNLF, we realized the arbitrary control of FSR of frequency combs. The study can find applications in optical communication and optical signal processing.

SC4 Solid State, Fiber, and Other Laser Sources

CIOP2019-2019-000026

980nm asymmetric wide waveguide InGaAs/GaAsP quantum well laser

Rui Huang, Zhiyong Wang

Beijing University of Technology, China

Abstract: The laser structures of GaAs, AlGaAs and GaAsP as barriers materials of InGaAs quantum well are simulated by using Lastip software respectively.

CIOP2019-2019-000035

Passively Q-switched mode-locked Tm, Ho:$CaYAlO_4$ laser at 2089 nm

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2. Institute of Physics and Optoelectronics Technology, Baoji University of Arts and Sciences, China
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Abstract: Employing MoS_2 as a saturable absorber, We firstly demonstrated a passively Q-switched mode-locked (QML) operation of a Tm, Ho:$CaYAlO_4$ solid-state laser.

CIOP2019-2019-000039

Wavelength self-sweeping Yb-doped bi-directional fiber ring laser

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2. School of Physics, Northwest University, 710069, Xi'an, China, China

Abstract: We reported a wavelength self-sweeping Yb-doped bidirectional fiber ring laser around 1037 nm. The fiber laser can generate a self-pulse signal and reverse wavelength self-sweeping with coverage of 2.75 nm.

Poster

CIOP2019-2019-000051

High-power low-noise green laser generation by single-pass second harmonic generation of a single-frequency fiber amplifier

Xin Zeng[1,2], Shuzhen Cui[1*], Jiaping Qian[1,2], Lei Zhang[3], Xiaohu Fu[3], Yan Feng[1*]
1. Shanghai Institute of Optics and Fine Mechanics, the Chinese Academy of Sciences, China
2. University of the Chinese Academy of Sciences, China
3. PreciLasers Co. Ltd., China

Abstract: We have investigated the noise performance and the transfer from the fundamental laser to the SHG in the single-pass SHG laser system theoretically and experimentally.

CIOP2019-2019-000111

Multi-Gigahertz monolithic waveguide laser mode-locked by molybdenum ditelluride saturable absorber

Ziqi Li
Shandong University, China

Abstract: We report on fundamentally mode-locked monolithic waveguide laser based on cladding microstructures and molybdenum ditelluride saturable absorber, achieving repetition rate as high as 6.546 GHz with the signal-to-noise ratio up to 55 dB.

CIOP2019-2019-000138

Periodically poled self-frequency-doubling green laser fabricated from Nd:Mg:$LiNbO_3$ single crystal

Dongzhou Wang[1*], Hong Liu[2]
1. Jinan Institute of Quantum Technology, China
2. Shandong University, China

Abstract: We report the fabrication by domain engineering of high quality periodically poled $LiNbO_3$, co-doped with Nd^{3+} and Mg^{2+}, which combines a laser medium and a high efficiency second harmonic conversion crystal into a single system.

CIOP2019-2019-000158

Beam smoothing scheme of broadband low-temporal-coherent light

Xiaohui Zhao
Shanghai Institute of Laser Plasma, CAEP, China

Abstract: Beam smoothing is an important issue in high-power laser-driven experiments. The smoothing scheme combining a diffraction-weakened lens array with the induced spatial incoherence method is proposed and demonstrated efficient for low-temporal-coherent laser systems.

CIOP2019-2019-000162

Study on multi-aperture beams array and error effects on the coherent combination efficiency

Tonglu Wang, Yuhai Yin, Lin Xu, Ye Li, Xinpeng Sun
China Southern Industrial Academy, China

Abstract: Analysis of coherent synthesis of multi-aperture laser arrays and error of phase, amplitude, position, etc. effects on the coherent combination efficiency

CIOP2019-2019-000183

Partial coherence measurement for the illumination system in excimer laser lithography based on CCD image sensor

Pei Lu[1], Xiaoyong Liu[2*], Qin Shi[2], Zhenzhen Zheng[2]
1. College of Information Science and Technology, Shihezi University, China
2. Department of Physics, School of Science, Shihezi University, China

Abstract: Partial coherence is one of the important parameters for evaluating the performance of lithographic tool. In this paper, we present a novel method of partial coherence measurement for the illumination system based on CCD image sensor.

CIOP2019-2019-000207

Inverse design of semiconductor laser parameters based on deep learning and particle swarm optimization method

Zihao Ma, Pei Feng, Yu Li
Shandong University, China

Abstract: An inverse design method based on the deep learning nerual network and PSO algorithm is proposed to obtain the semiconductor laser design parameters, with high efficiency and accuracy.

CIOP2019-2019-000223

The position offset effects on the generation of vector beams in Sagnac-like devices

Tonglu Wang [2*], Shiyao Fu [1], Yuhai Yin [2], Ye Li [2]
1. Beijing Institute of Technology, China
2. China Southern Industrial Academy, China

Abstract: Analyzing the influence the position of the reflector to the polarization of thevect or beams, when using Sagnac-like interferometer to generate vector beams,

CIOP2019-2019-000247

Ta_2NiS_5 as a saturable absorber for Er-doped pulse fiber laser

Mengyuan Ma[1], Xiaoli Wang[1], Yao Zhang[1], Junli Wang[1*], Zhiyi Wei[2]
1. Xidian University, China
2. Institute of Physics, Chinese Academy of Sciences, China

Abstract: Q-switched technique based on a novel saturable absorber Ta2NiS5isdemonstrated in Er-doped all fiber laser. The pulse duration, output power and center wavelength of Q-switching are 1.55 μs, 9.6 mW, and 1561 nm, respectively.

CIOP2019-2019-000331

Simulation and analysis on time evolution of laser power and temperature in static pulsed XPALs

Chenyi Su, Bailiang Pan
Zhejiang University, China

Abstract: A theoretical model is established to describe the thermal dynamic and laser kinetics in a static pulsed exciplex pumped Cs-Ar laser (XPAL). Temporal behaviors of laser output power and temperature rise in XPALs with a long-time pulse and multi-pulse operation modes are calculated and analyzed. In the case of long-time pulse pumping, the results show that the initial laser power increases with the rise of initial operating temperature, but the laser power decreases quickly due to heat accumulation. In the case of multi-pulse operation, simulation results show that the optimal laser output power can be obtained by appropriately increasing the initial temperature and reducing the thermal relaxation time.

CIOP2019-2019-000433

Supercontinuum generation covering visible and near-infrared band in random fiber laser structure

Lanjian Chen, Rui Song, Jing Hou
National University of Defense Technology, China

Abstract: A continuum spanning from 600 to 1700 nm is obtained with average power of 3.4 W under a maximum pump power of 43.9 W.

CIOP2019-2019-000537

Experimental study on all-Fiber 980-nm superfluorescent source with distributed side-coupled cladding-pumped Yb-doped fiber

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2. Hunan Provincial Key Laboratory of High Energy Laser Technology, Changsha 410073, China
3. Hunan Provincial Collaborative Innovation Center of High Power Fiber Laser Department, Changsha 410073, China

Abstract: A 32-W 980-nm all-fiber superfluorescent source fabricated with the distributed side-coupled cladding-pumped Yb-doped fiber is reported firstly, to the best of our knowledge. The slope efficiency is about 19.1% with 4.1-nm 3-dB bandwidth.

CIOP2019-2019-000549

Engineering characteristics of 10kW fiber-transmitted semiconductor lasers for oil well laser perforation

Rongwei Zha

Northwest University, Xi'an 710069, China, China

Abstract: This paper reports a 10kWlaser perforation study in oil and gas wells with an incoherent space beam combiner assembled by nineteen fiber-transmitted semiconductor laser around a wavelength of 972nm.

CIOP2019-2019-000574

Development of vehicle-mounted mie scattering lidar system and aerosol detection cases

Jiadi Shao, Chenbo Xie, Zhanye Zhang, Peng Zhuang, Lu Li, Zhiyuan Fang, Songlin Fu

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2. University of Science and Technology of China, Hefei 230026, China, China

Abstract: A Vehicle-mounted Mi lidar is developed. Based on the traditional Fernald method, the inverse astigmatic aerosol extinction coefficient is proposed by using the fixed scattering ratio method. Using the lidar system, the temporal and spatial distribution of aerosols over hefei was detected.

SC5 Silicon Photonics

CIOP2019-2019-000007

CMOS compatible high speed silicon based electro-optic modulator

Ai Kang, Kaikai Xu, Hongliang Sun

University of Electronic Science and Technology of China (UESTC), China.

Abstract: Electro-optical modulators compatible with complementary metal oxide semiconductor processes (CMOS) are an important component in future optical interconnect ICs. However, implementing an electro-optic modulator with low voltage and high operating speed compatible with the CMOS process is a difficult problem to solve; a silicon-based electro-optic modulator has been proposed as a possible solution to this problem.

CIOP2019-2019-000122

Ultracompact and broadband adiabatic power splitter with silicon nitride cladding

Yang Liu[1,2], Zezheng Li[1,2], Yingxin Kuang[1,2], Xingrui Huang [1,2], Huan Guan[1], Zhiyong Li[1*]

1. Institute of Semiconductors, Chinese Academy of Sciences, China
2. University of Chinese Academy of Sciences, China

Abstract: A high performance and fabrication flexible adiabatic optical power splitter based on silicon waveguides with the silicon nitride cladding is numerically proposed.

CIOP2019-2019-000206

Optical unitary transformation of general nonoverlapping-image multimode interference couplers

Zezheng Li[1], Yingxin Kuang[1], Zhiyong Li[2*], Weihua Han[2]

1. University of Chinese Academy of Sciences, Chinese Academy of Sciences, China
2. Institute of Semiconductors, Chinese Academy of Sciences, China

Abstract: The unitary transformation is obtained for a 4x4 non-overlapping-image MMI coupler based on 220-nm silicon-on-insulator within the deviation of 4×10^{-2} for orthogonal invariance among C-band spectral range.

CIOP2019-2019-000218

Polarization demultiplexer based on a silicon nitride-silica-silicon horizontal slot waveguide

Huan Guan, Yang Liu, Zezheng Li, Yingxin Kuang, Zhiyong Li

Institute of Semiconductors, Chinese Academy of Sciences, China

Abstract: A polarization demultiplexer is proposed based on silicon nitride-silica-silicon horizontal slot waveguide, TE and TM modes can efficiently go from different ports. The ER and IL are ~37.96 (21.77) dB and ~0.38 (0.2) dB for TE (TM) mode respectively.

CIOP2019-2019-000219

Four-wave mixing in integrated photonic waveguides

Hong Jianxun[1*], Hong Yixiao[2], Lin Xian[3], Cheng Xiaoyang[4], Tan Zhirong[3], Hu Weidong[3], Ge Hua[1*]

1. School of Information Engineering, Wuhan University of Technology, China
2. School of Electrical and Electronic Engineering, Hubei University of Technology, China
3. School of Navigation, Wuhan University of Technology, China
4. Department of Molecular and Material Sciences, Kyushu University, Kasuga-koen, Kasuga-city, Fukuoka, Japan

Abstract: We studied the four-wave-mixing in photonic waveguides. The pump power dependences of the conversion efficiencies were analyzed. The amorphous silicon is more efficient than the crystal silicon. SiN resonator enhanced the efficiency by 8.0 dB.

CIOP2019-2019-000282

Carbon nanotube-graphene hybrid films for broadband optical-fiber-compatible photodetector with ultrahigh responsivity

Xiaohe Liu, Xinyi Guo, Linqing Zhuo, Yanmei Lin, Wenguo Zhu

Department of Optoelectronic Engineering, Jinan University, Guangzhou, China

Abstract: We deposited carbon nanotubes on single layer graphene to achieve a broadband optical-fiber-compatible photodetector, which has a high photoresponsivity of 1.48*105 A/W and a fast response time of 55 ms over full near-infrared band.

CIOP2019-2019-000323

Direct wafer bonding of GaAs/Si by hydrophobic plasma-activated bonding

Yongqiang Zhao[1,2], Wen Liu[1*], Yidi Bao[1,2], Jing Ma[1,2], Xiaodong Wang[1,3,4*], Fuhua Yang[1,2,5]

1. Engineering Research Center for Semiconductor Integrated Technology, Institute of Semiconductors, CAS, China
2. College of Materials Science and Opto-Electronic Technology, UCAS, China
3. The School of microelectronics & Center of Materials Science and Optoelectronics Engineering, UCAS, China
4. Beijing Engineering Research Center of Semiconductor Micro-Nano Integrated Technology, China
5. The State Key Laboratory of Superlattices and Microstructures, Institute of Semiconductors, CAS, China

Abstract: The different power, activation time and gas flow rate of plasma to the roughness of GaAs and Si wafers in hydrophobic plasma-activated bonding were studied.

CIOP2019-2019-000402

Influence of the driving signal reflection in the electrode on the signal characteristics of silicon Mach-Zehnder modulators

Peiyan Zhao, Wei Jiang*
Nanjing University, China

Abstract: The influence of the driving signal reflection in the traveling-wave electrode on the signal characteristics of silicon modulators is investigated. The signal-to-noise ratio is strongly influenced by such reflection whereas the jitter shows less influence.

CIOP2019-2019-000409

Assisting second harmonic and sum-frequency generations in silicon nitride microring with a two-dimensional Gallium selenide

Yafei Ji, Linpeng Gu, Jiajie Li, Zhiwen Li, Xuetao Gan*
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Abstract: We experimentally demonstrate high-efficiency SHG and SFG from a Si_3N_4 microring resonator by integrating a two-dimensional GaSe. This integrated structure provides a new solution for the application of efficient frequency conversion and second-order nonlinear effects in Si3N4 waveguides.

CIOP2019-2019-000531

Silicon microring modulator with 40ghz electro-optic bandwidth for O band

Jin Zhou*, Xin Guo, Wanjun Wang, Jia Xu Sia, Zhongliang Qiao, Xiang Li, Chongyang Liu, Hong Wang*
Nanyang Technological University, Singapore

Abstract: In this paper, we experimentally demonstrated a high-speed silicon microring modulator for O band. The 3dB electro-optic bandwidth of the modulator is more than 40 GHz under -1 V bias.

CIOP2019-2019-000564

High birefringence photonic crystal fiber with elliptical defect

Yi Zhang
School of Electronic Engineering, Xi'an University of Posts & Telecommunications, China

Abstract: For the photonic crystal fiber with traditional circular air hole structure, the birefringence coefficient is not high, and the preparation is complicated. In this paper, a photonic crystal fiber with elliptical air hole defects is optimized by using silica as the substrate. The full-vector finite element method is used to simulate the relationship between the fundamental mode field distribution, birefringence, nonlinear coefficient, dispersion and limiting loss of the fiber and the structural parameters of the fiber.

CIOP2019-2019-000566

Erbium ytterbium silicate compound optical laser

Hepeng Zhao*, Xiujuan Zhuang
Hunan University, China

Abstract: In the process of information technology, as Moore's law becomes more and more close to the limit, the consensus to combine microelectronics and optoelectronics to develop silicon-based large-scale optoelectronic integration technology is inevitable. As the most important part of silicon photonic devices, a silicon-based light source still attracted great effort. In the traditional research, erbium-doped materials have played an important role in silicon-based light sources. Recent studies demonstrated that the erbium silicate compound had a high net gain attributable to a high erbium concentration that has no insolubility problem.

SC6 Microwave Photonics

CIOP2019-2019-000257

Study of the microwave photonic sensing by utilizing the incoherent light source with the serial fiber Brag gratings

Lin Gui*, Yuxuan Zhu, Suzhen Song
Shanghai Polytechnic University, China

Abstract: The incoherent microwave photonic sensor cascaded by FBG is demonstrated experimentally, and the sensitivities of 0.2219dBm/℃ are obtained by processing the average values of 3 points, 5 points, 7 points, 10 points and 15 points.

CIOP2019-2019-000505

Microwave channelization based on dual coherent optical frequency combs

Xin Zhang[1], Tian Jiang[1*], Jianghua Zhang[2]
1. College of Advanced Interdisciplinary Studies, National University of Defense Technology, China
2. National Innovation Institute of Defense Technology, Academy of Sciences PLA China, China

Abstract: We demonstrate a channelizer experimentally with six channels, 1 GHz channel spacing based on electric-optical frequency combs, covering frequency range from 1 GHz to 7 GHz.

CIOP2019-2019-000554

SNR enhancement receiver based on dual-comb microwave photonic channelization

Jianghua Zhang[1], Tian Jiang[2*], Xin Zhang[2], Yumin Luo[2], Jie Yang[1], Ke Yin[1], Xin Zheng[1]
1. National Innovation Institute of Defense Technology, China
2. National University of Defense Technology, China

Abstract: We propose and demonstrate a SNR enhancement receiver with wide processing bandwidth and tunability, where two coherent optical frequency combs (OFCs) based on multi-channel microwave source and electro-optic modulators are incorporated to accomplish simultaneous frequency down-conversion and channelization. According to the experiment result, 7.3dB SNR enhancement is achieved suing the physical receiver.

SC7 Micro and Nanophotonics

CIOP2019-2019-000009

Inverse optimization for designing wide angle diffractive optical element

Guowei Zhang[1,2*], Qiang Song[2], Lixin Wei[2], Xiaodong Yin[2]
1. Xi'an Jiaotong University, China
2. Beijing Yuguang Technology Development Co., Ltd., Beijing 100000, China

Abstract: In this work, we propose a hybrid iterative design method, which effectively utilizes the large-scale global optimization characteristics of scalar diffraction theory and the accuracy of the rigorous coupled wave analysis (RCWA) theory.

CIOP2019-2019-000154

Comparison of plasmonic tip nanofocusing based on external and internal excitation

Fanfan Lu, Jiachen Zhang, Wending Zhang*, Ting Mei*

Northwestern Polytechnical University, China

Abstract: We present a detailed analysis on nanofocusing and mode evolution process of grating-coupled surface plasmon polaritons on metallic tip with external illumination and metal-coated fiber tip with internal radial vector mode illumination.

CIOP2019-2019-000166

3D self-assembly technique applied to manufacturing microsphere whispering gallery mode laser

Ying Yue*, Hui Ding, Chen Chen, Chunyang Han

Xi'an Jiaotong University, China

Abstract: We propose an innovative approach to fabricate micro lasers using nanomaterials and the advanced self-assembly technique to construct silica-based high Q factor optical micro-cavities and embedding various high-performance gain material into it.

CIOP2019-2019-000186

Plasmonic Cu nanoparticles embedded in lithium niobate crystal by ion implantation for efficient 1μm Q-switched mode-locked waveguide lasing

Shixiang Wang

School of Physics, Shandong University, China

Abstract: We report on synthesis and enhanced nonlinear optical properties of lithium niobite crystal embedded Cu nanoparticles (CuNP:LN) via ion implantation. CuNP:LN was efficiently applied for multi-GHz mode-locked waveguide laser generation.

CIOP2019-2019-000251

Wet-etching-assisted femtosecond laser holographic processing of a sapphire concave microlens array

Fan Hua, Xiaowen Cao

State Key Laboratory of Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, China

Abstract: A rapid and mask-free fabrication of a sapphire concave microlens array is presented using a combined method of femtosecond laser holographic processing and wet etching.

CIOP2019-2019-000337

Energy propagation characteristics of micro/nanofibers and application

Dingxin Liang, Xining Zhang*

Huaqiao University, China

Abstract: The energy propagating characteristics in the micro/nanofibers are investigated in the simulations and experiments. The oscillation light path periodically displays in the later nanofiber after energy exchanges between micro/nanofibers, which could be used to assemble and easily adjust energy coupling in the photonic components.

CIOP2019-2019-000349

Optical vortex links and knots generated by dielectric metasurface

Xuyue Guo, Peng Li*, Jianlin Zhao*

Northwestern Polytechnical University, China

Abstract: We realize the generation of optical vertex links and knots in micron scale by dielectric metasurface. Meanwhile, utilizing digital holography, we accurately locate the phase singular points, and obtain the topological structures.

CIOP2019-2019-000355

Femtosecond laser nano-fabrication with extended processing range

Zhiyong Hu, Jianguan Hua, Zhennan Tian*

College of Electronic Science and Engineering, Jilin University, China

Abstract: we used a simple and universal method to correct the error of the 4f galvano-mirror-based scanning FsLDW system by the pre-compensation method, and realized the high-speed and high-precision one-step processing of micro/nano-optics with relatively large size.

CIOP2019-2019-000358

Photocatalytic reaction of graphene oxide: a new strategy to prepare graphene quantum dots and its optical property

Yue Su

Ocean University of China, China

Abstract: In this paper, visible light catalysis reaction, a new green, fast and general preparation method was used to prepare GQDs. Microsized sheets of graphene oxide (GO) were as precursor.

CIOP2019-2019-000498

Observation of a topological transition in 1D waveguide lattices

Licheng Wang, Wei Zheng, Zhennan Tian*

College of Electronic Science and Engineering, Jilin University, China

Abstract: We fabricated 1D waveguide lattices based on 1D SSH model by using femtosecond laser direct writing technique and observed propagating oscillation behaviors of topologically protected light.

CIOP2019-2019-000525

Up-conversion luminescence and C-band laser in Er^{3+}-doped fluorozirconate glass microspherical resonator

Haiyan Zhao, Pengfei Wang*

Harbin Engineering University, China

Abstract: Up-conversion luminescence and C-band microsphere laser was obtained in Er^{3+}-doped ZrF_4-BaF_2-YF_3-AlF_3 (ZBYA) fluorozirconate glass microsphere. The microsphere was fabricated via heating ZBYA glass filament with a CO_2 laser beam. The diameter of the microsphere was controlled at 68 μm.

CIOP2019-2019-000528

Fabrication of spiral zone plate on diamond crystal via ultraviolet femtosecond laser

Si Gao, Qiang Gao, Zhen-Nan Tian*

College of electronic science & engineering, Jilin University, China

Abstract: Spiral zone plate (SZP) was prepared on diamond surface by ultraviolet femtosecond laser. The graphite produced in the laser processing was removed by pickling treatment, making the surface morphology of the structure improved, and better optical properties of the SZPs were obtained.

CIOP2019-2019-000538

Moderation the red upconversion emission of Er^{3+} in $LiYF_4$ nanoparticles

Zeyu Sun, Jie Zhang, Chenxue Zhang, Feifei Wu, Qingyan Han, Jun Dong, Wei Gao*

School of Electronic Engineering, Xi'an University of Posts and Telecommunications, China

Abstract: $LiYF_4$:Yb^{3+}/Er^{3+} nanocrystals doped with Yb^{3+} of different concentrations have been synthesized by thermal decomposition. In the Yb^{3+}/Er^{3+} co-doped $LiYF_4$ up-conversion nano-system, the effect of red emission is optimized by the occurrence of CR processes between luminescent ions which are very close.

CIOP2019-2019-000550

The optical properties of Sb_2S_3 films and nanoparticles

Gao Kun, Kang Du, Wei Zhou, Wending Zhang, Ting Mei*

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Abstract: Sb_2S_3, as a phase-changing semiconductor, is exploited for Mie resonators for the first time. The fabrication, the material and optical properties of the films and nanoparticles are presented.

CIOP2019-2019-000556

Design of a Talbot array illuminator based on two-dimensional binary phase grating

Wei Wang

Shandong Jiaotong University, China

Abstract: Anew type Talbot array illuminator based on two-dimensional pure phase (0, π/2) grating was presented. Theoretical analysis and experimental results proved that the Talbot array illuminator with a compression ratio of 2 can be can be realized.

CIOP2019-2019-000565

Electro-photo-thermal coupling characteristics of organic light-emitting devices

Zhuo Chen

School of Electronic Engineering; Xi'an University of Posts & Telecommunications, China

Abstract: Organic light-emitting diodes (OLEDs) are very sensitive to temperature changes. A small temperature change may cause a strong change in conductivity, which in turn affects the generation of light and heat energy. At present, there are many studies on the electrothermal properties of OLEDs, but few on the three-field coupling of electro-photo-thermal.

SC8 Optical Materials

CIOP2019-2019-000025

Eye-safe 1521.4 nm single-longitudinal-mode passively-Q switched pulse microchip laser

Yujin Chen*, Yanfu Lin, Yidong Huang

Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, China

Abstract: Eye-safe 1521.4 nm single-longitudinal-mode passively-Q switched pulse laser with energy of 13.8 μJ, repetition frequency of 20.4 kHz, duration of 3.6 ns and peak power of 3.83 kW was demonstrated in an $Er:Yb:YAl_3(BO_3)_4$ crystal.

CIOP2019-2019-000120

Reshaping of embedded Cu nanoparticles for nonlinear optical properties modulation and wave-guide lasers generation

Chi Pang*

Shandong University, China

Abstract: The embedded nanoparticles were fabricated in lithium tantalite crystal and further reshaped by swift heavy ion irradiation. The nonlinear optical response was significantly enhanced for multi-GHz waveguide laser generation.

CIOP2019-2019-000152

Anisotropic 2D material based optical modulator

Yidi Pang, Jing Liu*, Xiaodong Hu
State Key Laboratory of Precision Measurement Technology and Instruments, Tianjin University, China

Abstract: Designed a ReS_2 based optical modulator on SiO_2/Si substrate in visible range. Analyzed the effect of ReS_2 thickness on experimental results by atomic force microscope (AFM) and optimized in this aspect.

CIOP2019-2019-000292

Temperature dependent dynamics of domain wall motions of MgO-doped lithium niobate via high voltage poling

Qilu Liu[1,2], Dongzhou Wang[2]
1. Shandong university, China
2. Jinan Institute of Quantum Technology, China

Abstract: The dynamics of domain wall motion was studied during 130℃ to 190℃ .

CIOP2019-2019-000396

Comparative study of the beam steering by a single layer of dielectric and magnetic cylinders

Shuxu Liu
Zhejiang Normal University, China

Abstract: By exciting the different order resonances in an array of dielectric and magnetic cylinders, the Gaussian beam is shown to be negatively refracted or totally reflected, rendering the distinction and connection of two systems.

CIOP2019-2019-000398

Dendrimer phthalocyanine based nanoparticles: an effective photosensitizer for enhanced photodynamic therapy

Kuizhi Chen, Ruotao Guo, Shuanghuang Xiao, Xia Li, Jiao Wang, Yiru Peng*
Fujian Normal University, China

Abstract: An effective dendrimer phthalocyanine based nanoparticles for enhanced photodynamic therapy.

CIOP2019-2019-000400

Study on optimizing the structure of light guide plate with diffusion function

Zhipeng Ma, Yuting He, Wan Wei, Zhanxu Chen*
Guangdong Polytechnic Normal University, China

Abstract: We simulate the light output effect of the separation and combination of DP and LGP respectively by the tracePro software.

CIOP2019-2019-000523

Design and simulations of titanium dioxide strip-loaded waveguides on yttrium orthosilicate crystal

Xintong Zhang, Lei Wang*
Shandong University, China

Abstract: A strip-loaded method is designed to form waveguide structures in the surface of YSO crystals. The Width and thickness of TiO_2 stripes were investigated.

CIOP2019-2019-000567

Metal nitride nanoparticles saturable absorber for Mode-Locked fiber laser

Simin Liu
Nanjing University of Posts and Telecommunications, China

Abstract: In this paper, we study the application of metal nitride nanoparticle saturated absorber in mode-locked fiber lasers. Two kinds of mode-locking phenomena, passive mode-locking and Q-switching mode-locking, have been realized in 2 micron band.

CIOP2019-2019-000570

Interfacial charge transfer between $CsPbBr_3$ quantum dots and ITO nanoparticles revealed by single-dot photoluminescence spectroscopy

Bin Li1*
Shanxi University, China

Abstract: Colloidal-halide-based perovskite quantum dots (QDs) are excellent materials for making solar cells due to their attractive optical and electronic properties as well as low cost and solution processability. It has been reported that the efficient Fermi level alignment between perovskite layer and indium tin oxide (ITO) transport layer can improve the photoelectric conversion efficiency of solar cells, but the deep physical reason is still indistinct.

CIOP2019-2019-000571

Two types of shallow trap states in single colloidal quantum dots

Wenli Guo*
Shanxi University, China

Abstract: We investigate the surface trap states in gradient alloyed $Cd_xZn_{1-x}Se_yS_{1-y}$/ZnS core/shell QDs. Two types of surface trap states are found in the single QDs, one type of trap state mainly reduces PL QYs of QDs, and the other type of trap state mainly causes the PL blinking. The investigation contradicts the conventional expectation that the surface traps both reduce the PL QYs and cause the PL blinking of QDs.

CIOP2019-2019-000573

Ultra-precision grinding of transparent AlON optical window

Chunyu Zhang*, Han Liu, Qingliang Zhao
Harbin Institute of Technology, China

Abstract: The ultra-precision grinding experiments were carried out on transparent AlON ceramic. The grinding parameters were optimized due to the influence of process parameters on surface quality. An AlON optical window was processed by ultra-precision grinding.

CIOP2019-2019-000576

A dual-wavelength harmonic mode-locking fiber laser based on Sheets-structured bismuthine

Wenxiong Xu [1], Zhanqiang Hui [1], Xiaohui Li [2]
1. Xi'an University of Posts & Telecommunications, China
2. Shaanxi Normal University, China

Abstract: Compare to few-layer bismuthene, bismuthene nanosheets present high modulate depth over 7.7% and potential value as saturable absorber. A 52^{th} dual-wavelength harmonic picosecond pulse is generated based on a bismuthine nanosheets in all fiber laser.

CIOP2019-2019-000578

Strain dependent electronic structure and optical properties tuning of InN/PtX_2 (X=S, Se) van der Waals heterostructures

Jiangtao Liu, Jianli Wang*
School of Physics, China University of Mining and Technology, Xuzhou 221116, China, China

Abstract: the electronic and optical properties of InN/PtX_2 (X=S, Se) van der Waals heterostructures are investigated by first-principle calculations. The heterostructures have appreciable optical absorption which is advantageous to efficient carrier separation and solar conversion.

CIOP2019-2019-000585

Hydrogen adsorption and storage of pristine and metal decorated hexagonal GaN monolayer: a first-principles study

Guoxiang Chen*
Xi'an Shiyou University, China

Abstract: Hydrogen molecules adsorbed on pristine and metal atom (Li, Na, K, Ni, Pd and Pt) decorated GaN monolayer (GaN-ML) using the first-principles calculations. The results show that the metal decorated GaN-ML substrates shows a significant enhancement of adsorption the hydrogen atom and hydrogen molecule than the pristine GaN-ML.

SC9 Optical Measurement and Metrology

CIOP2019-2019-000033

A method of measuring fp transmittance based on whispering gallery mode light source

Yufei Chu, Dong Liu, Decheng Wu, Zhenzhu Wang, qian Deng, Zhiqiang Kuang, Lu Li, Peng Zhuang, Zhiyuan Fang, Yingjian Wang*

Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

Abstract: The transmittance curve of the FP etalon can be measured at one time by the whispering gallery mode laser which the spacing of the frequency can be determined.

CIOP2019-2019-000044

Displacement measurement using talbot effect

Haibin Sun*, Tingting Liu

Taishan University, China

Abstract: Talbot effect has now been widely used in various technical fields. In the optical metrology, the Talbot effect has been exploited for the measurement of displacement and distance, the measurement of contouring and surface roughness.

CIOP2019-2019-000084

In-situ absolute measurement method for reference surface error of large aperture interferometer based on oblique incidence

You Zhou, Shijie Liu*, Yunbo Bai, Qi Lu

Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

Abstract: In-situ absolute measurement method based on oblique incidence is proposed for reference surface error of 600mm aperture interferometer. The various sources of measurement error are analyzed. The absolute measurement experiment is carried out on the 600mm aperture interferometer produced by Zygo.

CIOP2019-2019-000090

Calibration method for a laser-based alignment system

Xiaoxuan Xu[1], Yanhui Kang[2*], Zurong Qiu[1], Binhe Wang[2]

1. Tianjin University, China

2. National Institute of Metrology, China

Abstract: The principle of a laser-based alignment system is presented. In order to calibrate laser-based alignment systems, a set of measurement device is established. In addition, several key influencing factors for calibration are given. At last, the uncertainty of the calibration result is analyzed.

CIOP2019-2019-000105

A novel calibration approach for robot line structured light 3d vision system

Pengfei Tian, Shuming Yang

Xi'an Jiaotong University, China

Abstract: This paper proposes an automatic calibration method for both the light plane of linear structured light vision sensor and the robot hand-eye calibration to meet the requirement of robot vision measurement system.

CIOP2019-2019-000119

Smartphone based spectrometry platform for mobile-health: from spectrometer to multispectral imager

Chen Chen, Hui Ding*, Haicheng Zhao, Ying Yue, Chunyang Han
Xi'an Jiaotong University, China

Abstract: Smartphone based spectrometry platform including optical spectrometer and multispectral imager were developed for m-Health application, which aims to fill the translational gap in spectroscopy technology from central laboratory to clinical field.

CIOP2019-2019-000135

Robust Weighted least-squares phase-unwrapping algorithm

Canlin Zhou [1*], XiaoLei Li [2], Zhenkun Lei [3], YanJie Li [4]
1. School of Physics, Shandong University, China
2. School of Mechanical Engineering, Hebei University of Technology, China
3. Department of engineering mechanics, Dalian University of Technology, China
4. School of civil engineering and architecture, Jinan University, China

Abstract: The weighted least-squares unwrapping approach can detect and mask out the phase singularities, But it has the smooth effect on the phase map. In this paper, a Robust Weighted least-squares phase-unwrapping algorithm is proposed. Experiments are conducted to prove the validity of the proposed method.

CIOP2019-2019-000180

Study on mechanical structures for large flat applied to large-aperture interferometer

Jingyu Pan, Shijie Liu*, You Zhou, Qi Lu, Wenchao Ji
Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

Abstract: Two support and rotation mechanical structures for ϕ600mm reference mirror in large aperture interferometer are studied in this paper. The changes of internal stress and surface shape on both mechanisms are compared using the finite element method.

CIOP2019-2019-000217

Automatic small fluid displacement measurement by time of flight laser sensing technology for volume calibrator need

Jalu Ahmad Prakosa*, Alexander S. Kukaev, Vadim A. Parfenov, Vladimir Y. Venediktov
Dept. of Laser Measurement and Navigation Systems, Saint Petersburg Electrotechnical University LETI, Russia

Abstract: The measurement of fluid displacement automatically is urgent part to build an accurate calibrator of volume also such as its derivation on flow rate and pressure quantities. The primary standard of length quantity refers to the speed of light in vacuum. The application of laser to measure the fluid displacement length by time of flight technique is the best effort to achieve the accurate results and minimize human error. The emitter and receiver of laser with 940 nm wavelength are implemented to solve this task.

CIOP2019-2019-000222

Particle Scattering Field Calculation and Analysis Based on Mie Scattering Theory

Cheng Liao, Shuang Xu*, Ruyi Ma, Zhenyuan Xia
Wuhan University of Science and Technology, China

Abstract: A particle scattering model was built to calculate and analyze the scattering field of isolated particles and particles of standard polystyrene latex sphere (PSL) on a silicon wafer, which would be used in unpatterned wafer inspection.

CIOP2019-2019-000241

Interference fringes detection for laser doppler velocimeter with directional discrimination

Rong Huang, Qi Wang, Xiaoming Nie, Jian Zhou*
College of Advanced Interdisciplinary Studies, National University of Defense Technology, China

Abstract: The orthogonal signals detection of interference fringes is applied in the design of small-size LDV to discriminate the sense of velocity since the moving direction of the interference fringes represents the positive or negative sign of the velocity.

CIOP2019-2019-000242

Propeller rotation speed measurement of quad rotor helicopter by optoelectronics of non contact method

Jalu Ahmad Prakosa*, Alexander S. Kukaev, Alexander A. Sevryugin, Vladimir Y. Venediktov

Dept. of Laser Measurement and Navigation Systems, Saint Petersburg Electrotechnical University LETI, Russia

Abstract: The measurement results indicated that the propeller rotation increased non-linearly to the time. Therefore, the speed of propeller fluctuates dramatically which may be caused by noise and disturbance of sensor, counting error of microcontroller also the nonlinearity characteristic of DC motor as rotor. The measurement uncertainty tends to be larger on the higher speed. Because of these circumstances, a lot of data samples are required to estimate the true value of propeller speed measurement exactly.

CIOP2019-2019-000272

Camera dirtortion correction method based on Cross ration invariance

Wang Zhang, Xiaorong Gao, Jinlong Li*, Lin Luo

School of Physical Science and Technology, Southwest Jiaotong University, Chengdu, Sichuan, China

Abstract: Camera calibration is very important for visual measurement. We propose a new calibration method, which uses cross-ratio invariance to solve the initial parameters of the camera, and then approximates the exact values by iteration.

CIOP2019-2019-000277

Numerical simulation of rail surface defect detection with laser-induced ultrasound

Hao Sui [1], Xiaorong Gao [1], Hongna Zhu [1*], Lin Luo [1], Jinli Zhang [2], Zhenyu Zhu [1], Jianping Peng [1]

1. School of Physical Science and Technology, Southwest Jiaotong University, China
2. National Key Laboratory of Science and Technology on Blind Signal Processing, China

Abstract: Laser induced ultrasonic is a promising non-destructive testing method. In this paper the detection and depth evaluation of rail surface defects based on laser ultrasonic technology is studied.

CIOP2019-2019-000278

Numerical simulation of a Mueller matrix imaging ellipsometer through the grating

Cai Wang*, Xiuguo Chen*, Chao Chen, Shiyuan Liu

Huazhong University of Science and Technology, China

Abstract: we propose a full-vector model to describe the image formation of the optical system of the Mueller matrix imaging ellipsometer based on the finite-difference time-domain (FDTD) method and vector diffraction theory.

CIOP2019-2019-000332

A method for fast and robustly measuring the state of polarization of arbitrary beams based on Pancharatnam-Berry phase

Shuxia Qi, Sheng Liu*, Jianlin Zhao*

Northwestern Polytechnical University, China

Abstract: We present an approach for measuring the polarization distribution based on Pancharatnam-Berry phase theory. The method has fast measurement speed due to the single exposure, and strong robustness that eliminates the influence of reference beam.

CIOP2019-2019-000334

Accurate and rapid measurement of optical vortex links and knots

Jinzhan Zhong, Sheng Liu*, Peng Li, Jianlin Zhao*

Northwestern Polytechnical University, China

Abstract: We propose a method to more accurately and rapidly measure the topology of optical vortex fields. The proposed method is expected to rapidly observe the 3D evolution of other complicated light fields.

CIOP2019-2019-000376

A novel 3D profile measurement method based on digital photoelastic technology

Guanjun Chen, Bo Tao*, Gongfa Li*, Shuang Xu*, Fei Zeng*

Wuhan University of Science and Technology, China

Abstract: 3D object profile measurement method using photoelastic fringe analysis technology to obtain phase difference and triangulation principle to calculate depth information.

CIOP2019-2019-000382

A novel method for extracting structural light stripe centerline based on light intensity distribution direction

Hao Dou, Yunyong Cheng*, Wenguang Ye, Fuqiang Yang, You Du, Mingxuan Teng

Northwestern Polytechnical University, China

Abstract: A novel method for extracting structural light stripe centerline based on light intensity distribution direction is proposed, it can greatly reduce the amount of calculation, improve processing speed and accuracy of extraction.

CIOP2019-2019-000552

The optical delay measurement for Lijiang Exoplanet Tracker

Xiaoli Wang

Yunnan Observatories, China

Abstract: My presentation is about the optical delay measurement of the DFDI mode of LiJET.

CIOP2019-2019-000557

Study on multi-parameter measurement of an arbitrary wave plate

Wei Wang

Shandong Jiaotong University, China

Abstract: An automated multi-parameter measuring system of arbitrary wave plate base on spectral interference theory was developed. Experimental results prove that the method has some advantages, such as high measurement accuracy, simple extraction algorithm, high data utilization, and higher misalignment tolerance.

CIOP2019-2019-000562

Phase extraction method with spatial-temporal fringes

Ronggang Zhu*, Zhe Zhang

Jinling Institute of Technology, China

Abstract: The method combines the N step phase-shifting fringe patterns into a STF pattern that contains both temporal information and spatial information. Then, the phase of original fringe patterns can be obtained by STF pattern.

CIOP2019-2019-000563

Free-form surface measurement based on fringe reflection

Ronggang Zhu

Jinling Institute of Technology, China

Abstract: This paper describes the principles and methods of free-form Surface measurement which is based on fringe reflection technique (PMD).

SC10 Infrared and Terahertz Technologies

CIOP2019-2019-000080

Effect of the pressure on the performance of Pb_3O_4/Mg/PTFE infrared decoy

Zongsheng Chen
State Key Laboratory of Pulsed Power Laser Technology, National University of Defense Technology, China

Abstract: In order to study the effect of the pressure on the sample prepared by tablet press on the performance of trilead tetraoxide/teflon/Mg mixed powder (Pb_3O_4/PTFE/Mg), Maintaining the mass ratio of m(Mg):m(PTFE):m(Pb_3O_4)=10:3:7 in the mixed decoy and changing the pressure of the tablet press, we designed 4 different formulations.

CIOP2019-2019-000114

Fast detection and recognition method of UAV in sky background

Qi Ma*, Bin Zhu, Zhengdong Cheng, Yang Zhang
State Key Laboratory of Pulsed Power Laser Technology, National University of Defense Technology, China

Abstract: In this method, infrared and visible images are simultaneously input into the network for feature extraction, and the extracted depth features are concatenated, and it is used in the processing of multi-scale prediction network.

CIOP2019-2019-000124

Effect of IT-M doping on charge transfer and ultrafast carrier dynamics of ternary polymer organic solar cells

Hui Zhang, Peng Han*, Yan Zhang*
Department of Physics, Capital Normal University, China

Abstract: Using optical pump-terahertz time-domain spectroscopy measurement along with ab initio density functional theory calculations, we study the effect of IT-Molecule on the ultrafast dynamics and photoconductivity of conjugated polymer donor.

CIOP2019-2019-000163

Linear and circular polarization multiplexed metasurface hologram

Huan Zhao[1], Yan Zhang[1*], Shutian Liu[2*]
1. Department of Physics, Capital Normal University, China
2. Department of Physics, Harbin Institute of Technology, China

Abstract: A polarization multiplexed metasurface hologram based on the simultaneous control of the linear and circular polarizations is proposed and experimentally demonstrated. By controlling the polarization states of the incident and detection waves, the optical images encrypted in three independent channels are extracted.

CIOP2019-2019-000170

Highly-efficient polarization-insensitive antireflection metagrating for terahertz wave

Xinyu Ma, Yongchang Lu, Yanfeng Li*, Jiaguang Han, Weili Zhang
TianJin University, China

Abstract: A simple approach based on effective medium theory is proposed to design and evaluate a polarization-insensitive antireflection grating. The transmittances of the fabricated device for the TE and TM waves at 0.87 THz are 84% and 95%, respectively.

CIOP2019-2019-000172

Wide spectrum terahertz spectroscopy system based on difference frequency generation of GaSe crystal

Jiaqi Nie, Yan Zhang*
Department of Physics, Capital Normal University, China

Abstract: The different frequency effect of GaSe crystal under the pulse pumping of femtosecond amplifier system is employed to produce a broad spectrum with a range of 10-20 THz. A Michelson interferometer is used for non-coherent detecting the THz transient electric field.

CIOP2019-2019-000213

Polarization tunable plasmon induced transparency in graphene-based terahertz metamaterial

Kai Wang[1,2], Xiaoqiang Jiang[1,2], Wenhui Fan[1*]

1. Xi'an Institute of Optics and Precision Mechanics, China
2. University of Chinese Academy of Sciences, China

Abstract: A periodic two-dimensional metamaterial with plasmon induced transparency effect in terahertz region, composed of polyimide layer covered by a monolayer graphene ring-rod structure, is presented and numerically investigated.

CIOP2019-2019-000279

Intense terahertz waves generated by three-color laser with different frequency ratios

Hanqi Wang[1,2], Wenhui Fan[1]

1. Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China
2. University of Chinese Academy of Sciences, China

Abstract: Based on the transient photo-current model and numerical simulation, it is found that intense terahertz waves can be generated by the sawtooth-like asymmetric photoelectric field with different frequency ratios of three-color laser.

CIOP2019-2019-000297

Research on bp neural network for terahertz image segmentation

Yutong Wang[*], Qi Li, Yue Wang

National Key Laboratory of Science and Technology on Tunable Laser, Harbin Institute of Technology, China

Abstract: In this paper, terahertz holographic reconstructed image is segmented by using BP neural network. By modifying the parameters and training samples, the optimal segmentation results are obtained, and the average structural similarity reaches 0.95.

CIOP2019-2019-000513

Antireflection self-reference method based on ultrathin metallic nanofilms for improving terahertz reflection spectroscopy

Weien Lai

Hefei University of Technology, China

Abstract: We present the potential of an antireflection self-reference method based on ultra-thin tantalum nitride (TaN) nanofilms for improving terahertz (THz) reflection spectroscopy.

Poster

CIOP2019-2019-000542

Surface photon trap enhanced terahertz emission from vertically grown graphene

Lipeng Zhu[1,2], Yuanyuan Huang[2], Zehan Yao[2], Baogang Quan[3], Longhui Zhang[2], Junjie Li[3], Changzhi Gu[3], Xinlong Xu[2*], Zhaoyu Ren[2]

1. School of Electronic Engineering, Xi'an University of Posts and Telecommunications, Xi'an 710121, China
2. Institute of Photonics & Photon-Technology, Northwest University, Xi'an 710069, China
3. Beijing National Laboratory for Condensed Matter Physics, and Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China

Abstract: Terahertz (THz) emission from vertically grown graphene induced by photon drag effect has been investigated by THz emission spectroscopy. The unique surface structure can enhance light-graphene interaction because of the photon trap and further enhance the THz intensity.

SC11 Optical Imaging, Display and Storage

CIOP2019-2019-000022

Simultaneous denoising and super-resolution of optical coherence tomography images based on generative adversarial network

Yongqiang Huang, Yi Zhang*
Sichuan University, China

Abstract: In this paper, we propose a generative adversarial network (GAN)-based approach (named SDSR-OCT) to simultaneously denoise and super-resolve OCT images.

CIOP2019-2019-000041

Infrared dual-band image fusion with simplified pulse coupled neural network and visual saliency map in nonsubsampled shearlet transform domain

Xiyuan Su*, Changqing Cao, Xiaodong Zeng, Zhejun Feng, Jinna Ning, Wenrui Zhang, Yutao Liu, Ting Wang, Xu Yan
Xidian University, China

Abstract: In this paper, a new infrared dual-band image fusion with simplified pulse coupled neural network (PCNN) and visual saliency map (VSM) Framework in nonsubampled shearlet domain (NSST) is proposed.

CIOP2019-2019-000045

Singular skeleton in speckle field

Haibin Sun*, Tingting Liu
Taishan University, China

Abstract: A singular structure of the OV beam with the unit topological charge is very stable to the intensity and phase perturbations. The detection and diagnosis of singular elements in the light field (such as spiral dislocations) enables the reconstruction of singular skeleton of the light field.

CIOP2019-2019-000061

Target detection method for small defects in ink area of planar glass element

Zhengzhou Wang
Xi'an Institute of Optics and Precision Mechanics Chinese Academy of Science, China

Abstract: Target detection method for small defects in ink area of planar glass element.

CIOP2019-2019-000068

An object detection and recognition method based on binocular camera

Kaiyuan Zhu, Xiaobin Xu*, Xining An, Xiaoyu Xu, Benchao Wu
College of Mechanical & Electrical Engineering, Hohai University, China

Abstract: This paper uses a method based on binocular camera to recognize free-form objects in the complicated situation, which could be used in the tasks of robot picking.

CIOP2019-2019-000095

Cell image segmentation using Markov random field

Dongming Li[1*], Changming Sun[2], Lijuan Zhang[3], Yue Yu[4], Jinhua Yang[1*]
1. College of Opto-Electronic Engineering, Changchun University of Science and Technology, Changchun, China
2. Data61, CSIRO, Epping, NSW 1710, Australia
3. College of Computer Science and Engineering, Changchun University of Technology, China
4. School of Information Technology, Jilin Agricultural University, Changchun, China

Abstract: In this paper, a segmentation method for cell images using Markov random field (MRF) based on a Chinese restaurant process model (CRPM) is proposed.

CIOP2019-2019-000098

Identifying classic and florid lobular carcinoma in situ using multiphoton microscopy

Tingfeng Shen[1], Jiajia He[1], Deyong Kang[2*], Gangqin Xi[1], Zhong Chen[1], Wenjiao Ren[1], Jianxin Chen[1*]
1. Fujian Normal University, China
2. The Affiliated Union Hospital of Fujian Medical University, China

Abstract: Multiphoton microscopy (MPM) is used to identify florid lobular carcinoma in situ (FLCIS) and classic lobular carcinoma in situ (CLCIS). It is proved that MPM has the potential to be a real-time tool for breast cancer diagnosis.

CIOP2019-2019-000107

Differently aggregated components of amyloids and their optical properties

Yanxia Huang, Junle Qu[*], Feifan Zhou[*]
Shenzhen University, China

Abstract: We use the optical imaging methods like two-photon imaging and second harmonic generation imaging to study the self-assemble process of amyloid under different conditions and suggest that amyloid deposits can be identified based on their intrinsic nonlinear optical properties.

CIOP2019-2019-000109

Ultra-long optical needles with controllable homogeneously 3D spin-orientation produced with an annular spherical mirror

Hang Li, Ying Wang, Peifeng Chen[*]
Huazhong University of Science and Technology, China

Abstract: We theoretically generate ultra-long (1000λ) optical needles with controllable homogeneous 3D spin-orientation by an annular spherical mirror. The lateral sizes of the optical needles are under 0.5λ. The spin-orientation homogeneity purity is beyond 0.93.

CIOP2019-2019-000113

Memory effect based filter to improve imaging quality through scattering layers

Qianqian Chen, XIE Xiangsheng
Shantou University, China

Abstract: We demonstrate a high-speed method to image objects hidden behind a thin scattering medium. It is the first time to analyze the noise model of the imaging processing through scattering layer.

CIOP2019-2019-000127

Quantitative phase imaging using dual-exposure transport of intensity phase microscopy

Cheng Liu, Shouyu Wang, Miao Yu[*], Junbao Hu
Jiangnan University, China

Abstract: We design a dual-exposure TIE method to compute favorable-exposure image from short- and long-exposure intensities using wavelet fusion, and both simulations and experiments proved the designed method can obtain high accurate phase imaging.

CIOP2019-2019-000129

Novel superresolution method based on the principle of single-pixel imaging

Wei Zhang, Junle Qu[*]
Shenzhen University, China

Abstract: In this paper, we propose a novel superresolution method which aims to reach high temporal-spatial resolution.

CIOP2019-2019-000137

Identifying three different grades of human breast ductal carcinoma in situ using multiphoton microscopy

Zhong Chen[1], Tingfeng Shen[1], Liqin Zheng[1], Deyong Kang[2*], Jianxin Chen[1*]

1. Fujian Normal University, China
2. The Affiliated Union Hospital, Fujian Medical University, China
Abstract: Multiphoton microscopy was used to image human breast ductal carcinoma in situ (DCIS) without fluorescent dye. We demonstrated that MPM has high resolution to rapidly identify three different grades of human breast DCIS.

CIOP2019-2019-000150

Optical imaging through dynamic scattering media based on dual-polarized wavefront shaping

Runze Li, Tong Peng, Meiling Zhou, Xianghua Yu, Baoli Yao *
Xi'an Institute of Optics and Precision Mechanics, China
Abstract: We proposed a dual-polarized wavefront shaping method, in which the light from the guide star and the object are identified by polarization. Imaging through dynamic scattering media is realized by using this method.

CIOP2019-2019-000153

Interaction of gold nanorods with ovarian cells: toxicity, uptake and intracellular distribution

Kexin Wang, Xiang Sang, Shuanghuang Xiao, Hongqin Yang, Yiru Peng, Shusen Xie, Jianling Chen*
Fujian Normal University, China
Abstract: We investigated the toxicity of gold nanorods to the two different kinds of cells, the uptake of gold nanorods and the distribution of gold nanorods and the effect of protein corona on the internalization ability.

CIOP2019-2019-000167

Two photon luminescence of gold nanorods with breast cancer cells

Xiang Sang, Kexin Wang, Shuanghuang Xiao, Hongqin Yang, Yiru Peng, Shusen Xie, Jianling Chen*
Fujian Normal University,, China
Abstract: The two photon luminescence of silica modified gold nanorods incubated with different subtypes of breast cancer cells was observed. We demonstrate the effects of different subtypes breast cancer cells on cellular uptake of gold nanorods.

CIOP2019-2019-000176

Dual-color STED super resolution microscopy system with single laser source

Jialin Wang, Junyue Qu, Wei Yan
Shenzhen University, China
Abstract: We design an optical system that uses a single white laser source to achieve two-color STED imaging system, which greatly reduces the cost of the STED system.

CIOP2019-2019-000201

The influences of color space in the process of resolution enhancement for digital images

Rui Gong[1*], Xingliang Wang[1], Qing Wang[2]
1. School of Physics and Optoelectronic Engineering, Xidian University, China
2. School of Printing and Packing Engineering, Qilu University of Technology, China
Abstract: This study aimed to systematically investigate how the selection of color spaces take effect in the process of increasing image resolution, including two super resolution reconstruction methods and three pixel interpolation algorithms.

CIOP2019-2019-000209

Holographic AR display based on free-form lens combiner and LED illumination

Xin Yang, Shufeng Lin, Di Wang, Hanle Zhang, Qionghua Wang *
School of Instrumentation and Optoelectronic Engineering, Beihang University, China
Abstract: A holographic AR display system based on LED illumination with free-form lens as combiner is designed and carried out for high quality imaging without speckle noise.

CIOP2019-2019-000214

Imaging diagnostic of high-speed fuel sprays in the near-nozzle region by using supercontinuum illumination

Yipeng Zheng[1*], Jinhai Si[2]
1. Xi'an University of Posts & Telecommunications, China
2. Xi'an Jiaotong University, China

Abstract: We employ a supercontinuum illumination to image the high-pressure fuel sprays in the near-nozzle region. By suppressing the effect of speckles and avoiding the motion blurring effect, the identifiability of the microstructures in the spray is significantly improved.

CIOP2019-2019-000230

Phase-only optical image encryption and hiding based on normalization and orthogonalization phase-shifting algorithm

Jiaosheng Li[1], Xiaoxu Lu[1], Qinnan Zhang[2], Jindong Tian[2], Liyun Zhong[1*]
1. South China Normal University, China
2. Shenzhen University, China

Abstract: A phase-only optical image encryption method combining a normalization and orthogonalization phase-shifting algorithm is proposed to eliminate the influence of phase shifts deviation on the accuracy and improve the quality of the decrypted results.

CIOP2019-2019-000231

High-resolution imaging of optical interferometry telescope

Yuanyuan Ding[*], Xinyang Chen, Chaoyan Wang
Shanghai astronomical observatory, Chinese Academy of Sciences, China

Abstract: High resolution observation of celestial objects has always been the goal of optical interferometry technology. Fizeau interferometry telescope can achieve instantaneous direct imaging. We did some research and simulation on the reconstruction of optical interferometry images.

CIOP2019-2019-000235

Accurate X-ray source dimension measurement by the curved crystal imaging system

Jin Shen[1], Weiquan Zhang[2], Guibin Zan[2], Zhanglang Xu[2], Xuewei Du[2*], Qiuping Wang[2]
1. School of Engineering Science, University of Science and Technology of China, China
2. National Synchrotron Radiation Laboratory, University of Science and Technology of China, China

Abstract: A curved crystal imaging system is designed to measure the focal spot size of x-ray sources. It presents fine structure of the focal spot with a high spatial resolution and monochromatic image.

CIOP2019-2019-000236

A three dimensional point cloud registration method based on backpropagation neural network and random sphere cover set

Jiang Long, Jinlong Li[*], Yu Zhang, Xiaorong Gao, Lin Luo
School of Physical Science and Technology, Southwest Jiaotong University, Chengdu, Sichuan, China

Abstract: A point cloud registration method based on backpropagation (BP) neural network and Random Sphere Cover Set (RSCS) has been proposed, which can effectively improve the computational efficiency without losing the precision.

CIOP2019-2019-000255

A chaotic stochastic parallel gradient descent algorithm for fast phase correction of optical phased array

Wenchao Zhang[*], Lijing Li[*], Wen Chen[*]
School of Instrumentation and Opto-electronic Engineering, Beihang University, Beijing 100191, China

Abstract: To achieve fast adaptive phase correction, a chaotic stochastic parallel gradient descent (CSPGD) algorithm combining chaos theory and SPGD is proposed in this paper.

CIOP2019-2019-000268

Compression of digital holograms with wavelet transform

Zhixiang Jiang, Jinbin Gui*, Guoqing Wang, Xiaoyu Jin
Kunming University of Science and Technology, China

Abstract: We have researched three methods of wavelet transform for compression of holograms, and obtained the largest compression ratio of 220.35, 395.17, and 365.38 respectively, and maintained a high reconstruction quality.

CIOP2019-2019-000270

Color M-array shape reconstruction of using grid points and center points

Kai Yang, Zhi Ling*, Jinlong Li, Xiaorong Gao, Liming Xie, Zijian Bai
School of Physical Science and Technology, Southwest Jiaotong University, Chengdu, Sichuan, China

Abstract: In this paper, rectangular corner and center detection methods are used to reconstruct the object in three dimensions.

CIOP2019-2019-000271

Research on segmentation of key parts for train safety based on deep learning

Qian Zhang, Xiaorong Gao, Hongna Zhu*, Kai Yang, Zeyong Wang
School of Physical Science and Technology, Southwest Jiaotong University, Chengdu, Sichuan, China

Abstract: For train safety, an innovative method based on Mask R-CNN is proposed to segment the key parts, which can reach pixel to pixel level.

CIOP2019-2019-000273

Abnormal target detection for key components of locomotive based on image processing

Hui Yin, Jianping Peng*, Wenwei Song, Xiaorong Gao, Jianqiang Guo
School of Physical Science and Technology, Southwest Jiaotong University, Chengdu, Sichuan, China

Abstract: Safety inspection is an eternal theme for high-speed trains. In this paper, the matching method based on structural similarity is proposed to abnormal target detection for key components.

CIOP2019-2019-000290

Label-free imaging of collagen as a potential diagnostic marker for detection of gliomas

Fang Na[1], Wu Zanyi[2], Wang Xingfu[2], Kang Dezhi[2], Lin Yuanxiang[2*], Chen Jianxin[1*]
1. Fujian Normal University, China
2. The First Affiliated Hospital of Fujian Medical University, China

Abstract: Label-free imaging of collagen as a potential diagnostic marker for detection of gliomas.

CIOP2019-2019-000312

Research on crosstalk detection method for three-dimensional stereoscopic display

Feifei Gao
College of Information Science and Engineering, Huaqiao University, Xiamen, Fujian 361021, China

Abstract: Research on Crosstalk Detection Method for three-dimensional stereoscopic display.

CIOP2019-2019-000321

The ionization dose radiation effects of analog front-end for satellite-borne directional polarization camera

Pingping Yao[1,2], Bihai Tu[1,2], Dihu Chen[1,2], Meina Lu[1,2], Jin Hong[1,2]
1. Key Laboratory of Optical Calibration and Characterization, China
2. Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

Abstract: As the first comprehensive hyperspectral observation satellite in China, the GF-5 satellite is used to acquire hyperspectral and high-resolution remote sensing data and products.

CIOP2019-2019-000329

Inspection of impact damage on CFRP by lock-in induction thermography

Ting Liu, Yu Zhang
Southwest Jiaotong University, Chengdu, PR China, China

Abstract: Detection of reinforced carbon fiber with impact damage by using lock-in thermography. The amplitude images and phase images are obtained by Fast Fourier Transform.

CIOP2019-2019-000330

Interferenceless coded aperture correlation holography (I-COACH) adaptive compression imaging

Chao Liu, Yuhong Wan*, ALI ZIA
Beijing University of Technology, College of Applied Science, China

Abstract: In order to improve temporal resolution and suppress the bias terms and background noise in reconstructed images, this study develops a method of I-COACH adaptive image compression by combing nonlinear reconstruction technique and compressed sensing theory.

CIOP2019-2019-000336

Range-gated laser active imaging controlling system based on ARM+FPGA architecture

Laixian Zhang
Space Engineering University, China

Abstract: A range-gated laser active imaging controlling system based on ARM+FPGA architecture was designed in this paper, using FPGA to synchronize all subsystem, using ARM to interactive.5ns image gate was achieved using the system.

CIOP2019-2019-000339

Impacts of primary intensity of color gamut in multi-primary display

Guan Wang, Binghui Yao, Tianhao Dong, Chun Gu*, Lixin Xu
University of Science and Technology of China, China

Abstract: We proposed an algorithm to calculate the stereoscopic color gamut in multi-primary display, the intensity of primary is optimized based on our algorithm.

CIOP2019-2019-000342

Phase retrieval through scattering medium by compressive sensing

Tong Peng, Chen Bai, Runze Li, Junwei Min, Xianghua Yu, Baoli Yao
State Key Laboratory of Transient Optics and Photonics, Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China

Abstract: We present a technique to acquire the transmission matrix (TM) based on compressive sensing for reconstructing the complex amplitude of the target behind the scattering medium.

CIOP2019-2019-000346

Label-free imaging of bile duct tissues with multiphoton microscopy

Caihong Sun[2], Xueqin Xu[2], Guangxing Wang[2], Hongxin Lin[2], Shuangmu Zhuo[2], Youting Chen[1*]
1. First Affiliated Hospital of Fujian Medical University, China
2. Fujian Normal University, China

Abstract: In this study, label-freemultiphoton microscopy (MPM) can clearly distinguish normal bile duct, inflammatory bile duct and intrahepatic cholangiocarcinoma through cell morphology and tissue structure.

CIOP2019-2019-000352

Distinguishes normal and early gastric cancer mucosal structures by multiphoton microscopy

Xueqin Xu, Caihong Sun, Guangxing Wang, Hongxin Lin, Shuangmu Zhuo*, Xiaolin Zheng*
Fujian normal university, China

Abstract: We propose a method for distinguishing normal and early gastric cancer sites by multiphoton microscopy combined with acridine orange rapid staining.

CIOP2019-2019-000356

Imaging cancer-associated fibroblasts in human breast tumor tissue using multiphoton microscopy

Liqin Zheng[1*], Gangqin Xi[1], Jiajia He[1], Wenjiao Ren[1], Deyong Kang[2], Biying Yu[1], Jianxin Chen[1]
1. Fujian Normal University, China
2. Fujian Medical University Union Hospital, China

Abstract: In this study, MPM based on two-photon excited fluorescence (TPEF) and second harmonic generation (SHG) was used to identify the fibroblasts in breast cancer tissue. Normal fibroblasts with spindle shape and abnormal fibroblasts with stellate shape could be clearly obtained by MPM.

CIOP2019-2019-000362

Image super-resolution via deep residual network

Yakang Duan, Lin Luo, Yu Zhang[*]
School of Physical Science and Technology, Southwest Jiaotong University, China

Abstract: In this paper, a super-resolution based on deep residual network is proposed, which improves the super-resolution quality of images and reduces the convergence speed of the network.

CIOP2019-2019-000375

Low-dose CT with a deep convolutional neural network blocks model using mean squared error loss and structural similar loss

Yinjin Ma[*], Biao Wei
Chongqing University, China

Abstract: For making sure the diagnostic performance of CT images, a deep CNN blocks based denoising model for low-dose CT is presented. After training, it achieves promising performance in visual effects and quantitative measurements.

CIOP2019-2019-000378

Polarization visualization with low irradiance by perceptually uniform color space

Zhao Feng[1], Dong Yue[1], Zhang Jianlei[1], Feng Bin[2], Cheng Ximeng[1], Wu Rong[1], Zhang Yuan[1], Yang Meimei[1]
1. Xi’an University of Posts & Telecommunications, China
2. Northwestern Polytechnical University, China

Abstract: In this paper, we use the uniform color space $J_z a_z b_z$ as the target space, and map the polarization information s0, AoP, DoLP into J_z, C_z, h_z to complete the polarization visualization. The proposed method can significantly improve the lightness of the high polarization and low irradiance region, and intuitively obtain more polarization information.

CIOP2019-2019-000385

Measuring the biomechanical properties of prostate tumor tissues by atomic force microscopy

Xiaoqiong Tang[1,2], Weiwei Ruan[1,2], Jinshu Zeng[3], mengdan Chen[1,2], Yuhua Wang[1,2], Hongqin Yang[1,2*]
1. Fujian Provincial Key Laboratory for Photonics Technology, China
2. Key Laboratory of OptoElectronic Science and Technology for Medicine of Ministry of Education, China
3. Department of Ultrasound Medical, the First Affiliated Hospital of Fujian Medical University, China

Abstract: In this paper, the relationship between the pathological classification of different prostate tumor tissues and their biomechanical properties was studied by atomic force microscopy.

CIOP2019-2019-000389

High quality X-Ray imaging based on cumulation of forward projection of computed tomography

Fuqiang Yang[*], Dinghua Zhang, Hua Zhang, Kuidong Huang[*], You Du, Mingxuan Teng
School of Mechanical Engineering, Northwestern Polytechnical University, Xi’an 710072, China

Abstract: This study aims to address and test a shared noise which as the knowledge and is included in the signal applying to the sampled projection to generate high qualified X-ray imaging by reducing the artifacts in computed tomography (CT).

CIOP2019-2019-000404

Siamese region proposal network with optical flow assistant module

Yonghao Huang, Xiaoyu Chen, Jin Han, Lianfa Bai, Yi Zhang*

Nanjing University of Science and Technology, China

Abstract: We proposes a matching-and-tracking tracker for visual tracking, which calculates the optical flow field for supplement of template matching branch based on Siamese network.

CIOP2019-2019-000534

Finite element simulation of photoacoustic imaging of gastric tissue and the related tumor

Luo Yanghuan*, Li Zhifang, Li Hui

Fujian normal university, China

Abstract: This paper presents a finite element (FE)-based numerical simulation model of PAI of gastric tissue and the related tumor. A three-dimensional optical model of uniform gastric tissue embedded with spherical tumor and external irradiation short pulse laser point source was constructed.

CIOP2019-2019-000546

A scheme of color gamut measurement by color discrimination bBased on human eyes

Binghui Yao, Guan Wang, Yuhua Yang, Tianhao Dong, Chun Gu*, Lixin Xu

Departments of optics and optical engineering, University of Science and Technology of China, China

Abstract: Departments of optics and optical engineering, University of Science and Technology of China, China

We introduced the new color discrimination experiment based on human eyes to evaluate the color gamut of the display systems.

CIOP2019-2019-000560

Smart algorithms to improve super resolution structure on AI

Hua Liu*

Science and Technology on Electro-optic Control Laboratory, China

Abstract: Smartre structure technologies are used to improve the band width by reconstruction without the spectral alias in superresolution methods, a new coding technology with novel algorithms combining an optical encoding and the subpixel is proposed.

SC12 Optical communications and networks

CIOP2019-2019-000016

Wide-range frequency offset estimation method for a coherent optical FBMC/OQAM system

Daobin Wang*, Bo Chen, Handan Chong, Junjie Liu, Lihua Yuan, Xiaoxiao Li

Lanzhou University of Technology, China

Abstract: In this paper, we propose a wide-range frequency offset estimation method for a CO-FBMC/OQAM system. This method can not only estimate the fractional frequency offset, but also estimate the integer frequency offset.

CIOP2019-2019-000023

VCSEL-based optical module for high-speed short-reach interconnect

Ying Li, Zhiyong Wang

Institute of Laser Engineering, Beijing University of Technology, China

Abstract: In this paper, we introduce a new 4-ch optical module with power monitoring function using injection-molded all-polymer materials. We observed that the module's output power can be monitored by the PDs, and have successful simulated the optical paths in ZEMAX software.

CIOP2019-2019-000034

Integration of VCSELs and HBT: modeling and simulation

Guangzheng Zhou, Ying Li, Tian Lan, Jingjing Dai, Congcong Wang, Zhiyong Wang*
Institute of Laser Engineering, Beijing University of Technology, China

Abstract: The electro-optical characteristics of VCSEL and HBT integration device are simulated by using PICS3D software. The simulation results show that the power gain is up to 380mW/mA. The power gain cutoff frequency exceeds 1GHz.

CIOP2019-2019-000071

Design of CPA reflective mirror in space laser communication via multi-objective optimization

Yang Song[1], Yongming Hu[1*], Wenyi Chai[1], Jing Ye[1,2], Wei Xin[1], Bin Hu[1,2], Chenjie Wang[1,3]
1. Xi'an institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China
2. University of Chinese Academy of Sciences, China
3. Xi'an Jiaotong University, China

Abstract: The paper makes structure design of CPA (Coarse Pointing Assembly) reflective mirror in space laser communication system based on multi-objective optimization.

CIOP2019-2019-000096

Long-term beamwidth and quivering of a modified Bessel Gaussian Schell model vortex beam in oceanic turbulence

Qiyong Liang, Yixin Zhang*, Lin Yu, Shibao Deng
School of Science, Jiangnan University, Wuxi 214122, China, China

Abstract: The long-term beamwidth and quivering of modified Bessel Gaussian Schell vortex beamin oceanic turbulence based on the extended Huygens-Fresnel principle.

CIOP2019-2019-000141

Design and simulation of a polarization insensitive optical 90° hybrid based on an INP multimode interference coupler

Qingzi Lu, Qin Han*, Han Ye, Shuai Wang, Feng Xiao, Yanli Geng
Semiconductor Research Institute of Chinese Academy of Sciences, China

Abstract: We propose a multimode interference coupler (MMI) design for polarization insensitivity based on an InP platform, which can realize monolithic integration with detectors.

CIOP2019-2019-000181

Single channel encryption of color image based on compressed sensing and tricolor grating

Xiaoyong Liu[1], Pei Lu[2*], Qin Shi[1], Di Sun[1]
1. Department of Physics, School of Science, Shihezi University, China
2. College of Information Science and Technology, Shihezi University, China

Abstract: In the paper a single channel color image encryption method based on compressed sensing (CS) was proposed.

CIOP2019-2019-000221

Distribution of multipartite Einstein-Podolsky-Rosen steering in Gaussian systems

Yu Xiang[1*], Xiaolong Su[2], Yin Cai[3], Gerardo Adesso[4], Qiongyi He[1]
1. Peking University, China
2. Shanxi University, China
3. Xian Jiaotong University, China
4. University of Nottingham, UK

Abstract: We investigate the properties of EPR steering and its monogamy in paradigmatic multipartite Gaussian states such as cluster state and multimode state via a quantum frequency comb.

CIOP2019-2019-000246

Modulation format recognition scheme using orthogonal codewords for wavelength division multiplexing system

Rui Mao[1], Qi Zhang[1*], Xiangjun Xin[1], Wei Zhang[2], Qinghua Tian[1], Feng Tian[1], Ying Tao[2]
1. Beijing University of Posts and Telecommunications, School of Electronic Engineering, China
2. China Academy of Space Technology, China

Abstract: A modulation format identification scheme based on orthogonal coding scheme is proposed to solve the modulation format identification problem in wavelength division multiplexing systems. The scheme uses sidebands to carry orthogonally encoded modulation format information.

CIOP2019-2019-000252

Load balancing algorithm based on secure routing strategy in satellite optical networks

Yeqi Liu[1], Qi Zhang[1], Xiangjun Xin[1], Qinghua Tian[1], Feng Tian[1], Ying Tao[2], Naijin Liu[2*], Guixing Cao[2], Bo Zhang[2]
1. Beijing University of Posts and Telecommunications, China
2. China Academy of Space Technology, China

Abstract: Anoptimized load balancing algorithm based on secure routing strategy is proposed for satellite optical networks with wavelength routing, which can effectively decentralize the traffic in hot spots with the consideration of security by agents.

CIOP2019-2019-000262

Joint blind equalization of PDL and RSOP using Extended Kalman filter algorithm in Stokes vector direct detection system

Xue Mao, Yanfu Yang[*], Qian Xiang, Juntao Cao
Harbin Institute of Technology, China

Abstract: A joint blind equalization scheme of polarization-dependent loss (PDL) and the rotation of state of polarization (RSOP) rotation using Kalman filter is proposed for Stokes vector direct detection system. Compared with stochastic gradient scheme, the proposed scheme shows faster polarization tracking capability and needs less OSNR penalty that is 0.3dB, when PDL is 3dB and the rotation rate is 1Mrad/s.

CIOP2019-2019-000316

A probabilistic shaping 64QAM scheme based on multilevel coded modulation

Xia Sheng[1,2], Qi Zhang[1,2*], Xiangjun Xin[1,2], Feng Tian[1,2], Wei Zhang[3], Qinghua Tian[1,2], Ying Tao[3], Yang Wang[3], Yongjun Wang[2,4], Leijing Yang[1,2], Chao Yu[1,2]
1. Beijing University of Posts and Telecommunications, School of Electronic Engineering, China
2. Beijing Key Laboratory of Space-ground Interconnection and Convergence, China
3. China Academy of Space Technology, China
4. Beijing University of Posts and Telecommunications, China

Abstract: A probabilistic shaping 64QAM scheme based on multilevel coded modulation is proposed, which combines the advantages of multilevel coded modulation and probabilistic shaping, and achieves multiple code rate. The BER is analyzed by establishing a simulation system. The results show that the proposed scheme requires lower SNR under the same BER while achieving higher code rate.

CIOP2019-2019-000320

A probabilistic shaping 12-QAM scheme based on set-partitioned two-polarization

Xin Liu[1], Qi Zhang[1*], Xiangjun Xin[1], Wei Zhang[2], Qinghua Tian[1], Feng Tian[1], Ying Tao[2]
1. Beijing University of Posts and Telecommunications, School of Electronic Engineering, China
2. China Academy of Space Technology, China

Abstract: We propose a Probabilistic Shaping 12-QAM scheme based on Set-Partitioned Two-Polarization (PS-SP-TP-12QAM). Simulation results show that this scheme improves the effectiveness and reliability of PS-12QAM. In addition, this scheme has certain advantages over PS-8QAM and PS-16QAM.

CIOP2019-2019-000338

Decision rule based on SVM for 16-QAM and PS-16-QAM

Yuzhong Feng, Shaohua Hu, Pingping Lei, Jing Zhang*
UESTC, China

Abstract: In this paper, we propose support vector machine (SVM) to classify constellations with nonlinear noise in the 16-QAM or PS-16-QAM constellation mapping transmissions.

CIOP2019-2019-000341

Linear verification of signal demodulation in fiber nutation tracking system

Xueqiang Zhao[1,2*], Shaowen Lu[1,2], Tai Li[3], Xiaoxi Zhang[3], Min Gao[3], Ren Zhu[3], Xia Hou[2,3], Weibiao Chen[1,2*]
1. Key Laboratory of Space Laser Communication and Detection Technology, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Science, China
2. Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, China
3. Laboratory of Space Laser Engineering, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

Abstract: The performance of fiber nutation tracking system based on coherent demodulation is constrained by the nonlinearity of the device. We analyze the influence of optical amplifier and detectors on the signal intensity calculation.

CIOP2019-2019-000348

Design of variable weight 2D-MD code for spectra/spatial OCDMA systems

Xiang Li, Qingan Ding *, Bowen Nie, Changqing Liu, Juan Song, Shaoying Li
College of Electronic and Information Engineering, Shandong University of Science and Technology, China

Abstract: College of Electronic and Information Engineering, Shandong University of Science and Technology, China
A variable weight two-dimensional Multi-Diagonal code is proposed for supporting the QoS differentiation in Optical Code Division Multiple Access system, using one-dimensional Multi-Diagonal code and variable weight Multi-Diagonal code for spatial and spectral coding, respectively.

CIOP2019-2019-000380

A dynamic RWA algorithm based on genetic algorithm in SDON

Zhe Yang
National University of Defense Technology, China

Abstract: In order to adapt to the future development trend of SDON with higher speed, wideband, long distance and large capacity, this paper makes some improvements to the general GA, and proposes a dynamic, improved GA based RWA algorithm, which can effectively reduce the complexity of GA.

CIOP2019-2019-000381

Non-uniform QAM OFDM modulation system based on probabilistic shaping and geometric shaping

Xiumin Song[1], Qi Zhang[1*], Xiangjun Xin[1], Feng Tian[1], Qinghua Tian[1], Yang Wang[1], Wei Zhang[2], Ying Tao[2], Yongjun Wang[1], Leijing Yang[1]
1. Beijing University of Posts and Telecommunications, School of Electronic Engineering, China
2. China Academy of Space Technology, China

Abstract: Non-uniform QAM OFDM modulation system based on probabilistic shaping and geometric shaping can effectively resist the interference between signal waveforms and improve spectrum utilization and channel capacity.

CIOP2019-2019-000384

Amplitude-phase precoding scheme for high speed ROF-MIMO systems

Rui Li[1], Qi Zhang[1*], Xiangjun Xin[1], Feng Tian[1], Qinghua Tian[1], Wei Zhang[2], Ming Lin[3], Yang Wang[4], Yongjun Wang[5]
1. Beijing University of Posts and Telecommunications, School of Electronic Engineering, China
2. China Academy of Space Technology, China

Poster

3. Guangdong University of Technology, China
4. China Electric Power Research Institute Co., China
5. School of Electronic Engineering, Beijing University of Posts and Telecommunications, China
Abstract: A scheme of amplitude-phase precoding and MMSE precoding for high-speed ROF-MIMO system is proposed to solve the distortion caused by optical devices and link damage and reduce the complexity of processing at the user end.

CIOP2019-2019-000584

Propagation characteristics of vortex beam using visualization analysis

Yan Zhang[1], Yunzhe Zhang[2*], Minru Hao[1]
1. School of science, Xi'an Shiyou University, China
2. Xi'an University, China
Abstract: According to the paraxial theory, we analyzed the linear momentum density and orbital angular momentum (OAM) of the Gaussian vortex beam propagation characteristics in the free space, from which propagation characteristics are simulated and analyzed in the visualization.

CIOP2019-2019-000792

Neural network optimization and High-speed train wheel-set size prediction forecasting based on differential evolution

Jiawen Zhang, Lin Luo, Yu Zhang, Xiaorong Gao
Southwest Jiaotong University, China
Abstract: The wheel-set size data is obtained by optical intercept image detection, and the LMBP neural network prediction model based on differential evolution is designed and implemented.

SC13 Optical Fiber and Waveguide Technologies

CIOP2019-2019-000032

Model decomposition for the few mode fibers based on the scale invariant correlation filter

Wei Yan
1. College of Advanced Interdisciplinary Studies, National University of Defense Technology, China
2. Northwest Institute of Nuclear Technology, China
Abstract: We extend the existing modal decomposition method by incorporating the optical Mellin transform into the conventional matched filter. This extended ability allows the decomposition of modal fields without any restriction regarding their scale parameter.

CIOP2019-2019-000077

Optimal design for large-scale MZI Silica on silicon optical thermo switching matrix

Lijun Guo[1*], Lin Qi[1], Xin Du[2]
1. School of Science, Changchun University of Science and Technology, China
2. School of Mechanical, Changchun University of Science and Technology, China
Abstract: We calculated the transmission field of 2x2 Mach –Zehnder (MZI) silica on silicon thermo optic (TO) switch with different structure by using the finite difference beam propagation method (BPM). On the basis of optimization design, we constructed and simulated the large-scale 16x16 MZI silicon-based SiO_2 Silica on silicon thermo switching matrix.

Poster

CIOP2019-2019-000078

Effect of temperature on silicon based optical switching chip

Tianrui Wang, Lijun Guo
School of Science., Changchun University of Science and Technology, China

Abstract: This paper describes the influence of temperature on the working state of two kinds of switching chips, the Mach-Zehnder interferometer and the micro-resonator.

CIOP2019-2019-000205

Experimental study on pulsed gamma-ray radiation-induced absorption in optical fibers

Fuhua Liu[1*], Yuanxia Gong[1], Ping Wang[2], Chong Zhao[1], Jin Zhang[1]
1. Xijing University, China
2. Northwest Institute of Nuclear Technology, China

Abstract: The pulsed gamma-ray radiation-induced losses in conversional fibers and rare-earth-doped fibers are measured and analyzed.

CIOP2019-2019-000220

Design of high efficiency ITO phase/intensity modulator based on ultra-thin silicon strip waveguide

Yingxin Kuang[1,2], Xingrui Huang[1,2], Rui Jiang[1,2], Huan Guan[1], Qingquan Wei[1], Weihua Han[1], Zhiyong Li[1]
1. Institute of Semiconductors, Chinese Academy of Sciences, China
2. University of Chinese Academy of Sciences, China

Abstract: A high efficiency ITO phase/intensity modulator by combining ITO with ultra-thin silicon strip waveguide configuration is proposed and analyzed. This device enables its use in applications such as compact phase shifter, sensing, and optical switch.

CIOP2019-2019-000296

An open-cavity fiber Fabry-Perot interferometer fabricated by femtosecond laser micromachining for refractive index sensing

Yueying Liu, Ang Li, Qiang Liu, Peng Song, Rui Li, Zhenguo Jing, Wei Peng
Dalian University of Technology, China

Abstract: An open-cavity fiber extrinsic Fabry-Perot (FP) interferometer (EFPI), fabricated by using 800 nm femtosecond (fs) laser micromachining, for refractive index (RI) measurement isproposed and demonstrated.

CIOP2019-2019-000343

An efficient multiplexed optics fiber sensing method for human tracking

Qiuju Guan[1*], Bin Jin[2]
1. Zhongkai University of Agriculture and Engineering, China
2. The 7th research institute of china electronics technology group corporation, China

Abstract: Recently, optical fiber sensor has been explored for device-free human tracking due to its advantages of data-efficient, low-computational-cost and non-intrusive. We build a novel multiplexed sensing based tracking system using optical fiber sensors.

CIOP2019-2019-000360

Fiber-optic quasi-distributed acoustic sensing system at doubled repetition rate

Zitan Wang, Jialin Jiang, Ji Xiong, Zinan Wang
University of Electronic Science and Technology of China (UESTC), China

Abstract: A novel method to double the repetition rate of quasi-distributed acoustic sensing is proposed, based on chirped-pulse Φ-OTDR with coherent detection. This technology uses two probe pulses with positive and negative chirp respectively, which are in the same frequency band; the mixed reflected lightwaves of the two probe pulses are separated effectively with the matching filter.

CIOP2019-2019-000392

Theoretical analysis and ZEMAX simulation of the effect of target distance on collection efficiency of the fiber optic probe

Xiuming Li[1,2], Fajie Duan[1*], Tingting Huang[1]
1. Tianjin University, China
2. Yunnan Open University, China

Abstract: A theoretical model of fiber optic probe is proposed. The collection efficiency of fiber optic probe is derivated when target distance change, and the error is 1.17% between theoretical and ZEMAX simulation results.

CIOP2019-2019-000533

Generation and tuning properties of Fano-like resonance in all-fiber structure

Alan Li, Biqiang Jiang, Xuetao Gan, Jianlin Zhao
Northwestern Polytechnical University, China

Abstract: In this study, we have generated the Fano-like resonance in an all-fiber structure with a Mach–Zehnder interferometer. The Fano-like resonance lineshape can be tuned into Lorentzian and electromagnetically induced transparency-like (EIT) resonance lineshapes by bending the device, showing great potentials in all-optical switching, sensing, signal processing, etc.

CIOP2019-2019-000553

Laser annealing of glass waveguide is realized

Yingde Wang, Zhennan Tian, Dehui Li
Jilin University, China

Abstract: Laser annealing of glassy waveguides is performed by femtosecond laser, in order to reduce the optical waveguide transmission loss

CIOP2019-2019-000587

Humidity sensor based on twin-hole fiber filled with Black Phosphorus

Min Shao[1*], Liang Han[1], Xue Zhao[1], Xueguang Qiao[2]
1. School of Science, Xi'an Shiyou University, China
2. School of Physics, Northwest University, China

Abstract: An in-line fiber Mach-Zehnder interferometer (MZI) based on twin-hole fiber for humidity sensing was proposed and experimentally demonstrated.

SC14 Biophotonics and Optofluidics

CIOP2019-2019-000013

Super-resolution optical imaging of mitochondrial dynamics

Wenhui Pan, Wen Li, Junle Qu, Zhigang Yang[*]
College of Optoelectronic Engineering, Shenzhen University, China

Abstract: Currently, we achieved STORM imaging of mitochondria in live cells and the dynamic process of mitochondrial outer membrane as long as three minutes, with the temporal/spatial resolution of 1.5 s/60 nm, respectively. These studies provide a powerful tool for the study of ultra-fine structures of mitochondria in live cells and will promote the further development of mitochondrial biology.

CIOP2019-2019-000021

Stain-free histopathological analysis of metastatic cancer by multimodal optical methods

Binglin Shen, Junshuai Yan, JunleQu*, Liwei Liu*, Feifan Zhou, Rui Hu
Shenzhen University, China

Abstract: We introduced multimodal optical methods to offer stain-free non-invasive histopathological analysis of primary and metastatic cancers. Different excitation windows (NIR I and II) and multiphoton and multiharmonic signals were compared.

CIOP2019-2019-000074

Kinetic analysis of DNA and Dox binding process using fluorescence lifetime imaging

Sheng Ren, Yihua Zhao, Rui Hu, Junle Qu, Liwei Liu*
Shenzhen University, China

Abstract: First, prepare a microfluidic chip and determine the diffusion conditions by theoretical simulation. Then, the sample concentration and flow rate information are set according to the diffusion conditions. Finally, the corresponding life imaging information is obtained by the FLIM method.

CIOP2019-2019-000082

Parameters affecting image quality in photoacoustic tomography: a systematic study

Chao Tian*, Kang Shen, Songde Liu, Zhiming Hu
University of Science and Technology of China, China

Abstract: Based on a prototype photoacoustic tomography scanner, we systemically studied factors associated with the acoustic reception process and investigated how they would impact on the image quality. Simulations and experiments are both presented to support the findings in the study.

CIOP2019-2019-000099

Monitoring endocytosis of BSA based on fluorescence lifetime of a small squaraine dye in living cells

Fangrui Lin, Pintu Das, Yihua Zhao, Binglin Shen, Rui Hu, Feifan Zhou, Liwei Liu*, Junle Qu*
Shenzhen University, China

Abstract: In this work, we utilized the fluorescence lifetime of a small squaraine dye to monitor the endocytic process of BSA in single living cells.

CIOP2019-2019-000125

On-site portable single molecule fluorescence imaging device for high-sensitive and accurate mercury detection

Dan Jian[1*], Bin Wang[2], Cheng Liu[1], Shouyu Wang[1]
1. Jiangnan University, China
2. Nanjing Agrilcultural University, China

Abstract: We propose a portable and cost-effective single molecule fluorescence imaging device with large field of view of 1.5mm^2, high resolution of 2.2 μm and high signal to noise ratio of ~22 dB.

CIOP2019-2019-000130

Longitudinal monitoring of blood perfusion and brain tissue damage in photothrombotic ischemic stroke rat model

Shanshan Yang[1], Kezhou Liu[2], Guoqing Weng[2], Zhihua Ding[1], Peng Li[1*]
1. Zhejiang University, China
2. Hangzhou Dianzi University, China

Abstract: Spatio-temporal responses of blood perfusion and brain tissue damage were monitored with optical coherence tomography (OCT) in photothrombotic ischemic stroke rat model in the period up to two weeks.

CIOP2019-2019-000143

Solo smart fluorogenic probe for potential cancer diagnosis and tracking in vivo tumorous lymphatic systems via distinct emission signals

Meina Huang
Shenzhen University, China

Abstract: A versatile twisted-intramolecular-charge-transfer (TICT) based NIR (near infrared) fluorescent probe (L) has been judiciously designed and synthesized that could be utilized for potential cancer diagnosis and to track sentinel lymph node in tumor-bearing mouse.

CIOP2019-2019-000151

An improved opto-acousto-fluidic microscopic system for microfluidic applications

Fei Liu[1], Tian Jin[2], Lei Xi[2*], Chaolong Song[3]
1. University of Electronic Science and Technology of China, China
2. Southern University of Science and Technology, China
3. China University of Geosciences, China

Abstract: In this work, we build a new opto-acousto-fluidic microscopic system, which employs a fastone-dimensional galvanometer scanner and an ultrafast pulse laser (600 kHz).

CIOP2019-2019-000177

Effects of detection distance on the photoacoustic detection of glucose and concentration prediction

Zhong Ren[*], Guodong Liu
Jiangxi Science and Technology Normal University, China

Abstract: In this paper, the effect of detection distance on the photoacoustic detection of glucoses was experimentally investigated. Moreover, the effect of detection distance on the prediction of glucose concentrations was also studied.

CIOP2019-2019-000193

High speed portable optical resolution photoacoustic microscopy

Jian Zeng[1], Weizhi Qi[1,2], Tian Jin[1], Lei Xi[1,2*]
1. University of Electronic Science and Technology of China, China
2. Southern University of Science and Technology, China

Abstract: We report a high-speed portable ORPAM (HS-P-ORPAM) system, which dramatically improves the imaging speed.

CIOP2019-2019-000243

Inverse spatially offset Raman spectroscopy and its applications sub-surface material detections

Shuang Wang[1,2*]
1. Institute of Photonics and Photon-Technology, Northwest University, Xi'an, Shaanxi, China
2. Department of Physics, Northwest University, Xi'an, Shaanxi, China

Abstract: We propose to build Inverse Spatially offset Raman spectroscopy system and prove the feasibility of the system in detecting subsurface material information through experiments.

CIOP2019-2019-000264

A MEMS-based opto-acuostic-fludic system for cell imaging

Min Wang[1], Tian Jin[2], Fei Liu[1], Xingxing Chen[1], Lei Xi[1,2*]
1. University of Electronic Science and Technology of China, China
2. Southern University of Science and Technology, China

Abstract: In this work, we develop a new opto-acuostic-fludic system, which features high-throughput, high-speed, and high spatial resolution. In addition, the entire system is highly integrated.

CIOP2019-2019-000288

A facile way to synthesize dual-drug delivery nanocarrier for highly efficient therapy and tracing of intracellular drug release

Peng Chen[1*], Zhuyuan Wang[2], Wenzhe Li[1]

1. Jinling Institute of Technology, China
2. Southeast University, China

Abstract: To investigate the intracellular traceable delivery performance of this nanocarrier, the dual drug loaded nanocarrier was incubated with living HeLa cells. Experimental results indicated that this dual drug nanocarrier can effectively enter into HeLa cells. And the release of 6TG and DOX were triggered by the substation of GSH and the acidic environment of lysosomes, respectively.

CIOP2019-2019-000307

Diffusion correlation spectroscopy and color doppler ultrasound measurements of blood flow and pulse wave: a comparison study

Qisi Ge[1,2,3], Zhe Li[1,2,3*], Jinchao Feng[1,2,3], Kebin Jia[1,2,3*]

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2. Beijing Laboratory of Advanced Information Networks, Beijing 100124, China
3. Beijing Key Laboratory of Computational Intelligence and Intelligent System, Beijing University of Technology, Beijing 100124, China

Abstract: In this paper, a fast diffusion correlation spectroscopy (DCS) based on software correlator is constructed based on traditional DCS. Fast DCS is compared with color Doppler ultrasound to measure human blood flow and pulse wave.

CIOP2019-2019-000319

Synthesis and Photophysical properties measurement of polyfluoroalkyl yate silicon (IV) phthalocyanine

Jiao Wang[1], Shijun Wu[2], Qiuhao Ye[2], Xiuqin Chen[2], Yiru Peng[2*], Hongqin Yang[1*]

1.Key Lab of Optoelectronic Science and Technology for Medicine of Ministry of Education, Fujian Provincial Key Lab for Photonics Technology, Fujian Normal University, China

2.College of Chemistry & Engineering, Fujian Provincial Key Laboratory of Polymer Materials, Fujian Normal University, China

Abstract: A novel polyfluoroalkyl yate silicon (IV) phthalocyanine complex (SiPc-F) was synthesized. The effect of the fluorine substituent on the photophysical properties of phthalocyanine complexes and the quantum yield of singlet oxygen were compared.

CIOP2019-2019-000345

Evaluation of the synergistic effect of tamoxifen and HSP70 inhibitor on breast cancer cells based on optical metabolic imaging

Biying Yu, Liqin Zheng, Xiaoman Zhang, Hui Li[*]

Key Laboratory of OptoElectronic Science and Technology for Medicine of Ministry of Education, Fujian Provincial Key Laboratory for Photonics Technology, Fujian Normal University, Fuzhou 350007, China, China

Abstract: The ratio of NADH and FAD named optical redox ratio was used to evaluate the synergistic effect of tamoxifen and HSP70 inhibitor on breast cancer cells based on optical metabolic imaging.

CIOP2019-2019-000351

A low-cost detection device for imaging fluorescent contact lenses and diagnosing of fungal infections in the eyes

Wei Li

University of Sheffield, UK

Abstract: To overcome the challenge of the diagnosis and early treatment of eye infections in remote areas, an optical device was developed to distinguish the bacterial and fungal pathogens, and thereby help to optimize the treatment for the eye infection and prevent antibiotics abuse.

CIOP2019-2019-000363

Nonlinear optical microendoscopy based on a four-plate piezoelectric scanner for imaging of calcium activity in behaving mice

Xiang Li[1,2], Lu He[1,2], Ling Fu[1,2*]

1. Collaborative Innovation Center for Biomedical Engineering, Wuhan National Laboratory for Optoelectronics-Huazhong University of Science and Technology, Wuhan, Hubei 430074, China

2. Britton Chance Center and MOE Key Laboratory for Biomedical Photonics, School of Engineering Sciences, Huazhong University of Science and Technology, Wuhan, Hubei 430074, China

Abstract: Here we presented a miniature microscope based on a four-plate piezoelectric scanner. And we get the imaging of Ca^{2+} activity with high spatiotemporal resolution in awake, head-fixed mice by the scanner.

CIOP2019-2019-000379

Probing the surface micro-nanostructure of ovarian cancer cells using atomic force microscopy

Mengdan Chen[1,2], Weiwei Ruan[1,2], Yuhua Wang[1,2], Hongqin Yang[1,2*]

1. Fujian Provincial Key Laboratory for Photonics Technology, China

2. Key Laboratory of OptoElectronic Science and Technology for Medicine of Ministry of Education, China

Abstract: In this study, we studied the cell surface morphology and plasma membrane roughness of different ovarian cell lines, including normal cell lines HOSEpiC and cancerous cell lines HO-8910.

CIOP2019-2019-000390

Differentiation of benign and malignant tumors based on serum surface-enhanced Raman spectroscopy and multivariate data analysis

Xiaozhou Liang, Xuchao Miao, Zufang Huang[*]

Fujian Normal University, Key Laboratory of Optoelectronic Science and Technology for Medicine, China

Abstract: In this paper, the filter membrane based SERS method combined with multivariate statistical analysis was proposed and our preliminary results demonstrate a potential for objective and effective differentiation between benign and malignant thyroid tumors.

CIOP2019-2019-000395

Time-gated imaging of near- and short wave infrared photoluminescence from rare-earth ion doped nanoparticles

Roman Ziniuk, Artem Yakovliev, Junle Qu, Tymish Y. Ohulchanskyy[*]

Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of Physics and Optoelectronic Engineering, Shenzhen University, China

Abstract: The time-gated imaging system performing in near- and short wave infrared spectral range (900-1700nm) was developed. The setup was applied for spatial discrimination of rare-earth ion doped nanoparticles emitting in NIR-SWIR range.

CIOP2019-2019-000511

Significantly enhanced Raman scattering on two dimensional antimonene nanosheet

Yufeng Yuan[*]

Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of Physics and Optoelectronic Engineering, Shenzhen University, China

Abstract: Here, we prepared high quality two dimensional antimonene nanosheet via liquid exfoliation approach and studied the significant Raman enhancement on antimonene nanosheet.

CIOP2019-2019-000572

Customized ophthalmic photoacoustic microscopy

Huangxuan Zhao[1], Zhicheng Liu[1*], Chengbo Liu[2*]

1. Capital medical university, China

2. Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, China

Abstract: We have developed a photoacoustic microscope dedicated to small animal ophthalmic imaging that performs efficient and accurate anterior segment angiography imaging through a series of operations including depth scanning, motion correction, vascular enhancement and extraction.

SC15 Optical Fiber and Waveguide Technologies

CIOP2019-2019-000001

Research on CF_4 gas optical sensor detection method in high voltage GIS gas chamber based on NDIR technology

Shiling Zhang
State Grid Chongqing Electric Power Company Chongqing Electric Power Research Institute, China

Abstract: The portable CF_4 gas sensor was designed by applying non-dispersive infrared (NDIR) technology. The system adopts a single-beam dual-wavelength structure to determine the type of return light path gas chamber and improve the sensitivity of the system.

CIOP2019-2019-000004

Single-source double heterodyne coherent detection high-speed moving target

Jianying Ren
Space Engineering University, China

Abstract: A novel single source and double heterodyne coherent detecting high-speed moving targets is presented

CIOP2019-2019-000005

Crack width analysis of reinforced concrete using FBG sensor

Lili Wang
Ludong University, China

Abstract: The essence of the project is to reveal the detection principle of concrete crack width based on optical fiber gratings, develop the special theory and practical design method for this kind of optical fiber sensor.

CIOP2019-2019-000014

Relative intensity noise suppression of intensity modulator and semiconductor optical amplifier

Xin Liu
Beihang Univesity, China

Abstract: The paper shows the study on supressing the intensity noise of erbium-doped fiber source. And achieve a conclusion about the effect of intensity modulator and SOA on the supression.

CIOP2019-2019-000076

Experimental study of silica on silicon ring resonator in resonator micro optic gyroscope

Guosong Liu[1*], Lijun Guo[2]
1. School of Science, Changchun Institute of Technology, China
2. School of Science, Changchun University of Science and Technology, China

Abstract: This paper reports the experimental results of silica on silicon ring resonator in resonator micro optic gyroscope by our research group.

CIOP2019-2019-000092

Analysis of the normal mode effect in a Resonator Integrated Optic Gyro

YuMing He, FuHua Yang, Wei Yan, WeiHua Han, ZhaoFeng Li

1. Institute of Semiconductors, Chinese Academy of Sciences, China
2. University of Chinese Academy of Sciences, China

Abstract: Analysis shows that the differential normal mode loss caused by coupler sidewall roughness is the main source. The source is fully investigated and the conclusions are verified by Finite-Difference Time-Domain (FDTD) simulation software. Analysis shows that the correlation length should avoid the maximum point of scattering loss and the RMS deviation should be lowered.

CIOP2019-2019-000094

Strain sensitivity of FBG inscribed in twisted plastic optical fiber

Tianyi Ma[1*], Ryo Ishikawa[1], Heeyoung Lee[1], Antreas Theodosiou[2], Kyriacos Kalli[2], Yosuke Mizuno[1], Kentaro Nakamura[1]

1. Institute of Innovative Research, Tokyo Institute of Technology, Japan
2. Photonics and Optical Sensing Research Laboratory, Cyprus University of Technology, Cyprus

Abstract: We measured the twist dependencies of the plastic-optical-fiber-Bragg-grating-reflected spectrum and its strain sensitivity. The strain sensitivity was found to decrease with increasing twist with a coefficient of approximately–34.2 pm/%/turns/m.

CIOP2019-2019-000126

Paper chip based compact smart antibiotic sensor for on-site tetracycline detection

Shaowei Sun[1*], Jiahao Li[2], Cheng Liu[1], Shouyu Wang[1]

1. Jiangnan University, China
2. Nanjing Agrilcultural University, China

Abstract: We develop a smart antibiotic sensor combining with paper chip based enzyme-linked immunosorbent assay (ELISA), with high accuracy and extremely low detection limit of 0.05ng/mL.

CIOP2019-2019-000139

In-motion monitoring of atmospheric methane and ethane using a mid-infrared dual-gas simultaneous detection sensor

Weilin Ye[1], Zihan Tu[1], Bo Zhou[1], Fupei Wu[1], Tao Wu[1], Zhidan Zheng[1], Chuantao Zheng[2*]

1. Shantou University, China
2. Jilin University, China

Abstract: For realize the atmospheric alkane gases detection in wide area and long distance, a dual-gas simultaneous methane and ethane detection sensor was demonstrated and conducted in Greater Houston area.

CIOP2019-2019-000140

Fast automated calibration of MG-Y tunable lasers for fiber-optic sensing

Qiang Liu, Ang Li, Zhiyuan Huang, Yang Zhang, Yueying Liu, Zhenguo Jing, Wei Peng

School of Physics, Dalian University of Technology, China

Abstract: Asimple but efficient procedure to create look-up tables for modulation grating Y-branch (MG-Y) lasers was introduced, which could be applied to other VT-DBR lasers.

CIOP2019-2019-000146

Temperature sensing using photonic crystal fiber filled with thermo-optic liquid

Lu Xue[1,2], Yani Zhang[1,2,3*], Yuyu Zhu[1,2]

1. School of Physics and Optoelectronics Technology, Baoji University of Arts & Sciece, Baoji, Shaanxi, China
2. Baoji Engineering Technology Research Centre on Ultrafast Laser and New Materials, Baoji, Shaanxi, China
3. School of Arts and Sciences, Shaanxi University of Science & Technology, Xi'an, Shaanxi, China

Abstract: We use the photonic crystal fiber (PCF) filled with different concentrations of thermo-optic liquids to realize temperature sensing. The confinement loss peak occurs red shifts when the temperature rises and the intervals between loss peak are approximately equal which indicating a linear change. Finally, a temperature sensitivity as high as 6 nm/°C are obtained.

CIOP2019-2019-000148

SNR research of BOTDR sensing system using biorthogonal code

Yunqi Hao[1*], Nannan Liu[1], Qing Ye[2], Haiwen Cai[2]

1. Zhengzhou University of Light Industry, China
2. Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

Abstract: The linear Biorthogonal code technology is applied into the BOTDR sensing system. The SNR enhancement is analyzed in detail. The SBS threshold value decreases dramatically with the code length. The SNR enhancement for Biorthogonal code and multi-averaging single pulseis studied comparatively.

CIOP2019-2019-000200

Temperature compensation effect of different packaged FBGs under abrupt temperature changing environment

Li Xiong, Guozhang Jiang, Yongxing Guo, Shuang Xu, Yi Kuang

Wuhan University of Science and Technology, China

Abstract: This paper focuses on the temperature compensation problem of fiber Bragg grating (FBG) based sensors. The experimental results indicate that the compensation effect is influenced by both the FBG packaging method and the temperature change status.

CIOP2019-2019-000202

Research on manufacturing error and compensation method of Fabry-Perot solid-etalon

Lu Li, Yufei Chu

1. Key Laboratory of Atmospheric Optics, Anhui institute of Optics and Fine Mechanics, CAS, China

Abstract: The manufacturing error of the solid etalon could be compensated by the adjusting the incident angle or operating temperature. The results indicate that the compensation measures is effective to locate the central wavelength of the best working condition of the solid etalon.

CIOP2019-2019-000215

Microgroove based optical fiber refractive index sensor

Xiangyu Wei [1], Lingling Ran [2*], Zhaojun Li [1]

1. School of Electronic Engineering, Heilongjiang University, China
2. Key Lab of Electronics Engineering, College of Heilongjiang Province, Heilongjiang University, China

Abstract: In this paper, an all-fiber easily fabricated mach-zehnder interferometer (MZI) based refractive index (RI) sensor is presented and simulated. This RI sensor is composed of a single-mode fiber with a core diameter of 9 μm and a multimode fiber with a core diameter of 105 μm.

CIOP2019-2019-000225

Refractive index sensor based on two cascaded tapers in multimode fiber

Xiangyu Wei [1], Lingling Ran [2*], Zhaojun Li [1]

1. School of Electronic Engineering, Heilongjiang University, China
2. Key Lab of Electronics Engineering, College of Heilongjiang Province, Heilongjiang University, China

Abstract: Based on bipyramidal cascade, the intensity of MZI is increased, so the sensitivity of refractive index is improved.

CIOP2019-2019-000245

Optical fiber hydrogen sensor based on a no-core fiber structure

Xuhui Zhang, Yun Liu, Qiang Liu, Huizhen Yuan, Mengdi Lu, Shuwen Chu, Wei Peng

School of Physics, Dalian University of Technology, China

Abstract: A novel and simple optical fiber structure with no-core fiber for measuring hydrogen concentration is presented. Different concentrations are tested, from 4%-0.5%, shows the concentration is relevant with the response time and recovery time.

CIOP2019-2019-000248

An optic microfiber sensor based on Dopamine molecular imprinted for ultra-sensitive CRP detection

Wenfu Lin[1], Yan Huang[1], Li-Peng Sun[1*], Bai-Ou Guan[1], Xin Liu[2], Wei Xue[2], Yi Zhang[2,3*]
1. Institute of Photonics Technology, Jinan University, China
2. Department of Biomedical Engineering, Jinan University, China
3. School of Life Science, South China Normal University, China

Abstract: An ultrasensitive, label-free sensor based on polydopamine (PDA) molecular imprinting technology was developed for C-reactive protein (CRP) detection and monitoring.

CIOP2019-2019-000249

A color-free enzyme-linked immunosorbent assays detector using an optical microfiber

Yan Huang[1], Mingjin Yang[1], Jiongshen Pan[1], Li-Peng Sun[1*], Bai-Ou Guan[1], Yi Zhang[2], Zonghua Liu[2]
1. Institute of Photonics Technology, Jinan University, China
2. Department of Biomedical Engineering, Jinan University, China

Abstract: An enzyme-linked immunoassay (ELISA) is a traditional clinical diagnosis method. In this paper, we demonstrated an optical microfiber detected for enhanced analytical sensitivity and achieved color-free detection in ELISA.

CIOP2019-2019-000274

Information processing on three-dimensional imaging lidar guidance: review and prospect

Minle Li, Yihua Hu
State Key Laboratory of Pulsed Power Laser Technology, National University of Defense Technology, China

Abstract: In this paper, we make a review on the 3D imaging lidar guidance information processing, and propose a reasonable development direction and trend prospect.

CIOP2019-2019-000309

Quasi-distributed temperature sensing using apodized fiber bragg grating array

Wenjing Gao[1], Hao Bi[1], Yangjie Li[1], Shan Jiang[2], Haihu Yu[1*], Desheng Jiang[1]
1. Wuhan University of Technology, China
2. Wuhan WUTOS CO., LTD, China

Abstract: An apodized fiber Bragg grating array was in-line fabricated on a drawing tower. The sidelobes were decreased by -21.9 dB. The grating array was used for quasi-distributed temperature sensing. The temperature sensitivity is 10.15 pm/℃ .

CIOP2019-2019-000313

Sensing properties of tapered optical fiber coated with atactic polystyrene thin film

Jing Yao[1], Haihu Yu[1], Yangjie Li[1], Huazhang Yu[2], Yuqi Zhu[2], Jianxia Liu[1,2*]
1. National Engineering Laboratory for Fiber Optic Sensing Technology, Wuhan University of Technology, China
2. School of Electrical and Information Engineering, Hubei University of Science and Technology, China

Abstract: An optical mode interference type biosensor consisting of a tapered fiber with APS film is demonstrated. The sensing properties are experimentally investigated. The sensitivity of the coated fiber is much higher than the uncoated fiber.

CIOP2019-2019-000371

Multi-mode high-dynamic-range photodetecting scheme based on the novel gate-controlled lateral thyristor

Keyang Sun, Liyang Pan
Institute of Microelectronics, Tsinghua University, China

Abstract: A novel gate-controlled lateral thyristor (GC-LT) and a pixel circuit featuring intrinsic high dynamic range more than 140dB.

CIOP2019-2019-000373

Compact data acquisition system for micro spectrometer

Longping Huang[1,2], Likun Hu[2], Ming Yu[1], Yongqing Geng[3], Hui Lin[1,3*]
1. Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China
2. Guangxi University, China
3. Shenzhen Key Laboratory of Precision Engineering, China

Abstract: This paper introduces a compact data acquisition system for micro spectrometer. This system has smaller size and lower cost, making it suitable for use in micro spectrometer.

CIOP2019-2019-000388

Multispectral three-dimensional vein imaging system

Jinzhou Ge, Xiaowen Wang, Xiaotian Lou, Jing Han, Lianfa Bai
Nanjing University of Science and Technology, China

Abstract: Multi-spectral three-dimensional venous imaging system for non-invasive real-time imaging of venous disparity map and projection display,achieve deep vein non-invasive and real-time parallax imaging.

CIOP2019-2019-000394

Advanced space-time adaptive precision imaging

Hua LIU
Science and Technology on Electro-optic Control Laboratory, China, China

Abstract: Precision Imaging, as a challenging technology, is overcoming the limitation of space-time adaptability precisely, and imaging in the niche surrounding in tissues, blood flow fields and even nuclei of living organisms.

CIOP2019-2019-000526

Design of low noise processing technology based on digital domain

Dalei Yao
Xi'an Institute of Optics and Precision Mechanics of CAS, China

Abstract: In order to break through the bottleneck of traditional CCD camera in suppressing noise, this paper designs a new system of digital domain correlation double sampling.

CIOP2019-2019-000530

Er/Yb codoped double clad fiber modal interferometer and its applications in fiber sensor and laser

Hening Yang[1], Bo Dong[1*], Wei Zhao[1], Enqing Chen[2], Yang Li[2], Jinhai Si[3]
1. State Key Laboratory of Transient Optics and Photonics, Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Science, China
2. University of Chinese Academy of Sciences, China
3. School of Electronics and Information Engineering, Xi'an Jiaotong University, China

Abstract: Tunably sensitive refractive index sensor and tunable fiber laser based on Er/Yb Codoped Double Clad Fiber Modal Interferometer are proposed and demonstrated.

CIOP2019-2019-000535

High sensitivity fiber acoustic sensor probe based on L-shaped polymer microstructure fabricated by two-photon polymerization technique

Min Li, Jiwen Yin
College of Physics and Intelligent Manufacturing Engineering, Chifeng College, China

Abstract: An ultracompact fiber acoustic sensor probe based on L-shaped polymer microstructure was fabricated by using two-photon polymerization technique.

CIOP2019-2019-000536

Influence of Electronic Filter Bandwidth on the performance of frequency-scanning BOTDR

Qinglin Wang, Qing Bai, Hang Gu, Wei Yan, Changshuo Liang, Jingsheng Li, Baoquan Jin

Key Laboratory of Advanced Transducers and Intelligent Control Systems, Ministry of Education, Taiyuan University of Technology, Taiyuan 030024, China, China

Abstract: This paper mainly analyzes the influence of electric filter bandwidth on measurement spectral width of BGS and spatial resolution of the frequency-scanning Brillouin optical time domain reflectometer (FS-BOTDR).

CIOP2019-2019-000558

Study on a fiber Bragg grating accelerometer based on push-pull compliant cylinders

Dakuan Yu

Northwestern Polytechnical University, China

Abstract: A compact double FBGs accelerometer based on push-pull compliant cylinders is presented. Experimental results show that the resonant frequency of the accelerometer is 640Hz, the sensor has a broad flat frequency range from 20 to 500 Hz, the sensitivity of the accelerometer is 48.5 pm/G.

CIOP2019-2019-000588

Fiber bragg grating acceleration sensor based on double hole beam structure

Wei Fan

Xi'an Shiyou University, China

Abstract: In this paper, the FBG accelerometer with double-hole beam structure is studied. The response characteristics of FBG accelerometer based on double-hole beam structure are mainly studied, including amplitude-frequency characteristics and linear response of acceleration.

CIOP2019-2019-000589

Theoretical and experimental study of the resonance frequency of fiber bragg grating accelerometer based on equal strength cantilever beam

Hong Gao[1*], Xueguang Qiao[2], Qinpeng Liu[1], Min Shao[1]

1. Xi'an Shiyou University, China

2. Northwest University, China

Abstract: An improved calculation for resonance frequency of triangle cantilever beam based fiber Bragg grating accelerometer by Rayleigh method has been theoretically and experimentally demonstrated.

CIOP2019-2019-000680

Numerical simulation and measurement studies on the designed 3D Si SOI array microdosimeter

Shuhuan Liu, Kun Zhang, Zhuoqi Li

Xi'an Jiaotong University, China

Abstract: For evaluating and measuring microdosimetry magnitudes in radiobiology or other ionizing irradiation environment with semiconductor detector, a primary Si SOI microdosimeter with 3D cell-sized pixel sensitive volume and small dead area was proposed in this paper.

SC16 Atomic Physics, Quantum Photonics, and Quantum Information

CIOP2019-2019-000116

Compact all-fiber polarization-independent up-conversion single-photon detector

Longyue Liang[1], Junsheng Liang[2], Quan Yao[3], Mingyang Zheng[3], Xiuping Xie[3], Qiang Zhang[3,4*]
1. Jinan institute of quantum technology, China
2. Shandong Institute of Quantum Science and Technology Co., Ltd., China
3. Jinan Institute of Quantum Technology, China
4. University of Science and Technology of China, China

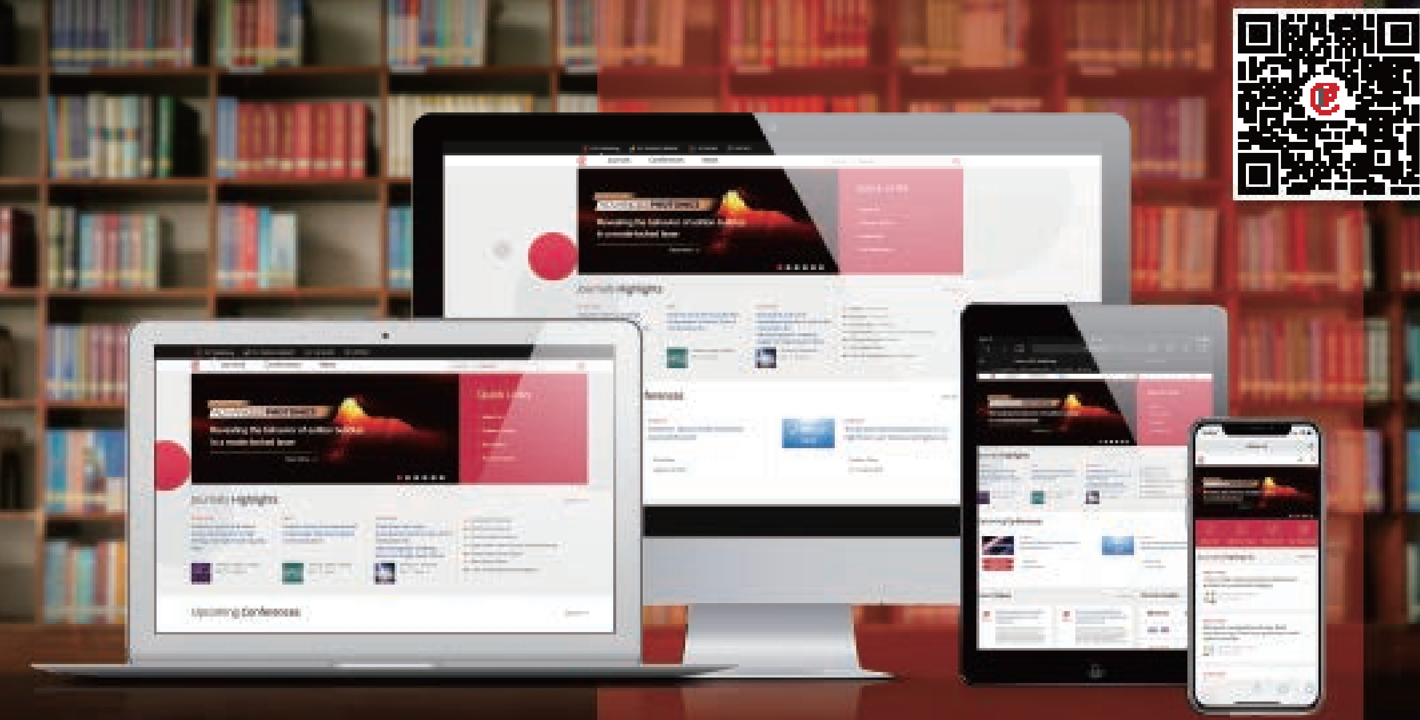
Abstract: We demonstrate a compact all-fiber polarization-independent up-conversion single-photon detector based on an integrated dual-channel periodically poled lithium niobate (PPLN) waveguide device in the polarization diversity configuration.

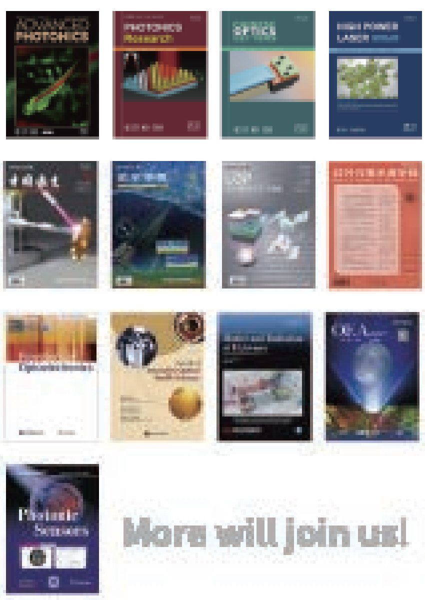
CIOP2019-2019-000333

Quantum-enhanced metal target detection based on quantum illumination

Lifei Li[1*], Yan Kang[1,2], Biao Wang[3,4], Yangcao Wu[5], Tongyi Zhang[1,2]
1. Xi'an Institute of Optics and Precision Mechanics, China
2. University of Chinese Academy of Sciences, China
3. Science and Technology on Electromagnetic Scattering Laboratory, China
4 .School of Electronic Engineering, Xidian University, China
5. The Northwest China Research Institute of Electronic Equipment, China

Abstract: We report the quantum-enhanced metal target detection based on quantum illumination, and experimentally verified that quantum illumination still helps low-reflectivity target detection in photon loss scenarios.





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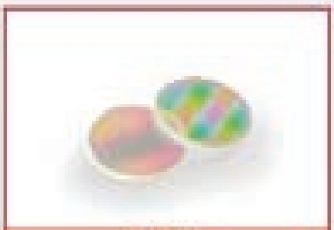
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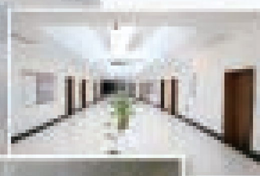
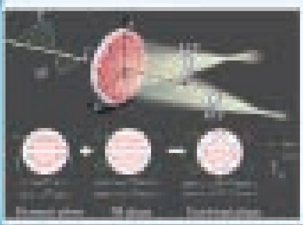
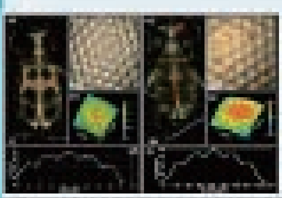


The State Key Laboratory of Transient Optics and Photonics (SKLTOP) was founded in 1991 and opened to international and domestic scientists from 1993. It had passed four times the national assessment, respectively, in 2002, 2007, 2012 and 2017. Professor Yao Baoli is the director of the Lab, and Professor Xu Tao is the director of academic committee of the Lab.

There are 97 research staffs in the Lab, including 1 CAS academician and 27 professors. There are 160 PhD & MSc graduate students studying in the Lab, majored in Optics, Optical Engineering, Physical Electronics, Communication and Information Processing, Signal and Information Processing. Two postdoctoral stations of Physics and Optical Engineering are set in the Lab.

The Lab has established widespread academic cooperation with institutions domestic and abroad including Germany, USA, UK, France, Austria, Italy, Japan, etc., promoting its reputation in the field of ultrafast photonics, and playing an important role as the base of opening academic exchange and cooperation. The Lab will keep strengthening the innovation ability, developing leading-edge techniques and training more high-level talents.





Main Research Fields:

1) Ultrafast Photonics: Theory, Technology and Application

Focused on femtosecond optical frequency comb, attosecond pulse generation and measurement, high power ultrashort pulsed fiber laser, microwave photonics, etc.

2) Advanced optical imaging

Focused on super-resolution and 3D imaging, quantitative phase imaging, computational imaging, polarization imaging, optical manipulation, freeform optics, etc.

3) Ultrafast diagnostic technology

Focused on streak camera, MCP-gated framing camera, all-optical solid-state framing camera, time-resolved electron diffraction, nonlinear photonics, large area photomultiplier, etc.

4) Ultrahigh speed optical information transmission, exchange and Processing

Focused on space high-speed long-distance laser transmission, optical switching, underwater wireless optical communication, etc.

5) Photofunctional Materials and Devices

Focused on Micro/Nano photonics, photonic integrated circuits, fiber-grating-based devices, Infrared glass fiber, Terahertz metamaterials, etc.

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Support institution: Xi' an Institute of Optics and Precision Mechanics, CAS.

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Contact: Ms. Li Ping, Duan Tao **E-mail:** Liping@opt.ac.cn, duantao @opt.ac.cn


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公司简介

上海屹桐光电科技有限公司依托于中国科学院上海光机所、中国激光杂志社和其他科研院所及高校的专家资源，经过发展已在光电产品研发选购和实验系统搭建方面积累了丰富的经验，并与国内部分高校知名的专家合作，共同建立激光应用研究协同中心，拓展光电技术服务业务。主要开展以下三个业务：

- 专业的实验室搭建方案和技术服务
- 高品质光学元件与光电设备销售
- 推广销售高校研究所的产品

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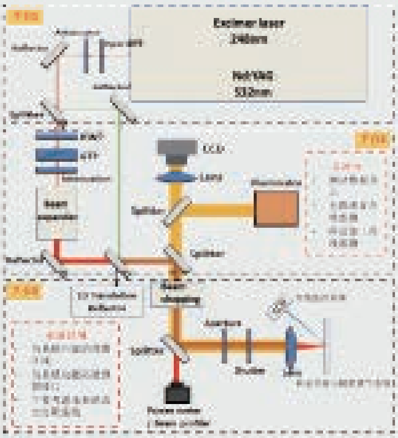
超快激光加工与微纳制造

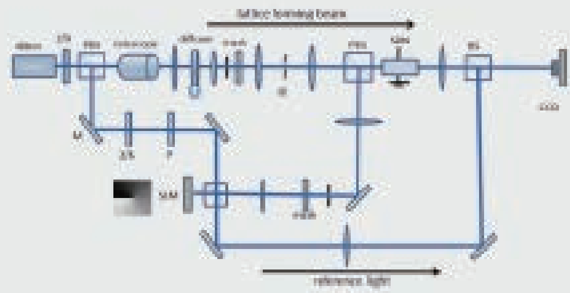
超快激光直写、双光子聚合、干涉光刻等为代表的激光微纳制造技术，已经成为举足轻重的先进制造核心技术。



激光直写微纳加工光路结构

激光光场调控、传输及应用

光场调控研究主要涉及光场调控原理和技术、调控光场传输机理和特性、新型光场与物质相互作用、光场调控技术应用等。



周期性结构中操控涡旋光实验系统

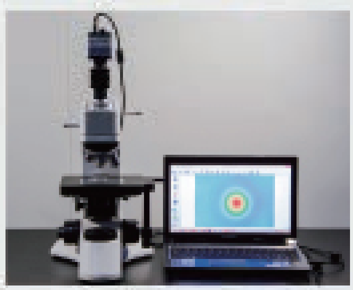
光学平台&隔振系统

- 蜂窝状芯板、U型滑槽台、研磨哑光台面
- 独特的水平调节机构，可以实现轻松水平调节的目的
- 稳定性高、隔振效果好
- 气浮隔振器垂直共振频率低至1.2Hz

光学元件

空间光调制器

数字全息显微镜



光功率计

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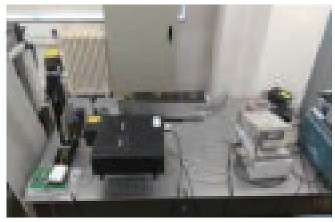
电话：021-80198332　E-mail:sales@oeshow.net

高精度激光测振仪

矩阵科技致力于为客户提供一系列尖端的光声系统-高精度激光测振仪。矩阵科技提供具有开放功能的超声卡、AD卡、相控阵超声等设备，用于系统集成。高精度激光测振仪利用激光脉冲在介质（组织）中产生超声波并利用激光检测超声回波（穿透和反射）。与传统的压电换能器技术相比，高精度激光测振技术可以重复产生很窄的超声脉冲，在时间和空间均具有极高的分辨率。高精度激光测振技术具有非接触、远距离探测、频带宽及检测可达性好等优点。

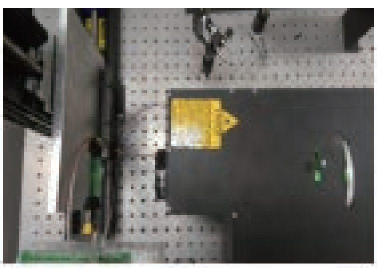
Quartet：高精度激光测振仪

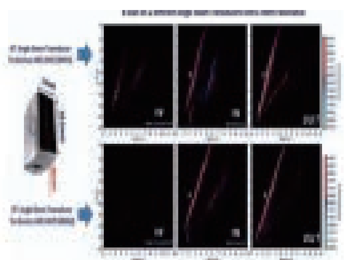
一个探测器相当于N个并行干涉仪；采用独特的数据处理技术；激光接收器基于多探测器的专利技术，适用于从实验室到工厂的各种声学和超声波应用。



Tempo：二维分量二波混频干涉仪

Tempo是适于实验室应用的理想化高精度激光测振仪，对于任意表面均能同时测量出面内位移和离面位移，精度可高达亚皮米级；与传统的干涉仪相比，Tempo使用大孔径的激光头以便能接收到更多的散射光束，这使得Tempo具有极高的灵敏度和信噪比。系统特点：可根据实际检测需要来选择最佳的检测带宽；可根据实际检测需要选择最佳的焦点尺寸以获得更高的分辨率；可同时测量面内和离面位移。





高精度激光测振仪应用：

高精度激光测振仪对于研究微纳结构中的声子与光子的相互作用，发展适用于微纳光子学器件的设计制备、性能表征及其光子学领域中的应用研究起着不可替代的重要作用。

在超声计量与测量领域，高精度激光测振仪（干涉仪）的横向分辨率真正实现了高频超声换能器表征的测量与计量。

在生物医学光子学领域，高精度激光测振仪实现了光声非接触测量，是一种无污染的检测方法。

专题
征稿

《光学学报》
“计算光学成像”

截稿日期
2019年8月31日

当今，成像技术飞速发展，光信号作为物理世界中最重要的信息载体之一，其各个维度（空间、时间、角度、光谱和相位）都能独立地以极高质量记录下来。与此同时，成像模型不断发展，光源、光学、传感器、光调制器等成像元件不断完善和创新，可以实现高维、高分辨率的连续光信号调制。另一方面，数字信号处理、计算机视觉、机器学习等研究领域正在取得跨越式进展，从而实现了更大规模、更高速高效的信息计算。这两个研究领域的协同交叉和碰撞促进了计算光学成像的诞生和发展。与依赖于现成成像设备的传统成像方法不同，计算成像技术系统地处理整个成像过程，以捕获高维、多尺度、多样性和高质量的视觉信息为目标，克服了传统成像方法的局限性，为生命和生物医学科学、材料科学、计算机视觉和图形等相关领域的发展带来了全新的视角和机遇。为此，《光学学报》计划于2020年第1期上推出“计算光学成像”专题。现特向广大专家学者征集计算光学成像相关原创性的研究论文（暂不接受自由来稿综述），旨在集中反映该领域最新的研究成果及研究进展。

征稿范围

光场计算成像 / 计算光谱成像 / 瞬态计算成像 / 数字全息计算成像 / 计算显微成像 / 阵面编码计算成像 / 去雾、去抖、去糊 / 暗光和弱光计算成像 / 医学计算成像（CT、MRI等） / 基于深度学习的智能成像与处理 / 宽视场高分辨计算成像 / 计算鬼成像 / TOF成像 / 单点探测计算成像 / 压缩感知计算成像 / 多维信号计算成像 / 单光子成像 / 多模态融合计算成像 / 遥感计算成像 / 计算成像的人工智能应用

投稿方式及格式

通过《光学学报》期刊官网“作者中心”直接进入投稿系统，按系统要求填写信息，上传稿件（作者留言中备注“计算光学成像”专题投稿）。投稿模板及要求请参见官网作者服务或者投稿系统作者中心首页。

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专题征稿

《中国激光》

截稿日期
2019年10月7日

“六十载激光与生物医学的融合发展”

自1960年第一台激光器诞生以来，经过60年的不断发展，激光已经融入到现代科学技术和社会经济的各个方向，特别是被广泛应用于医学科学和生命健康领域。生物医学光子学是激光与生物医学交叉融合衍生的新兴前沿学科，研究者利用激光与细胞或生命体相互作用的各种物理过程，发展新型光子学方法和技术，为生命健康领域中的重要科学与技术问题提供解决方案。

进入21世纪以来，生物医学光子学的研究发展如火如荼、日新月异，荧光蛋白、超分辨成像、光镊操控等技术先后获得了诺贝尔奖，这些重大突破进一步揭示了激光与生物组织相互作用的光物理与光化学机制、推动并促进了光学成像、光学诊断、光遗传和激光治疗与监测等方面的发展与临床应用。

为促进学术交流，推动相关领域向纵深发展，同时也为纪念第一台激光器发明60周年，特别是集中展示我国科研工作者在生物医学光子学领域的最新成果及研究进展，《中国激光》决定在2020年第2期推出“六十载激光与生物医学的融合发展”特别专题，现公开征集相关领域的高水平研究论文及综述。

投稿方式及格式

通过《中国激光》官网进入“作者中心”，按系统要求填写信息，上传稿件投稿（作者留言注明“六十载激光与生物医学的融合发展”专题投稿）。投稿模板及要求请参见作者中心首页或者《中国激光》官网。

征稿范围

- 多模态生物医学光子学融合成像技术
- 精准医学中的微纳检测新技术及仪器
- 在体纳米生物医学光子技术应用
- 医学光子治疗新方法、光动力治疗药物及临床应用
- 在体切伦科夫成像及太赫兹技术的作用机理
- 光学活体病理检测及在体光学诊断
- 光生物效应与调控机制
- 生物医学传感器、柔性可穿戴传感器件
- 荧光共振能量转移技术
- 生物信息精准获取与光信息处理
- 大数据及人工智能在医学光学图像识别与处理中的应用

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