OGC2019
Optoelectronics Global Conference

2019 Optoelectronics Global Conference

3-6 September, 2019

Shenzhen Convention & Exhibition Center (SZCEC), Shenzhen, China

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ORGANIZERS

IEEE Photonics Society

IEEE Photonics Society Guangdong Chapter

LOCAL HOST

CIOE CHINA INTERNATIONAL OPTOELECTRONIC EXPO

CIOEC 中国国际光电高峰论坛 CHINA INTERNATIONAL OPTOELECTRONIC CONFERENCE

Academic 亚昂学术

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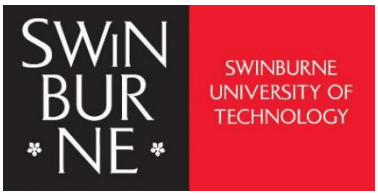
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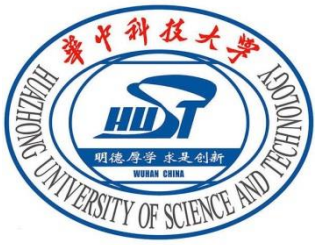
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WUHAN CHINA
HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY


1896
SHANGHAI JIAO TONG UNIVERSITY


BEIJING UNIVERSITY OF POSTS AND TELECOMMUNICATIONS
北京邮电大学


中国科学院
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CHINESE
ACADEMY OF
SCIENCES
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華南理工大學
1934
SOUTH CHINA UNIVERSITY OF TECHNOLOGY


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SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY
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中山大學
SUN YAT-SEN UNIVERSITY


1933
華南師範大學
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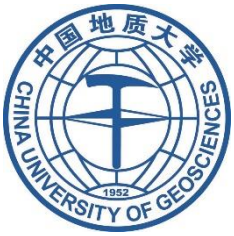
中国地质大学
1952
CHINA UNIVERSITY OF GEOSCIENCES


北京交通大学
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UNIVERSITY


四川大学
1896
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1958
CHANGCHUN UNIVERSITY OF SCIENCE AND TECHNOLOGY


SPIE.


SHENZHEN UNIVERSITY
深圳大學
1983

CONTENTS

ABOUT OGC 2019

The big leaps in optoelectronic technology and academia have drawn increasing attention from the industry community which is always in searching of innovative solutions. OGC was created to pave the way connecting optoelectronic academia and industry as well as connecting China and the rest of the world.

OGC 2019 will be held concurrently with the 21st China International Optoelectronic Exposition (CIOE) in Shenzhen. The conference aims to promote interaction and exchange of various disciplines among professionals in academia and industry at home and abroad. In addition, it also serves to turn technologies into industrial applications.

OGC will be an ideal platform for scholars, researchers and professionals to exchange insights and discuss the development of optoelectronics industry. It will be a perfect gathering to learn about new perspectives, technologies and trends which might pushes the boundaries of the technology and eventually creates a broader future for optoelectronics applications.

7 symposia are being arranged in the conference with the topics covering precision optics, optical communications, lasers, infrared applications, and fiber sensors. Welcome the professionals, experts, managements and students from the universities, research institutions, military enterprises, and optoelectronic companies to attend the conference.

Symposia

- Laser Technology
- Optical Communication and Networks
- Infrared Technologies and Applications
- Precision Optics
- Fiber-Based Technologies and Applications
- Optoelectronic Devices and Applications
- Biophotonics and Biomedical Optics

Special Session

- Optical fiber technology in endoscope

Workshop

- China Optoelectronics Industry and Policy Conference

PUBLISH WITH OGC 2019

Accepted papers after proper registration and presentation, will be published in the conference Proceedings by Conference Publishing Services, and reviewed by the IEEE Conference Publication Program for IEEE Xplore.

CONFERENCE COMMITTEE

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Haizhi Song
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Jinan University, China

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Qin Chen
Jinan University, China

S7. BIOPHOTONICS AND BIOMEDICAL OPTICS

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Special Session Chair

Special Session <Optical Fiber Technology in Endoscope>

Yunxu Sun
Harbin Institute of Technology, Shenzhen, China

Workshop Chair

Workshop <China Optoelectronics Industry and Policy Conference>

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AGENDA OVERVIEW

*** Conference Venue Note:**

Sign-in Site	5th Floor, SZCEC
Breakout Rooms	5th Floor, SZCEC - Lotus Hall (荷花厅); Rose Hall (玫瑰厅);
Main Conference Room	6th Floor, SZCEC - Jasmine Hall (茉莉厅);
Lunch Restaurant	B1 Floor, SZCEC (负一楼餐厅);
Banquet Restaurant	Jinhuangting Restaurant (金皇廷酒家) Located in Golden Central Tower, 3037 Jintian Rd, Futian District, Shenzhen City, China 深圳市福田区金田路与福华路交汇处，金中环商务大厦裙楼五楼（地铁会展中心 E 出口）

Sept. 03, 2019

Venue: 5th Floor, SZCEC

10:00-17:00 Participants Sign-in & Materials Collection

Venue: Lecture Hall, Research Building #1, Southern University of Science and Technology, China

13:30-18:00 Workshop: China Optoelectronics Industry and Policy Conference (For Applicants Only)

Sept. 04, 2019 – Morning Schedule

Venue: Jasmine Hall, 6th Floor, SZCEC

Chair Person: Perry Shum, Nanyang Technological University, Singapore

09:00-10:00 **Opening Ceremony:** Opening Speech, Leader's Speech

10:00-10:40 **Plenary Speech I Prof. Qingming Luo**
President of Hainan University, China
Speech Title: Brain-wide Positioning System for Brainsmatics

10:40-11:20 **Plenary Speech II Prof. Chennupati Jagadish**
President of IEEE Photonics Society, Australian National University, Australia
Speech Title: Semiconductor Nanowires for Optoelectronics Applications

11:20-12:00 **Plenary Speech III Prof. Xiang Zhang**
President of University of Hong Kong, China
Speech Title: Photonics beyond diffraction limit

12:00-12:10 **Group Photo**

12:10-13:30 **Lunch - B1 Floor Restaurant**

Sept. 04, 2019 – Afternoon Schedule

13:30-15:30 Technical Sessions

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*
Session No.	**T01***	**T02***	**T03***	**Special Session**

***T01** – **Laser Technology - A**

Invited Speeches (Huailiang Xu; Tao Zhu; Cunzhu Tong); Oral Presentations (C010; C023)

***T02** – **Optical Communication and Networks - A**

Invited Speeches (Hon Ki Tsang; Daoxin Dai; Xiang Li; David Li)

***T03** – **Infrared Technologies and Applications - A**

Invited Speech (Jijun Feng); Oral Presentations (C063; C068; C047)

15:30-16:00 Coffee Break

16:00-18:00 Technical Sessions

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*	*Lounge*
Session No.	**T04***	**T05***	**T06***	**Special Session**	**Poster Session***

***T04 – Optoelectronic Devices and Applications - A**

Invited Speeches (Xinlun Cai; Tao Chu; Zhiyuan Li); Oral Presentation (C014)

***T05 – Biophotonics and Biomedical Optics - A**

Invited Speeches (Linbo Liu; Guanghui Wang; Xuming Zhang)

***T06 – Fiber-Based Technologies and Applications - A**

Invited Speeches (Ho Wai Lee; Weihong Bi; Kan Wu; Feng Wang)

***Poster Session -** C002; C005; C008; C009; C011; C017; C018; C020; C021; C028; C039; C057

Sept. 05, 2019

9:00-10:30 Technical Sessions

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*
Session No.	**T07***	**T08***	**T09***	**T10***

***T07 – Laser Technology - B**

Invited Speeches (Xiaosheng Xiao; Tigang Ning); Oral Presentation (C064)

***T08 – Optical Communication and Networks - B**

Invited Speeches (Changyuan Yu; Tong Ye; Kei May Lau)

***T09 – Infrared Technologies and Applications - B**

Invited Speeches (Fansheng Chen; Xu Hu); Oral Presentation (C060)

***T10 – Optoelectronic Devices and Applications - B**

Invited Speeches (Yongjin Wang; Yaxin Zhang; Yong Zhang)

10:30-10:50 Coffee Break

10:50-12:20 Technical Sessions

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*
Session No.	**T11***	**T12***	**T13***	**T14***

***T11 – Biophotonics and Biomedical Optics - B**

Invited Speeches (Xunbin Wei; Sihua Yang; Jun Qian)

***T12 – Fiber-Based Technologies and Applications - B**

Invited Speeches (Lilin Yi; Yongkang Dong; Zhenggang Lian)

***T13 – Fiber-Based Technologies and Applications - C**

Invited Speeches (Fei Xu; Xinyu Fan; Jun Yang)

***T14 – Optoelectronic Devices and Applications - C**

Invited Speeches (Lin Yang; Xiaobo Xing; Xiangfei Chen)

12:20-13:30 Lunch - B1 Floor Restaurant

13:30-15:30 Technical Sessions

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*
Session No.	**T15***	**T16***	**T17***	**T18***

***T15 – Laser Technology - C**

Invited Speeches (Chunxiang Xu; Luming Zhao; Xiaohui Li); Oral Presentation (C082)

***T16 – Optical Communication and Networks - C**

Invited Speeches (Jie Zhang; Xiaoguang Zhang; Bin Chen; Jianping Li); Oral Presentation (C004)

***T17 – Infrared Technologies and Applications - C**

Invited Speeches (Zhichuan Niu; Zhenghua An; Kaikai Xu); Oral Presentations (C033; C070)

***T18 – Precision Optics - A**

Invited Speeches (Yaocheng Shi; Guijun Li; Xiahui Tang; Jingping Zhu)

15:30-16:00 Coffee Break

16:00-18:00 Technical Sessions

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*	*Lounge*
Session No.	**T19***	**T20***	**T21***	**T22***	**Poster Session***

***T19 – Optoelectronic Devices and Applications - D**

Invited Speeches (Yu Yu; Tianye Huang; Jianjun He)

***T20 – Optical Communication and Networks - D**

Invited Speeches (Chongjin Xie; Fan Zhang; Zhi Liu; Aiqun Liu); Oral Presentations (C012)

***T21 – Fiber-Based Technologies and Applications - D**

Invited Speeches (Shuhui Liu; Chi Chiu Chan); Oral Presentations (C016; C072; C084)

***T22 – Biophotonics and Biomedical Optics - C**

Invited Speeches (Tianxun Gong; Aaron Ho); Oral Presentations (C053; C075)

***Poster Session -** C051; C056; C058; C059; C062; C071; C077; C078; C079; C080; C086

18:30-20:00 **Banquet** (Non-student Registration Only)

Sept. 06, 2019

9:00-10:30 **Technical Sessions**

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*	*Lotus Hall 5*
Session No.	**T23***	**T24***	**T25***	**T26***	**T27***

***T23 – Infrared Technologies and Applications - D**

Invited Speeches (Weidong Wu; E Wu); Oral Presentations (C025; C054)

***T24 – Laser Technology - D**

Invited Speeches (Chengbo Mou; Jianfeng Li)

***T25 – Fiber-Based Technologies and Applications - E**

Invited Speeches (Fufei Pang; Bo Lin; Baishi Wang)

***T26 – Precision Optics - B**

Invited Speeches (Zhihua Li; Jianwen Dong; Nan-Kuang Chen)

***T27 – Infrared Technologies and Applications - E**

Invited Speeches (You Wang; Zhenzhou Cheng)

10:30-10:50 **Coffee Break**

10:50-12:20 **Technical Sessions**

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*
Session No.	**T28***	**T29***	**T30***	**T31***

***T28 – Infrared Technologies and Applications - F**

Invited Speeches (Guangwei Deng; Andrey Generalov); Oral Presentations (C031; C055)

***T29 – Biophotonics and Biomedical Optics - D**

Invited Speeches (Junle Qu; Zhilin Xu;); Oral Presentations (C038)

***T30 – Fiber-Based Technologies and Applications - F**

Invited Speeches (Songnian Fu; Yixin Zhang; Xuping Zhang)

***T31 – Optical Communication and Networks - E**

Invited Speeches (Shanguo Huang; Tianshu Wang); Oral Presentations (C026; C032)

12:20-13:30 Lunch - B1 Floor Restaurant

13:30-15:30 Technical Sessions

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*	*Lotus Hall 2*
Session No.	**T32***	**T33***	**T34***	**T35***

***T32 – Infrared Technologies and Applications - G**

Invited Speeches (Zaixing Yang; Jun Zhao); Oral Presentations (C046; C065; C074)

***T33 – Fiber-Based Technologies and Applications - G**

Invited Speeches (Zhifang Wu; Chao Wang; Nicolas Joly; Guiyao Zhou)

***T34 – Optoelectronic Devices and Applications - E**

Invited Speeches (Shangjian Zhang; Hau Ping Chan; Jianji Dong); Oral Presentations (C027; C061)

***T35 – Fiber-Based Technologies and Applications - H**

Invited Speeches (Minghong Yang; Xiaopeng Dong); Oral Presentations (C076; C081)

15:30-16:00 Coffee Break

16:00-18:00 Technical Sessions

Venue	*Lotus Hall 6*	*Lotus Hall 4*	*Rose Hall 1*
Session No.	**T36***	**T37***	**T38***

***T36 – Optoelectronic Devices and Applications - F**

Invited Speeches (Changzheng Sun; Liangming Xiong); Oral Presentations (C024; C067)

***T37 – Fiber-Based Technologies and Applications - I**

Invited Speeches (Changjian Ke; Xinyong Dong); Oral Presentation (C083)

***T38 – Biophotonics and Biomedical Optics - E**

Invited Speeches (Donghyun Kim; Hongbao Xin); Oral Presentations (C050; C066)

PLENARY SPEAKER

Qingming Luo
President of Hainan University, China

Qingming Luo is an elected Fellow of AIMBE, SPIE, OSA, IET and COS. He has been devoted to new techniques and novel applications in life sciences, including laser speckle imaging (LSI) and combination with optical intrinsic signal imaging (ISI), small animal imaging of fluorescence diffusion optical tomography (fDOT) coregistered with micro-CT, micro-optical sectioning tomography (MOST), and functional near infrared (NIR) imaging. He created “the most detailed three-dimensional map of all the connections between the neurons in a complete mouse brain” and “demonstrated the first long-range tracing of individual axons in the mouse brain” with BPS.

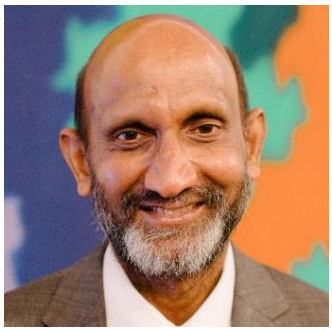
TALK ON

Brain-wide Positioning System for Brainsmatics

Abstract. Deciphering the fine morphology and precisely positioning the neurons and neural circuits are crucial to enhance our understanding of brain function and diseases. Traditionally, we have to map brain images to coarse axial-sampling planar reference atlases to orient neural structures, which might fail to orient neural projections at single-cell resolution due to position errors resulting from individual differences at the cellular level. In last one and half decade, my lab developed a Micro-Optical Sectioning Tomography (MOST) and several types of fluorescence MOST (fMOST), which is a novel combination of the microscopic optical imaging and the physical sectioning to obtain the tomographic information of a whole brain with sub-micron voxel resolution. In the first part of my talk, I will introduce the principles of Brain-wide Positioning Systems (BPS) which refers to MOST/fMOST serial techniques. In the second part of my talk, I will demonstrate how to brain-widely position the labelled neurons and neuronal networks, including whole-brain samples preparing, whole-brain optical imaging as well as massive brain-image processing and analyzing. The unique features of BPS include 1) robust absorption/fluorescence imaging, 2) multi-color imaging, 3) submicron voxel resolution for a single cm-size whole mouse brain, 4) automatic in sectioning, imaging and data acquisition, 5) no registration needed for 3-D imaging, 6) extensible for 3-D large scale imaging, potentially to 10 10 10 cm3. Based on BPS, we have acquired the first 3D structure atlas of whole mouse brain at single-neuron resolution; achieved tracing axonal pathways in the mouse brain without interruption for the first time; first dissected neural structures with anatomical annotation at single-neuron resolution; revealed the mechanism of fluorescent signal change in resin-embedded sample; realized the automatic tracing and reconstruction of neuronal populations with dense dendrites. We propose a new term: BRAINSMATICS, which refers to the integrated, systematic approach of measuring, analyzing, managing and displaying brain spatial data with unprecedented single-neuron resolution. The serial BPS have the advantages of high resolution, high throughput and long-time stability. With the brain-spatial information of neuron types, neural circuits, vascular networks and 3D fine brain atlas, we believe that brainsmatics makes it possible to better decipher genetically defined cell types and connectome.

PLENARY SPEAKER

Chennupati Jagadish
President of IEEE Photonics Society, Australian National University, Australia



Professor Jagadish is a Distinguished Professor and Head of Semiconductor Optoelectronics and Nanotechnology Group in the Research School of Physics and Engineering, Australian National University. He has served as Vice-President and Secretary Physical Sciences of the Australian Academy of Science during 2012-2016. He is currently serving as President of IEEE Photonics Society, President of Australian Materials Research Society. He is a visiting professor at Oxford Univ, hold honorary appointments at Oxford Univ, Tokyo Univ, National Taiwan Univ (distinguished chair professor), UESCTC-Chengdu (thousand talents short term professor), CIOMP-CAS, Nanjing Univ, Central South Univ-Changsha, Hefei Univ of Technology, Taiyuan Univ of Technology, Inst.of Chemical Technology-Mumbai, Anna Univ-Chennai and Mangalore Univ.

Prof. Jagadish is an Editor/Associate editor of 6 Journals (EIC: Progress in Quantum Electronics), 3 book series and serves on editorial boards of 19 other journals. He has published more than 630 journal papers, holds 5 US patents, co-authored a book, co-edited 13 books and edited 12 conference proceedings and 17 special issues of Journals. He is a Fellow of the 9 Academies and 14 professional societies and won many awards.

TALK ON

Semiconductor Nanowires for Optoelectronics Applications

Abstract. Semiconductor Nanowires are considered as building blocks for the next generation electronics and photonics. In this talk, I will review our recent results semiconductor nanowires and nanomembranes for discuss about their optical and electronic properties. I will discuss control of crystal phases and associated changes in optical properties. I will present results on nanowire lasers, nanowire THz photodetectors and polarizers, use of nanowires for energy and neuroscience applications. I will also discuss about the future prospects of nanowires.

PLENARY SPEAKER

Xiang Zhang
President of University of Hong Kong, China

Professor Xiang Zhang was appointed the 16th President and Vice-Chancellor of the University of Hong Kong (HKU) on December 15, 2017.

Prior to joining HKU, he was the inaugural Ernest S. Kuh Endowed Chair Professor at the University of California, Berkeley, and the Director of the Nano-scale Science and Engineering Center (SINAM). He has also served as the Director of Materials Science Division at Lawrence Berkeley National Laboratory (LBNL).

Professor Zhang is an elected member of the US National Academy of Engineering (NAE) and of Academia Sinica, a foreign member of the Chinese Academy of Sciences, and a Fellow of the American Physical Society (APS), the Optical Society of America (OSA), the American Association for the Advancement of Science (AAAS), and the International Society of Optical Engineering (SPIE).

Professor Zhang received his PhD from UC Berkeley (1996), MS from the University of Minnesota and MS/BS from Nanjing University, China. He was an assistant professor at Pennsylvania State University (1996-1999), and associate professor and full professor at UCLA (1999-2004) prior to joining Berkeley's faculty in 2004.

Professor Zhang's current research focuses on materials physics, metamaterials and nano-photonics. He has published over 340 journal papers including 70 publications in Science and Nature family series. He has given over 330 Keynote, Plenary and Invited talks at international conferences and institutions. He was a Co-Chair of the NSF Nano-scale Science and Engineering Annual Grantee Conferences in 2004 and 2005, and has served as Chair of the Academic Advisory Board for the Research Center for Applied Science (RCAS), Academia Sinica.

In 2008, Professor Zhang's research was selected by Time Magazine as one of the "Top Ten Scientific Discoveries of the Year" and "50 Best Inventions of the Year", Discover Magazine's "Top 100 Science Stories" in 2007, and R&D Magazine's top 25 Most Innovative Products of 2006. His research has been frequently featured in international media, including the BBC, CNN, ABC, New York Times, and Wall Street Journal.

Professor Zhang is a recipient of the NSF CAREER Award (1997), the SME Dell K. Allen Outstanding Young Engineer Award (1998) and the ONR Young Investigator Award (1999). He was awarded the Chancellor's Professorship by UC Berkeley (2004-2009), named Rohsenow Lecturer at MIT (2009) and William Reynolds Lecturer at Stanford (2012), and in 2017, chosen for the Pearsall Distinguished Lecture at Duke, the Hall Engineering Lecture at Vanderbilt, and the Towers Distinguished Lecture at Michigan Tech. In 2011, he was awarded the Fred Kavli Distinguished Lectureship by the Materials Research Society (MRS), the Miller Professorship by UC Berkeley, and named Distinguished Visiting Scientist (DVS) by the University of Toronto. He was awarded the Fitzroy Medal in 2014, the Charles Russ Richards Memorial Award in 2015, the Max Born Award from the Optical Society of America in 2016, the Julius Springer Prize for Applied Physics in 2016, the Excellence Award in Scientific Leadership in 2016, and the A. C. Eringen Medal from the Society of Engineering Science in 2017.

TALK ON

Photonics beyond diffraction limit

Abstract. TBA

WORKSHOP

Sept. 03, 2019 – Workshop (For Applicants Only)

China Optoelectronics Industry and Policy Conference

Chair: Ting Zhang, The Investment Association of China, the New High-Tech Investment Committee, China

Venue: Lecture Hall, Research Building #1, Southern University of Science and Technology, China

13:30-14:00 Signing

14:00-14:15 Guest Introduction

14:15-14:20 Leader Speech

14:20-15:30 Policy Analyzing

15:30-15:50 Coffee Break

15:50-17:30 RoundTable

17:30-18:00 Free Communication

INSTRUCTIONS FOR PRESENTATION

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For Oral Presentation

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The duration of a presentation slot is 15 minutes. Please target your lecture for a duration of about 12 minutes for the presentation plus ab. 3 minutes for questions from the audience.
A projector & computer will be available in every session room for regular presentations.
We suggest you bring a backup PDF-version of your presentation.

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For Poster Presentation

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A0 size (1189mm x 841mm, height > width) in Portrait mode.
We expect that at least one author stands by the poster for (most of the time of) the duration of the poster session, answering to the viewers who are interested in it.

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For Invited Speech

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The duration of a presentation slot is 30 minutes. Please target your lecture for a duration of about 25 minutes for the presentation plus ab. 5 minutes for questions from the audience.

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For Workshop

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Participants who wish to attend the workshop should submit the application form in the first place.
Attention should be paid to the time and the venue of the workshop.

Tips for Participants

- Your punctual arrival and active involvement in each session will be highly appreciated.
- The listeners are welcome to register at any working time during the conference.
- Get your presentation PPT or PDF files prepared.
- Regular oral presentation: 15 minutes (including Q&A).
- Laptop (with MS-Office & Adobe Reader), projector & screen, laser sticks will be provided by the conference organizer
- Please keep all your belongings (laptop and camera etc.) with you in the public places, buses, metro.

Sept. 04, 2019 – Technical Session 01

T01 - Laser Technology - A	
Invited Speeches (Huailiang Xu; Tao Zhu; Cunzhu Tong); Oral Presentations (C010; C023)	
Session Chair: Tianye Huang, China University of Geosciences (Wuhan), China	
Time: 13:30-15:30	**Venue: Lotus Hall 6**

13:30-14:00 Invited Speaker | **Huailiang Xu** | Jilin University, China

Huailiang Xu received his Ph.D degree in Physics from Lund University, Sweden in 2004. He then worked as a postdoctoral researcher at the Department of Physics, Laval University, Canada. In January 2008, he became an Assistant Professor at the Department of Chemistry, University of Tokyo, Japan. Since September 2009, he has been a full professor at Jilin University, China. His research interests include nonlinear laser spectroscopy, strong-field laser physics, laser fabrication, and atomic and molecular spectroscopy. He received National Distinguished Young Scholar from NSFC in 2016, and Zasshikai Lectureship Award from The University of Tokyo in 2018. He has published more than 150 papers in journals and 5 Springer book chapters

Air Lasing: Phenomena and Mechanisms

Abstract. Remote generation of population-inverted gain media in air is a promising step towards the realization of bright and coherent atmospheric lasers for a variety of atmospheric applications. In this talk I will demonstrate that both the major atmospheric constituents, that is, molecular oxygen and nitrogen, can be population-inverted by intense laser pulses, giving rise to forward or backward coherent emissions, popularly called “air lasing”. I will then present an overview of the generation of air lasing in nitrogen molecular ions N_{2+}, in which the establishment of population inversion is contrast to the common understanding that molecular ions generated by intense laser fields are prepared mostly in their electronic ground states. I will finally discuss the mechanism responsible for the population inversion of N_{2+} and show the result that the intensity of the air lasing can be well manipulated by molecular alignment and time-dependent polarization-modulated pulses.

14:00-14:30 Invited Speaker | **Tao Zhu** | Chongqing University, China

Tao Zhu received his Ph.D. degree in Optical Engineering from Chongqing University, China, in 2008. During 2010-2011, he was a Postdoctoral Research Fellow at the Department of Physics in University of Ottawa, Canada. Since April 2011, he is a professor of Chongqing University, China. Prof. Zhu has published over 200 papers in the international journals and the conference proceedings. Prof. Zhu is one of the associate editor of IEEE Photonics Journals and Opto-Electronic Engineering. His research focuses on lasers tuning technology and optical fiber sensing technology.

Compression Mechanism of Laser Linewidth and Its Applications

Abstract. With excellent properties of the high purity spectrum and long coherent length, narrow-linewidth lasers can be applied in many fields, such as optical quantum information, high-resolution spectroscopy and precise sensing. We proposed a fundamental route to achieve the deep compression of the laser linewidth and demonstrated that the Rayleigh Backscattering (RBS) as weak feedback is an efficient linewidth-compression mechanism to realize the route. We demonstrated theoretically and experimentally that the proposed linewidth compression methods can be applicable in both fiber lasers and semiconductor lasers.

14:30-15:00 Invited Speaker | **Cunzhu Tong** | Changchun Institute of Optics, Fine Mechanics and Physics, China

Cunzhu Tong is currently a professor of Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), and is the executive deputy director of State Key Lab of Luminescence and Applications. He received his PhD degree in Microelectronics from Chinese Academy of Sciences (CAS), and was the senior member of IEEE. He won the Outstanding Young Scientist Award, the Excellent Award for Hundred Talents Program of CAS, the Important Achievements in China Optics 2015, and Wang Daheng Optical Award. He has authored and co-authored 100 refereed journal papers and 17 patents. His current research interests include the high beam-quality semiconductor lasers, beam combining, and semiconductor disk lasers.

High Power high brightness semiconductor lasers

Abstract. High power semiconductor lasers are well established laser sources for a variety of applications, such as pump of solid state lasers and fiber lasers, material processing, medical treatment, space telecommunication and display technology. However, semiconductor lasers still suffer the drawbacks of far-field properties, including high divergence, ellipse beam, poor beam quality and injection sensitive far-field. In this talk, the approaches to engineer the modes in vertical and lateral direction of inner cavity and external cavity to improve the far-field properties were presented. These approaches lead to the significant improvement of beam quality and brightness of high power semiconductor lasers. Bragg reflection waveguide was used to control the vertical mode and low divergence (<5°) semiconductor laser with circular beam was demonstrated. The microstructures were used to engineer the lateral modes and high power low lateral-divergence broad-area semiconductor laser with injection insensitive far-field was realized. In the mode engineering of external cavity for the purpose of power scaling, several approaches were invented to break the beam-quality limitation of beam combining.

15:00-15:15 Oral Presentation C010

Fiber-based Lyot-filter using in broad spacing dual-wavelength modelocked fiber laser generation

Yuanjun Zhu, Xiangnan Sun, Lei Jin, Sze Yun Set and Shinji Yamashita
University of Tokyo, Japan

Abstract. Dual-wavelength fiber laser generated from one laser cavity is now attracting more and more attention for the applications in Terahertz wave generation, microwave generation and dual-comb laser source. Generally speaking, techniques that can be used to generate dual-wavelength pulses from a mode-locked fiber laser include comb filters, comb filters combining with mode-locked technologies and programmable attenuator. However, it's hard to obtain broadband spacing dual-wavelength fiber laser by using comb filters because of the small free spectrum range (FSR) induced by comb filters. Also, by just inserting attenuator into the laser cavity, stable dual-wavelength pulse laser is difficult to be generated for the hardness to control the gain tilt of Erbium doper fiber (EDF). In this report, a short length Lyot-filter is utilized in the laser cavity to obtain dual-wavelength mode-locked fiber laser output.

15:15-15:30 Oral Presentation C023

A Fast Acquisition Strategy of Laser Communication on Airship Platform by Small Divergence Angle Composite Scanning

YunJie Teng, Shoufeng Tong
Changchun University of Science and Technology, China

Abstract. In this paper, we designed and optimized the ship-to-airship capture scheme of laser communication system according to the characteristics of airship platform. A composite scanning strategy was proposed to solve the problem of the long capture time under the condition of small divergence angle and far distance. The working principle of this composite scanning strategy and the influencing factors in the capture process were analyzed

emphatically, meanwhile, LABVIEW was used to simulate the process. It is proved that the capture strategy saved a lot of capture time of dynamic laser communication between the airship and the ship. The simulation results show that the acquisition time is better than Existing modes.

Sept. 04, 2019 – Technical Session 02

T02 - Optical Communication and Networks - A	
Invited Speeches (Hon Ki Tsang; Daoxin Dai; Xiang Li; David Li)	
Session Chair: Anhui Liang, Guangdong University of Technology, China	
Time: 13:30-15:30	**Venue: Lotus Hall 4**

13:30-14:00 Invited Speaker | **Hon Ki Tsang** | The Chinese University of Hong Kong, China

Hon Ki Tsang received the Bachelor of Arts (Hons.) , and Ph.D. degrees from the University of Cambridge, in 1987 and 1991 respectively. He joined The Chinese University of Hong Kong as a Lecturer in 1993, becoming Associate Professor in 1996 and Professor in 2003. In 2002 he worked at Bookham Technology plc where he helped develop some of its commercially deployed silicon photonic integrated circuits products. He returned to Chinese University of Hong Kong in 2003 and served as the Chairman of the Department of Electronic Engineering from 2010 to 2016. He is currently the Associated Dean (Research) of the Faculty of Engineering. He has co-authored about 400 papers in journals and conferences. His research interests include photonic integrated circuits, silicon photonics, nonlinear waveguides, hybrid integration of two-dimensional materials, optical communications, and integrated quantum photonics. He is currently the Editor-in-Chief of the IEEE JOURNAL OF QUANTUM ELECTRONICS. He is a Fellow of IEEE and Fellow of OSA.

Silicon Photonics for Advanced Communications

Abstract. We review our recent work on advanced waveguide grating couplers for space and mode division multiplexing and describe some of our recent implementations of advanced photonic circuits for advanced modulation formats and coherent communications.

14:00-14:30 Invited Speaker | **Daoxin Dai** | Zhejiang University, China

Daoxin Dai received the Ph.D. degree from the Royal Institute of Technology, Stockholm, Sweden, in 2005. He joined ZJU as an Assistant Professor in 2005 and became a Full Professor in 2011. He worked at the University of California, Santa Barbara, USA, during the years of 2008-2011. Currently he is the QIUSHI Distinguished Professor at ZJU and is leading the Silicon Integrated Nanophotonics Group and the Joint International Research Laboratory of Photonics (Ministry of Education). 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 >75 keynote/invited talks and served as the TPC Chair/Member for many 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).

Silicon photonic devices for optical communications

Abstract. In this talk, the recent progress of silicon photonic devices for optical communications will be reviewed. Here we will focus on novel silicon photonic devices with structural asymmetry and higher-order modes, which have been developed very well and have been attractive for realizing high-capacity optical communication systems. It includes the following parts: (1) on-chip polarization-handling devices; (2) on-chip mode manipulation devices; (3) on-chip wavelength-selective devices.

14:30-15:00 Invited Speaker | **Xiang Li** | Wuhan Research Institute of Post and Telecommunications, China

Xiang Li received the M.S. degree in optics engineering from the Huazhong University of Science and Technology, China, in 2011, and the Ph.D. degree in electrical and electronic engineering from Nanyang Technological University, Singapore, in 2016.

He joined Wuhan Research Institute of Posts and Telecommunications, as a Member of Technical Staff in 2015. Since then, he has been primarily working on technologies for high-speed optical transport systems including advanced modulation formats, fiber nonlinearity and coherent optical transmission. He has authored and coauthored over 70 journal and conference papers.

High capacity coherent UDWDM-PON in optical access networks

Abstract. Optical access networks based on coherent detection and ultra-dense wavelength-division multiplexing (UDWDM) technology can provide higher network capacity, receiver sensitivity and number of users than previous direct-detection technology.

In this talk, we propose a coherent UDWDM/TDM-PON scheme for 1000 users including both downlink and uplink. The line card made of real-time digital signal processing for 10-Gb/s DP-QPSK each user is achieved by FPGAs at OLT and ONU sides. For experimental demonstration, a coherent UDWDM-PON scheme is realized based on C-band 1000×10-Gb/s downlink optical signals at 5-GHz channel spacing and L-band 200×10-Gb/s uplink optical signals at 12.5-GHz channel spacing over 40-km SSMF. The BER keeps below 7% FEC threshold of 3.8×10^{-3} for the 1000 users with 28 dB loss budget. As far as we know, this is the first real-time experimental demonstration of 1000 users in bidirectional PON systems.

15:00-15:30 Invited Speaker | **David Li** | Hisense Broadband, China

Dr. David Li is the CTO of Hisense Broadband. He received the BS from Shandong University and the MSEE from BUAA. He received the Doctor of Engineering degree from UESTC and the Ph.D. from University of Houston, respectively. Prior to join Hisense in 2003, he held a variety of positions as professor, principal design engineer, director of engineering and VP engineering in UESTC, Texas Center for Superconductivity, EL Electronics, Molex and Ligent Photonics. He has been involved in the design and manufacturing of the high-speed electrical, optical modules and subsystems for more than 25 years. Dr. Li has been participating actively with the customers, standard organizations and the industry in general to define and develop the new technologies in the future access networks. He lead the technical team developed the innovative EPON/GPON, 10G-PON, NG-PON1, NG-PON2 and WDM-PON modules successfully, which have been widely deployed around the world.

Optical Transceiver Technology and Trend

Abstract. The key optical transceiver technologies for optical access, datacenter and transport are reviewed in this presentation. The major technical challenges for the latest 5G wireless and data center applications are discussed. The possible solutions to improve the performance of the high speed modules, as well as the cost reduction efforts, will be elaborated.

Sept. 04, 2019 – Technical Session 03

T03 - Infrared Technologies and Applications - A	
Invited Speech Jijun Feng; Oral Presentations (C063; C068; C047)	
Session Chair: Haizhi Song, Southwest Institute of Technical Physics, China	
Time: 13:30-15:30	Venue: Rose Hall 1

13:30-14:00 Invited Speaker | **Jijun Feng** | University of Shanghai for Science and Technology, China

Jijun Feng received the B.S. and B.Eng. degrees from the University of Science and Technology of China, Hefei in 2005 and Ph.D. degree from the Shanghai Institute of Optics and Fine Mechanics, CAS, Shanghai in 2010. He worked as a postdoctoral research fellow and JSPS research fellow at the National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan, from 2010 to 2015. Then he joined the University of Shanghai for Science and Technology, as a Professor of Special Appointment (Eastern Scholar) at Shanghai Institutions of Higher Learning. He is currently a Professor in optical engineering. His research interests include ultrafast laser micromachining and photonic integrated devices and related applications.

Three-dimensional silicon nitride photonic integrated device based infrared filters

Abstract. This talk will present three-dimensional silicon nitride ($S_{i3}N_4$) photonic integrated device based infrared filters. $S_{i3}N_4$ is a promising wave-guiding material for integrated photonics applications due to its wide transparency bandwidth and the compatibility with CMOS technology. $S_{i3}N_4$-based passive devices offer a large fabrication tolerance, superior performance in the coupling and propagation loss, and convenience to realize three dimensional integration. Based on the three-dimensional $S_{i3}N_4$ platform, tunable racetrack resonators were also realized with a microring resonator on a bottom layer and a feedback cross-coupled waveguide on a top layer, which can realize different filtering performance with effective wavelength tuning. The presented devices have a great potential to be applied as a tunable modulator/switch as well as a highly-sensitive sensor.

14:00-14:15 Oral Presentation C063

Broadband near-infrared frequency upconversion at single photon level

Jianhui Ma, Huiqin Hu, Yu Chen, Xiuliang Chen, Haifeng Pan, E Wu
East China Normal University, China

Abstract. We proposed and demonstrated high efficiency broadband near infrared single-photon upconversion and detection with a broadband pump laser. By using a pump laser with a spectral bandwidth of 10 nm, the signal single-photons centered at 1562 nm with a broadband bandwidth up to 7.2 nm was frequency-converted to the visible regime. A maximum conversion efficiency of 18.6% had been achieved.

The infrared single-photon has taken an indispensable position in many research fields, and various techniques have been investigated to detect infrared single photons. Frequency upconversion detection is one of the most promising method among them. In previous frequency upconversion process, the bandwidth of interacting signal and pump was severely restricted due to the requirement of phase matching. Here we proposed and demonstrated high efficiency broadband near infrared single-photon upconversion and detection with a broadband pump laser. By using a pump laser centered at 1040 nm with a spectral bandwidth of 10 nm, the signal single-photons centered at 1562 nm with a broadband bandwidth up to 7.2 nm was frequency-converted to the visible regime. We had achieved a maximum conversion efficiency of 18.6%, while the background noise was only 1.2×10^{-3} counts/pulse.

The setup consisted of the laser sources part, the frequency conversion part and the detection part. The signal and the pump sources were composed of two master-slave synchronized fiber lasers. The signal beam was produced by an Er-doped fiber laser (EDFL) centered at 1562.2 nm and its full width at half maximum (FWHM) was 9.1 nm. The

pump was produced by an Yb-doped fiber laser (YDFL) centered at 1040 nm, the FWHM of which was 10 nm. After polarization modulation and delay, the two beams were combined and focused into a PPLN bulk crystal with a quasi-phase matching period of 11 μm to produce the SFG. After filtering the spectrum of SFG was recorded by an optical spectrum analyzer (OSA). The temperature of the PPLN crystal and the delay between the signal and the pump were adjusted precisely to achieve the maximum conversion efficiency.

The power of signal was fixed at 26 μW, and the pump power was set at the maximum of 65 mW. The spectrum of the unconverted signal at the maximum of conversion efficiency was shown in Fig. 1 with comparison to the original incident signal spectrum. The light red shadow implies spectral components of the signal being converted to the SFG. The bandwidth of converted signal was 7.2 nm with the central wavelength at 1562 nm. The spectrum linewidth of the SFG was measured to be about 0.25 nm corresponding to a spectral compression factor of 28.8.

14:15-14:30 Oral Presentation C068

Modeling Background Response and Applications for Mid-infrared Remote Sensing Camera

Zhuoyue Hu, Xiaoyan Li, Xinyue Ni and Fansheng Chen*

Key Laboratory of Intelligent Infrared Perception, Shanghai Institute of Technical Physics, Chinese Academy of Sciences, China

Abstract. Radiometric calibration is necessary for the quantitative application of remote sensing camera data. Background response is a considerable portion of the total output especially for the MWIR/ LWIR cameras. However, it's undesirable signals which is need to be substracted from the total output in the calibration process. Usually, onboard radiometric calibration is completed by viewing the deep space and internal blackbody regularly. The fluctuation of instrument temperature leads to the variation of background response which can be up to 25.34% during approximately 800 days on-orbit. Due to the limit of scan pattern, the interval time between the two deep space view can be several days. Therefore, the accuracy of radiometric calibration is affected. Considering the long interval time of the view of deep space and its effect on radiometric calibration, we build a model to calculate the background response based on the thermal condition of Mid-infrared camera and it has been applied in the prelaunch and on-orbit data. Photons emitted from instrument can be collected by the detector and the model's variables are temperatures of instruments. To ensure the variable subset is significant, an independent variable selection method called step-regression is used.

In the prelaunch test, temperature of scan mirror, internal blackbody, primary mirror, optical path, rear optical path and dewar are added in the model. Here, a reference thermal condition is used in the calculation.

Compared with the pre-launch test, thermal condition becomes more complex on-orbit, especially for the temperature of hood which is largely influenced by the sunlight and other external light source. So the model is modified on-orbit. Two temperatures of hood are added in the model. Experiment results show that the range of residual is less than 3.68% and 3.26% in prelaunch and orbit data. The average and standard deviation of residual are -0.1822 and 9.7227 on-orbit, respectively. Once the temperatures of components in the system are transferred to the earth, background response can be updated timely.

14:30-14:45 Oral Presentation C047

A novel high-speed photon counting system with programmed dead time

Fei Yuan, Xiao-Long Lu and Li Jing

Southwest Institute of Technical Physics, China

Abstract. With high sensitivity at single photon level, Geiger-Mode (GM) avalanche photodiodes (APD) are widely used in spectrum measurement, 3D imaging, astronomical observation, biomedical and other fields. In this paper, a high-speed photon counting system is proposed with an active quench and reset integrated circuit (AQR-IC) that drives a near infrared InGaAs GM-APD. The avalanche current is converted into voltage signal by utilizing parasitic capacitance of APD and circuit's input port. Multi-stage inverters detect the induced voltage, and generate an output

TTL pulse indicating occurrence of avalanche event. At the same time, the active quench circuit is introduced to stop avalanche quickly. Then the active reset circuit makes APD working in Geiger mode after a programmable delay time which could be set by field programmable gate array (FPGA). The adjustable dead time enormously improve the flexibility of photon counting system applications. The proposed AQR-IC was fabricated in SMIC 0.18 μm CMOS process. Applied for InGaAs GM-APD, experimental results show that the circuit is capable of fast quenching and recovering. The system provides adjustable dead time from 64 ns up to 163.6 μs with a setting resolution of 20 ns, corresponding to a maximum counting rate of 15.6 MHz. The system can meet the application requirement of free-running mode detection.

Sept. 04, 2019 – Special Session

SS – Optical Fiber Technology in Endoscope	
Session Chair: Yunxu Sun, Harbin Institute of Technology, Shenzhen, China	
Time: 13:30-15:30	**Venue: Lotus Hall 2**

13:30-14:00 Invited Speaker | **Zhenxi Zhang** | Xi'an Jiaotong University, China

Advance on medical photonics

14:00-14:30 Invited Speaker | **Peng Qi** | Tongji University, China

Optical Fiber sensor for medical robotics

14:30-15:00 Invited Speaker | **Yingying Wang** | Beijing University of Technology, China

Special optical fiber and application

Sept. 04, 2019 – Technical Session 04

T04 – Optoelectronic Devices and Applications - A	
Invited Speeches (Xinlun Cai; Tao Chu; Zhiyuan Li); Oral Presentation (C014)	
Session Chair: Qin Chen, Jinan University, China	
Time: 16:00-18:00	**Venue: Lotus Hall 6**

16:00-16:30 Invited Speaker | **Xinlun Cai** | Sun Yat-sen University, China

Xinlun Cai received his PhD in Bristol University in U.K. in 2012, where he worked on design and fabrication of semiconductor ring lasers and silicon photonic devices for spatial division multiplexing. From 2012 to 2014, he worked as a postdoc in Bristol University for silicon quantum photonic devices. From 2014 to present, he worked as a full professor in Sun Yat-sen Univerisity.

High-performance hybrid silicon and lithium niobate Mach–Zehnder modulators

Abstract. Optical modulators are at the heart of optical communication links. Ideally, they should feature low loss, low drive voltage, large bandwidth, high linearity, compact footprint and low manufacturing cost. Unfortunately, these criteria have been achieved only on separate occasions. Based on a silicon and lithium niobate hybrid integration platform, we demonstrate Mach–Zehnder modulators that simultaneously fulfil these criteria. The high-performance modulator is realized by seamless integration of a high-contrast waveguide based on lithium niobate—a popular modulator material—with compact, low-loss silicon circuitry. The hybrid platform demonstrated here allows for the

combination of ‘best-in-breed’ active and passive components, opening up new avenues for future high-speed, energy-efficient and cost-effective optical communication networks.

16:30-17:00 Invited Speaker | **Tao Chu** | Zhejiang University, China

Prof. Tao CHU received the Bachelor of Science degree from Sichuan University, China, in 1991. He received the Master of Engineering and Doctor of Engineering degree from Kyoto Institute of Technology, Japan, in 1999 and 2002. From 2003 to 2011, he worked in NEC Central Research Laboratories and National Institute of Advanced Industry Science and Technology (AIST), Tsukuba, Japan, as a Principal Researcher and a Senior Manager, respectively, Tsukuba, Japan. From 2011 to 2016, he worked in Institute of Semiconductors, Chinese Academy of Science, Beijing, China, as a CAS Distinguished Professor. In 2017, he joined the college of Information Science and Electronic Engineering, Zhejiang University, Hangzhou, China, as a full professor and the director of ZJU Institute of Integrated Microelectronic Systems.

Silicon Photonics in China

Abstract. Accompanying the rapid developments of the big-data society, novel technologies for constructing high-speed and low-power-consumption data processing and communication systems are highly demanded. Silicon photonic integration is widely regarded as one of the most promising ways in various applications, due to the low-cost and high-density-integration of silicon photonic devices. In this presentation, the latest researches and developments on silicon photonic devices of most chinese academic research groups and some companies will be introduced, including silicon based laser, modulators, wavelength MUX/DeMUX, Mode MUX/DeMUX, polarization controller, EO/TO large-scale switches, photodetectors, with their designs, fabrications, measurements and future applications on optical network, high-performance computers, data-centers, microwave photonic radars.

17:00-17:30 Invited Speaker | **Zhiyuan Li** | South China University of Technology, China

Prof. Zhi-Yuan Li is a professor in School of Physics and Optoelectronics, South China University of Technology. Before this he worked in Institute of Physics, CAS 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 22,000 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 120 invited talks in international and domestic conferences.

Coherent White Laser from a Single Lithium Niobate Nonlinear Crystal

Abstract. We discuss design and realization of simultaneous multiple high-harmonic generation (HHG) (including 2-8 HG) and supercontinuum white laser from a single chirped periodic poled lithium niobate (CPPLN) nonlinear crystal. The CPPLN crystal offers a series of broad QPM bands with a considerably large effective nonlinear susceptibility to support high-efficiency cascaded three-wave mixing up-conversion processes. Visible-band supercontinuum white laser covering 350-1000nm can be created upon illumination of a mid-IR or near-IR femtosecond pulse laser with a conversion efficiency near 30%. The CPPLN nonlinear crystal opens up a new and powerful means to realize supercontinuum coherent laser encompassing an ultra-broadband from violet to visible and to infrared.

17:30-17:45 Oral Presentation C014

The study of Silicon Drift Detector fabricated by low-temperature process

Ke Tao, Shuai Jiang, Rui Jia
Institute of Microelectronics of the Chinese Academy of Sciences, Beijing, China

Abstract. In this paper, a low-temperature process was proposed to fabricate silicon drift detector. On the one hand, a stack of S_iO_2/AlOx/S_iO_2 was developed to passivate the undoped area of silicon substrate. The first SiO2 thin films were prepared by NAOS (nitric acid oxidation of silicon), and the second SiO2 layer was prepared by PECVD. AlOx was deposited by thermal ALD system. The sandwich structure of the oxidation layers provides excellent surface passivation of silicon substrate. Experimental results show that with the passivation structure of S_iO_2/Al2O3/S_iO_2, the effective minority carrier lifetime reaches 5223μs at an injection level of 5e10^{15} cm^{-3}. On the other hand, doped polycrystalline silicon thin films deposited by LPCVD was adopt for the drift rings and guard rings. By changing the deposition time and annealing temperature, a large sheet resistance value ranges from 2.5 to 36.5 kΩ/□ can be achieved and it is very convenient to adjust the sheet resistance precisely by controlling these two parameters. In addition to that, the polysilicon resistors have very low temperature coefficients and resistance values remainunchanged until the largest voltage of 200 V that the equipment can apply. The width of the polysilicon film strips can reach 2 μm and the uniformity of the polysilicon films is 6.14% on the whole 2 in. wafer, which makes polysilicon films very suitable for fabricating high-resistance voltage dividers in silicon drift detectors. By combination of surface passivation and low temperature polycrystalline silicon thin films, silicon drift detector was fabricated with a leakage current density lower than 1nA/cm2, and our detector successfully detected the x-ray signals from Am (241) source.

Sept. 04, 2019 – Technical Session 05

T05 –Biophotonics and Biomedical Optics - A	
Invited Speeches (Linbo Liu; Guanghui Wang; Xuming Zhang)	
Session Chair: Linbo Liu, Nanyang Technological University, Singapore	
Time: 16:00-18:00	**Venue: Lotus Hall 4**

16:00-16:30 Invited Speaker | **Linbo Liu** | Nanyang Technological University, Singapore

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. Currently, Dr Liu is with School of Electrical and Electronic Engineering and School of Chemical and Biomedical Engineering as an Associate Professor and 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.

High performance optical coherence tomography

Abstract. Optical coherence tomography (OCT) has been established as a routine diagnostic tool in the eye clinics. Over the past 20 years, the performances of OCT have been improved dramatically, such as speed, resolution, sensitivity and functional imaging capacity. However, the system cost has also increased as performances improve, which preclude its applications in resources limited areas. We aim to achieve high performances by use of novel technologies and strategies that simplify or maintain the current hardware system. We demonstrate that imaging sensitivity, resolution, and contrast can be improved without adding system cost.

16:30-17:00 Invited Speaker | **Guanghui Wang** | Nanjing University, China

Guanghui Wang received his Ph.D. degree from Nanyang Technological University, Singapore. He is an associate professor at Nanjing University, China. His research areas focus on the sensor technology of nano-optics devices and applications of micro-fluidic chips.

Hollow-core Fiber based all-fiber microfluidics ant its online Raman detection

Abstract. Based on hollow-core optical fiber, we demonstrate the all-fiber microfluidics including droplet generation, mixing, and focus on all-fiber online Raman detection. Raman spectroscopy is the predominant technique in principle, but its wide application is limited on account of weak scattering efficiency. Surface Enhanced Raman Spectroscopy (SERS) technique provides a solution for signal enhancement, but may not good at fast detection due to cross contamination and bulky instruments. Hollow-core fiber-based Raman cell with long interaction length can achieve high detection sensitivity, but it also suffers from low flow rate, bulky high-pressure equipment and light coupling structure, which also restricts its application for fast detection. In order to solve those problems, we proposed a portable Raman cell, by using metal-lined hollow-core fibers (MLHCF) with large bandwidth, good field confinement, extremely large numerical aperture and arbitrary length. With our proposed fiber inserted light coupling and light reflecting method, a Raman cell of 3.1 cm in length provides nearly 50 times of signal enhancement compared with direct detection using bare fiber tip. Furthermore, the sample exchange rate could be as fast as 1 second even under normal pressure without any cross contamination. Both the experiment results and the theoretical analysis demonstrated that our device has the potential for fast online Raman detection, which also possesses high-sensitivity and high-accuracy.

17:00-17:30 Invited Speaker | **Xuming Zhang** | The Hong Kong Polytechnic University, China

Xuming Zhang is currently an associate professor with Department of Applied Physics, Hong Kong Polytechnic University. He received BEng degree in Precision Mechanical Engineering from the University of Science & Technology of China (USTC) in 1994, and Ph.D. degree from School of Electrical & Electronic Engineering, Nanyang Technological University (NTU) in 2006. He has published more than 90 journal papers. His research interests cover mainly optofluidics, artificial photosynthesis, biomimetics and green energy.

Artificial photosynthesis of glucose from CO_2 using sunlight

Abstract. Recent years have witnessed a rapid increase of research interest in the conversion of solar energy into chemical energy. Our group has explored the microfluidics technology to generate glucose using CO_2 and sunlight by mimicking the natural photosynthesis, and have found that the optofluidic structures enable to cascade various steps of photosynthetic reactions while avoiding the common problems like enzyme deactivation, oxygen toxication, etc. New one-step fabrication method of artificial photosystem I (PSI) has also been developed using g-C_3N_4 and M. It shows an enhancement of the reaction speed by 23 times as compared to the control (here the bulk g- C_3N_4-slurry system).

Sept. 04, 2019 – Technical Session 06

T06 –Fiber-Based Technologies and Applications - A	
Invited Speeches (Ho Wai Lee; Weihong Bi; Kan Wu; Feng Wang)	
Session Chair: Weihong Bi, Yanshan University, China	
Time: 16:00-18:00	**Venue: Rose Hall 1**

16:00-16:30 Invited Speaker | **Ho Wai Lee** | Baylor University, USA

Howard (Ho Wai) Lee is currently Assistant Professor in the Department of Physics at Baylor University and IQSE Fellow and visiting professor in the Institute for Quantum Science and Engineering (IQSE) at TexasA&M. He was a Postdoctoral Fellow at the Caltech, working with Prof. Harry Atwater in active plasmonics/metasurfaces. He received his PhD in Physics from the Max Planck Institute for the Science of Light in Germany in 2012 under the supervision of Prof. Philip Russell (2015 President of OSA). His current research focuses on active linear, nonlinear, and quantum plasmonic/metasurface/zero-index optics, quantum biophotonics and imaging, “meta”-fiber optics, and hybrid photonic-plasmonic on-chip optical devices. His work on nano-optics, plasmonics, and photonic crystals has led to publications in various journals, such as Science, Nano Letters, Advanced Materials, ACS Photonics, and Laser & Photonics Reviews as well as 45 invited talks and 130 conference papers. Dr. Lee is a recipient of a 2018 NSF CAREER Award, a 2017 DARPA Young Faculty Award, a 2018 OSA Ambassador, a 2017 APS Robert S. Hyer Award, a 2018 Baylor Young Investigator Award, a 2016 Baylor Proposal Development Award, and a 2012 Croucher Postdoctoral Fellowship. His group has awarded for external grants with total amount of > $3.5M in the first three and half years at Baylor University. He currently serves as an Associate Editor for OSA Continuum and Nature Scientific Report journals.

Metasurface and epsilon-near-zero material integrated optical fiber devices

Abstract. Optical fiber is well-known example of a way to guide and manipulate light. It has been used extensively in various applications including long distance optical communication, light generation using fiber lasers, remote and optical sensing, fiber imaging in endoscopes, and fiber laser surgery. Although a dielectric optical waveguide is very efficient in transmitting light, its functionality is somewhat limited by the dielectric material of the core, which has poor electronic, magneto-optical, and nonlinear-optical responses and has the dielectric diffraction limit. Therefore, the optical properties of the optical fiber waveguide such as phase, amplitude, polarization state, and mode profile cannot be altered after the fiber drawing fabrication, thus limiting the development of novel in-fiber optical devices.

In this talk, I will present our study on “meta”-optical fiber by integrate novel optical metasurface and epsilon-near-zero material into fiber components for enhanced processing and transmission capabilities and novel functionalities. I will present recent results on “meta”-optical fiber by integrating metasurfaces with optical fibers to develop novel and ultracompact in-fiber optical devices such as an optical fiber metalens and color filter [1,2]. In addition, I will report a novel optical waveguide design of a hollow step index fiber modified with a thin layer of conducting oxide epsilon-near-zero materials. We show an excitation of highly confined waveguide mode in the proposed fiber near the wavelength where permittivity of conducting oxide material approaches zero [3]. These advanced “meta”/ENZ-optical fibers open the path to revolutionary in-fiber optical imaging and communication devices.

16:30-17:00 Invited Speaker | **Weihong Bi** | Yanshan University, China

Prof. Bi Weihong obtained her Ph.D from Harbin Institute of Technology in 2003 Now she is director of The Key Lab of Special Fiber and Fiber Sensor, Yanshan University. Her major research interests are fiber optic sensors and photoelectric detection. The projects in photonic crystal fiber fusion splicer, fiber optic current/voltage sensor, and sensing optical cable have been finished. More than 50 technical research papers had been published, and she obtained more than six patents. Due to the research work in fiber optic sensors and optoelectronic signal processing, she received second Awards for Scientific and Technological Advances from National Mechanical Industry Ministry and Hebei Province, third Awards for Technological Invention from Hebei Province, respectively.

Fish Density Optical Detection System for Marine Ranching

Abstract. China is a big country in fishery and aquaculture and have abundant freshwater resources and freshwater fish resources. Modern fishery farming is inseparable from systematic management. Online monitoring systems based on pattern recognition, machine vision, and artificial intelligence can exactly satisfy the requirement of industrial aquaculture. The online video surveillance system is proposed to analyze and process the video signals captured by the camera to realize localization of the farmed fish, and identification of size and quantity information of the fish. This system can not only reduce labor expenditures in fishery farming, but also respond to emergencies in a timely manner. Based on machine vision, this article has conducted in-depth research on key technologies such as image acquisition, image processing and image transmission in fish intelligent monitoring.

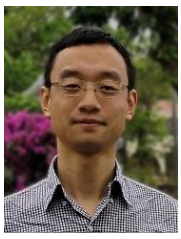
17:00-17:30 Invited Speaker | **Kan Wu** | Shanghai Jiao Tong University, China

Dr. Kan Wu is an associate professor in State Key Laboratory of Advanced Optical Communication Systems and Networks, Shanghai Jiao Tong University, China. Dr. Wu received his B.E. and M.S. degrees from Shanghai Jiao Tong University in 2006 and 2009, and Ph.D. degree from Nanyang Technological University in Singapore 2013. He was supported by Shanghai Yangfan Program in 2014. Dr. Wu's research interests mainly focus on high-speed pulse train generation including mode-locked lasers, nanomaterial saturable absorbers, and integrated opto-electronic technology. Dr. Wu has published more than 50 papers on Light Science and Applications, Physical Review X, Optics Letters and Optics Express, etc. including four ESI hot / highly cited papers. Dr. Wu has a citation more than 1300 and three >100-citation papers.

High-repetition-rate pulse train generation: From fiber laser to chip

Abstract. Pulse train near 1550 nm with high repetition rate and low noise provides a highly stable pulsed source for photonic signal processing as well as microwave photonic systems. We first review our work on fundamentally mode-locked fiber lasers for few-hundred-MHz repetition rate operation including the noise characterization, noise suppression and short-cavity mode locking . Then we discuss the high-speed pule train generation on an integrated chip for few-GHz repetition rate operation as well as pulse shape control.

17:30-18:00 Invited Speaker | **Feng Wang** | Nanjing University, China



Feng Wang, Ph. D., Associate Professor, Deputy Director of Institute of Optical Communication Engineering, Nanjing University. His research interest is mainly on the optical fiber sensing technology. He has published more than 50 SCI papers and one book chapter, and has more than 30 patents. He has won 3 first class prizes of ministerial and provincial-level awards.

Elimination of the impact of polarization in the Φ-OTDR assisted by UWFBG array

Abstract. The state of polarization (SOP) of lightwave has significant impact on the demodulation of Φ-OTDR's signal. In Φ-OTDR assisted by UWFBG array, we propose a composite-double-probe-pulse, which can effectively eliminate the impact of polarization. Moreover, we propose a method which can break the limitation of phase unwrapping for large amplitude signal by the combination of polarization signal and phase signal.

Sept. 04, 2019 – Special Session

SS – Optical Fiber Technology in Endoscope	
Session Chair: Yunxu Sun, Harbin Institute of Technology, Shenzhen, China	
Time: 16:00-18:00	**Venue: Lotus Hall 2**

16:00-16:30 Invited Speaker | **Shuang Song** | Harbin Institute of Technology, Shenzhen, China

Minimally invasive surgery robots

16:30-17:00 Invited Speaker | **Jianan Li** | Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China

Machine learning and endosocpy in medical application

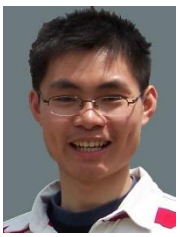
17:00-17:30 Invited Speaker | **Yunxu Sun** | Harbin Institute of Technology, Shenzhen, China

Imaging and sensing from Single multimode optical fiber

Sept. 05, 2019 – Technical Session 07

T07 – Laser Technology - B	
Invited Speeches (Xiaosheng Xiao; Tigang Ning); Oral Presentation (C064)	
Session Chair: Tianye Huang, China University of Geosciences (Wuhan), China	
Time: 9:00-10:30	**Venue: Lotus Hall 6**

9:00-9:30 Invited Speaker | **Xiaosheng Xiao** | Tsinghua University, China



Xiaosheng Xiao received the B.S. and Ph.D. degrees from Tsinghua University, Beijing, China, in 2002 and 2007, respectively. Then he moved to Nanyang Technological University, Singapore, as a Research Fellow. Since 2009, he has been with the Faculty in Tsinghua University. His research interests include pulsed fiber laser technique and its applications, optical fiber communications, and optical fiber sensor.

Spatiotemporal dynamics of multimode pulse in mode-locked multimode fiber lasers

Abstract. Spatiotemporal mode-locking, i.e., simultaneously locking of multiple transverse and longitudinal modes, is a more general form of mode-locked lasers compared to traditional lasers with only single transverse mode. Experimental observations and numerical analysis of several spatiotemporal self-organization effects, e.g. multipulsing, in multimode fiber lasers will be presented.

9:30-10:00 Invited Speaker | **Tigang Ning** | Beijing Jiaotong University, China

Prof. Tigang Ning, He received the Ph. D. degree in telecommunication and information system from Northern Jiaotong University, Beijing, China in 2003. He has engaged in two projects of Hi-Tech research and Development Program of China and two projects of National Natural Science Foundation of China. He has published more than 200 papers, and 70 authorized patents. His research interests include All-optical networking, high power fiber laser, fiber sensors and radio over fiber. He is New Century Excellent Talents in University

Recent progress and industrialization of key technology in high-power fiber laser

Abstract. High-power fiber lasers with exceptional properties, such as compact all-fiber designs, high efficiency and better beam quality, have attracted increasing attentions because of extensive applications in industry, military and

other fields. However, further output power scaling for fiber laser is posing a huge challenge. For one hand, there is a theoretical limit output power of single-mode fiber lasers, and for the other hand, the nonlinear effects, optical damage and transverse mode instability seriously limit further scaling of the output power from a single fiber. These two critical issues result in a pressing need for high power technologies. In this report, we introduce recent progress of high-power fiber lasers and analyze the present limitations for power scaling. Then, we discuss the advanced and critical techniques for power scaling in detail. According to basic requirements of power scaling for single-mode fibers, we proposed various large-mode-area (LMA) fibers to suppress nonlinear effects and transverse mode instability, such as LMA segmented cladding fiber with resonant ring, bend-resistant LMA segmented cladding fiber and LMA fiber with uniaxial crystal cladding. Aiming at achieving high output power and beam quality simultaneously, mode field and bending characteristics of those LMA fibers with novel fiber structures and optical material were theoretically investigated. Simulation results indicate that those proposed LMA fibers can mitigate nonlinear effects and transverse mode instability by achieving large mode area and single-mode operation. These excellent properties of the proposed LMA fibers are potential for developing a compact high power fiber laser and amplifier system. In addition, we introduce three settlements for improving threshold of Stimulated Brillouin Scattering (SBS) for high-power narrow linewidth amplifiers. These settlements can theoretically achieve high threshold of SBS by setting pressure or temperature gradient along fiber length. LMA fibers break through the limitation of single-mode fibers to improve output power for fiber lasers, while laser beam combining technology is expected to break through power scaling limitation of a single fiber. Finally, a high-power narrow linewidth fiber laser that can be employed to laser beam combining is introduced, and then we summarize prospects and some key applications of high-power fibers lasers.

10:00-10:15 Oral Presentation C064

Pulsed laser ablation in liquid synthesized $YGdO_3$:Er upconversion luminescent nanoparticles for optical thermometry

Zhen Liu, Dihu Chen

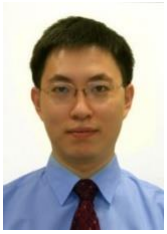
Sun Yat-Sen University, Guangzhou, China

Abstract. Rare earth Er^{3+} ions doped $YGdO_3$ (abbreviated as $YGdO_3$:Er) luminescent nanoparticles are prepared by pulsed laser ablation in liquid. The structural, morphology and upconversion properties of the sample are characterized by X-ray diffraction, Transmission electron microscope and photoluminescence spectra. Under excitation of 980 nm diode laser, it is observed near infrared to visible upconversion emission, exhibiting strong green emission bands and relative weak red emission bands. All emission bands show obvious stark splitting. Based on the green emission bands and their fluorescence intensity ratio, the optical thermometry properties are investigated in the temperature range of 300 K to 450 K. The constant sensitivity of linear temperature sensing reaches 0.0077K-1. Power dependent upconversion confirms the process of upconversion photoluminescence are two photons absorption and interaction. Based on the double exponential function, the lifetime of upconverison emissions are calculated. The characteristic average fluorescence lifetime values of green band are 370μs at 538 nm and 436μs at 563 nm. The fluorescence lifetime of red emission band is 808μs at 661nm.

Sept. 05, 2019 – Technical Session 08

T08 – Optical Communication and Networks - B	
Invited Speeches (Changyuan Yu; Tong Ye; Kei May Lau)	
Session Chair: Hongyan Fu, Tsinghua University, China	
Time: 9:00-10:30	Venue: Lotus Hall 4

9:00-9:30 Invited Speaker | **Changyuan Yu** | The Hong Kong Polytechnic University, China



Dr. Changyuan YU received his Ph.D. in Electrical Engineering from the University of Southern California, USA in 2005. He joined the faculty of National University of Singapore (NUS) in 12/2005, where he served as the founding leader of Photonic System Research Group in Department of Electrical and Computer Engineering. He was also a joint senior scientist with Institute for Infocomm Research (I2R), Agency for Science, Technology and Research (A*STAR) in Singapore. In 12/2015, he joined The Hong Kong Polytechnic University as a tenured associate professor in Department of Electronic and Information Engineering. And he also continues as an adjunct associate professor of NUS. His research focuses on photonic devices, subsystems, optical fiber communication and sensor systems, and biomedical instruments. He has authored/co-authored 6 book chapters and 400+ journal/conference papers (75 invited, including OFC2012 in USA). His group won 6 best paper awards in conferences and the championship in biomedical area in the 3rd China Innovation and Entrepreneurship Competition in 2014.

Non-invasive Health Monitoring System Based on Optical Fiber Interferometer

Abstract. Optical fiber communication systems and techniques can also be applied to sensing applications. Vital signs monitoring is a key tool in healthcare. Current monitors need invasive electronic sensors attached to user's body, which is inconvenient and uncomfortable. We demonstrate vital signs system based on sensor mat embedded with optical fiber interferometer. When a user simply lies/sleeps on the sensor mat, his/her breath/heartbeat will introduce slight strain changes on the mat and affect the light propagating within the fiber. Respiration/heartbeat waveforms can be achieved from the output light with signal processing. The system can collect the user's signals continuously and remotely to provide big data for health analysis.

9:30-10:00 Invited Speaker | **Tong Ye** | Shanghai Jiao Tong University, China

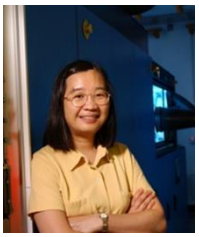
Tong Ye received the BS and MS degrees from the University of Electronic Science and Technology of China, Chengdu, China, in 1998 and 2001, respectively, and the PhD degree in electronics engineering from the Shanghai Jiao Tong University, Shanghai, China, in 2005. He was with the Chinese University of Hong Kong for one and half years as a postdoctoral research fellow. He is currently an associate professor at Shanghai Jiao Tong University, where he is with the State Key Laboratory of Advanced Optical Communication Systems and Networks. His research interests include the design of optical network architectures, optical network systems and subsystems, and silicon-ring- based optical signal processing. He is a member of the IEEE.

Modular AWG-based Interconnection for Large-Scale Data Center Networks

Abstract. Along with the recent surge in scale expansion of data centers, the interconnection scheme is facing a grave challenge. A huge amount of cables between the switches make the system maintenance and heat dissipation extremely difficult. A promising solution to this problem is using the arrayed waveguide grating (AWG), which can provide a set of wavelength links between its inputs and outputs. However, the scalability of the AWG-based interconnection scheme is restricted by the coherent crosstalk and the wavelength granularity of AWGs. In this paper, we propose a generic modular AWG-based interconnection scheme with scalable wavelength granularity for mega data centers. We first devise a matrix-based method to decompose the AWG into a three-stage network of smaller AWGs, while preserving the nonblocking wavelength routing property of the AWGs. We then

introduce the concept of wavelength independency based on the partitioning of the optical connections, such that modular AWGs in the network can reuse the same wavelength set with smaller granularity. We show that the proposed modular AWG-based interconnection network can simplify the cabling complexity of data center networks, while preserving the same function and bandwidth as the original data center network.

10:00-10:30 Invited Speaker | **Kei May Lau** | The Hong Kong University of Science and Technology, China



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 and OSA, 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 Applied Physics Letters, IEEE TED and Journal of Crystal Growth.

III-V Lasers Directly Grown on Silicon

Abstract. To fulfil the needs of energy-efficient high-performance computing and data-communication, increasing adoption and integration of optics and electronics using silicon photonics is necessary. Application of silicon photonic technologies to integrated systems will significantly impact future generations of high-performance and energy-efficient mobile and stationary data center systems, with much reduced form factor and power consumption. Design and implementation of compound semiconductor components on a silicon material platform for photonic and electronic integration is the most logical path forward. Most communication wavelength lasers with excellent device performance have been grown on III-V substrates and bonded to silicon. For monolithic integration, there are considerable advantages in a technology that allows growth and fabrication of such lasers on III-V/ Si compliant substrates. I will discuss recent success of III-V active medium with quantum dots grown on compliant III-V/Si substrates exhibiting excellent lasing characteristics in whispering-gallery-mode (WGM) micro-lasers and conventional Fabry Perot lasers emitting in the 1.3 -1.5 μm bands.

Sept. 05, 2019 – Technical Session 09

T09 – Infrared Technologies and Applications - B	
Invited Speeches (Fansheng Chen; Xu Hu); Oral Presentation (C060)	
Session Chair: Weida Hu, Shanghai Institute of Technical Physics, Chinese Academy of Sciences, China	
Time: 9:00-10:30	Venue: Rose Hall 1

9:00-9:30 Invited Speaker | **Fansheng Chen** | Shanghai Institute of Technical Physics, Chinese Academy of Sciences, China

He's a professor, doctoral advisor in ShangHai Institute of Technical Physics, CAS. He has been engaged in research on space-based infrared remote sensing and detection technology for a long time, and has presided over the development of several highly sensitive detection cameras. At present, he is a deputy chief of CASEarth satellite, and presides over the development of three high-sensitivity infrared payloads.

Wide-range high-resolution thermal infrared imaging technology

Abstract. The thermal infrared band can be used to measure sea surface temperature, land surface temperature and amount of water vapor in the atmosphere in remote sensing. Combined with the day/night band, it can effectively realize the depiction of human activity traces day and night. This report will introduce the current status and development trend of thermal infrared remote sensing, and discuss a new technology for swath width, high-resolution thermal infrared imaging.

9:30-10:00 Invited Speaker | **Xu Hu** | Kunming Institute of Physics, China

Hu Xu graduated from Chongqing University in 2005 with a Ph.D. in Circuits and Systems. During the early years of the Kunming Institute of Physics, he was involved in the development and production of pyroelectric sensors for the terminal sensitive bombs. As a major researcher involved in the "973" project, "Major Instrument Special Project", and the Natural Science Foundation Major Project, he was invited as a visiting professor at the Shanghai Institute of Ceramics of the Chinese Academy of Sciences. He then led the research and development of pyroelectric uncooled infrared focal plane detectors. Final identification test. Presided over the research and development of pyroelectric materials for the preparation of earth sensors, the performance of the device is comparable to that of imported detectors. In recent years, the large-scale infrared detectors applied for aerospace have been developed, and the performance of the devices is close to the engineering and practical level.

Large-Scale Infrared Detectors for Application in Aerospace

Abstract. With the development of domestic infrared technology, the demand for aerospace infrared detectors is increasing rapidly, and domestic research institutes and universities have set off a climax for large-scale infrared research and development of aerospace. In recent years, Kunming Institute of Physics has paid close attention to the use of infrared detectors for aerospace and has actively invested in related research and development. This paper will focus on the research and development of Kunming Institute of Physics in large-scale infrared detectors for aerospace in recent years, including high-performance fast-response pyroelectric devices for low-orbit satellite attitude control, for long-haul lines of high-orbit satellites, and column attitude sensor. In recent years, Kunming Institute of Physics has successively developed 2k×2k shortwave, 1024×256 shortwave, 1024×256 medium wave and 1024×100 long wave detectors. The paper finally pointed out the development direction of Kunming Institute of Physics in the future research and development of infrared detectors for aerospace.

10:00-10:15 Oral Presentation C060

Sensitive broadband infrared photon counting detection by nondegenerate two-photon absorption in silicon avalanche photodiode

Guangjian Xu, Xinyi Ren, Qucheng Miao, Ming Yan, Haifeng Pan, Xiuliang Chen, Guang Wu, and E Wu
East China Normal University, Shanghai, China

Abstract. Infrared light attracts the attention of many researchers because of its wide applications. However, the infrared photons are difficult to be detected because of their low photon energy. Therefore, one of the main tasks in the infrared light technology is to develop sensitive infrared detection at photon counting level. InGaAs avalanche photodiodes (APDs) and single-photon frequency upconversion because their shortcomings could not fully meet the requirements for applications. However, the nondegenerate two-photon absorption (ND-TPA) detector can generate photoelectrons directly for detection without requirement on the phase matching compare with frequency upconversion, thus it is capable of sensitively detecting the infrared signal light in a wide spectral range. We report on the sensitive detection of photons at broadband infrared wavelengths based on the nondegenerate two-photon absorption in the Si avalanche photodiodes. The detected 1700~1850 nm infrared photon energy is lower than Si band gap and the energy difference is complemented by a high intensity pump laser field at 1550 nm. The linear intensity response of the detector to the incident infrared photons was observed when the power of pump laser was about 12.42 μW, indicating the dominance of ND-TPA in the infrared photon detection. An enhancement factor of 20 was observed for the incident signal photon numbers of ~0.14×10^6 photons per pulse.
We recorded the photon-counting rate as a function of the relative delay between the pump and the signal beams as shown in Fig.1(a), which has been background-corrected by removing the noise offset caused by the D-TPA of pump and signal beams. When the two beams overlapped temporally, meaning that the pump light and the signal light reach the APD at the same time, the ND-TPA signal appeared. As the power of the pump beam increases from 0 to 12.42 μW, the slope of the counting rate is shown as a function of the incident photon flux, gradually decreasing from 2.02 to 1.13 in Fig.1(b). As gradually increasing the pump intensity, the dominance of D-TPA is getting weaker, while the ND-TPA is taking over the control. As a result, a larger than 20 times enhancement of the photon counting rate was recorded when the incident photon numbers of signal beam is approximately 0.14×10^6 photons per pulse. It can be considered as a direct proof of that the ND-TPA effect functions an effective sensitivity improvement of the silicon detector in the infrared regime.

Sept. 05, 2019 – Technical Session 10

T10 – Optoelectronic Devices and Applications - B	
Invited Speeches (Yongjin Wang; Yaxin Zhang; Yong Zhang)	
Session Chair: Yong Zhang, Shanghai Jiao Tong University, China	
Time: 9:00-10:30	**Venue: Lotus Hall 2**

9:00-9:30 Invited Speaker | **Yongjin Wang** | Nanjing University of Post and Telecommunications, China

Prof. Dr. Yongjin Wang held various research positions in Germany, Japan, and UK with the support of Alexander von Humboldt research fellowship, Japan Society for the Promotion of Science research fellowship, and the Royal Academy of Engineering research fellowship, respectively. Since 2011, he works with Nanjing University of Posts and Telecommunications as a professor. His main research interests include III-nitride monolithic circuit and subwavelength vertical-structure LEDs.

III-nitride monolithic photonic circuit

Abstract. Multiple-quantum-well (MQW) diode can detect the higher-energy photons emitted by the itself because the MQW-diode inherently exhibits the spectral overlap between the electroluminescence spectra and photocurrent

responsivity spectra, which is termed the simultaneous emission-detection phenomenon of the MQW-diode. According to this intriguing light-emitting light-detecting behavior, a variety of monolithic III-nitride photonic circuits, which integrates transmitter, waveguide, modulator and receiver into a single chip, are proposed, fabricated and characterized. The multicomponent system forms an in-plane light communication system for diverse applications.

9:30-10:00 Invited Speaker | **Yaxin Zhang** | University of Electronic Science and Technology of China, China

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.

High Speed GaN-HEMT THz modulator

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 GaN-HEMT modulator by combing the microstrip line and active GaN-HEMT 2DEG meta unit-cell. The experimental results show that such modulator can reach to more than 10Gbps modulation speed with 90% modulation depth. More important, this modulator can be integrated on chip for compact THz application systems.

10:00-10:30 Invited Speaker | **Yong Zhang** | Shanghai Jiao Tong University, China

Dr. Yong Zhang received the Ph.D. degree from Huazhong University of Science and Technology, Wuhan, China, in 2015. He joined Shanghai Jiao Tong University, Shanghai, China, as an assistant professor in 2015 and as an associate professor in 2019. His research interests include silicon photonics devices, polarization and mode devices, microcavity devices. Dr. Zhang has published over 65 journal and conference papers, including Advanced Optical Materials, Photonics Research, Optics Letters, Optics Express, APL Photonics, and OFC/ ECOC/ CLEO conferences and so on.

Dr. Zhang served as a guest editor of Science China Information Sciences (2017) and an editorial board member of Light & Laser: Current Trends (2017-), Journal of Semiconductors (2018-). He was the treasurer (2017-) and the secretary (2016-2017) of IEEE Photonics Society Shanghai chapter. He also served as a TPC member of international conferences. Dr. Zhang is a member of IEEE and OSA.

On-chip silicon mode, polarization and wavelength processing devices

Abstract. We discuss on-chip silicon mode-, polarization- and wavelength- processing devices. Firstly, we demonstrate a thermo-optic tunable filter with an ultra-high tuning efficiency of 21 nm/mW based on a suspended photonic crystal nanobeam cavity. Then, we experimentally demonstrate a silicon polarization splitter and rotator using a nonlinearly-tapered directional coupler. Next, we demonstrate a silicon on-chip high order mode (de)multiplexer using subwavelength grating (SWG) structure, which supports 11-mode (de)multiplexing on a TE polarized light (TE0–TE10). We also demonstrate a compact silicon waveguide mode converter using all-dielectric metasurface structure with a tilted subwavelength periodic perturbation. Finally, an on-chip silicon 2 × 2 mode- and polarization-selective switch that can route four data channels on two modes and two polarizations simultaneously is proposed and experimentally demonstrated.

Sept. 05, 2019 – Technical Session 11

T11 – Biophotonics and Biomedical Optics - B	
Invited Speeches (Xunbin Wei; Sihua Yang; Jun Qian)	
Session Chair: Liwei Liu, Shenzhen University, China	
Time: 10:50-12:20	Venue: Lotus Hall 6

10:50-11:20 Invited Speaker | **Xunbin Wei** | Shanghai Jiao Tong University, China

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 and Beckman Laser Institute 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 100 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.

Near infrared light therapy for treating Alzheimer's disease

Abstract. Alzheimer's disease (AD) is a chronic neurodegenerative disease. It is generally believed that there are some connections between AD and amyloid protein plaques in the brain. The typical symptoms of AD are memory and spatial learning difficulties, language disorders, loss of motivation and behavioral issues. Currently, the main therapeutic method is pharmacotherapy, which temporarily relieves symptoms, and yet brings with some side effects. Near infrared (NIR) light therapy has been studied in a range of single and multiple irradiation protocols in previous studies and was found beneficial for neuropathology. In our research, we demonstrated the effect of NIR light on AD through transgenic mouse model. We designed an experimental apparatus consisted of a box with a LED array emitting NIR light inside. After the treatment, we assessed the effects of infrared light by testing cognitive performance of mice in Morris water maze, and detecting plaque load by immunofluorescence analysis. Our results show that NIR therapy is able to attenuate the Aβ burden and cognitive deficits in the mouse model. It might provide a novel and safe way to treat AD.

11:20-11:50 Invited Speaker | **Sihua Yang** | South China Normal University, China

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 60 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.

Photoacoustic endoscopy for biomedical applications

Abstract. Photoacoustic endomicroscopy (PAEM), which enables internal organ imaging with high spatial resolution, has the potential for comprehensive biomedical applications. However, conventional PAEM suffers a rapidly deteriorated transverse resolution out of the focal zone owing to the short depth of focus (DOF). In this report, we

present several recently proposed methods for DOF extension, including (1) autofocusing PAEM, which employs a liquid lens to change the focal length; (2) large-depth-of-field PAEM, which exploits an elongated focus lens that produces Bessel beams to extend the DOF, and is therefore more suitable for real-time three-dimensional imaging; (3) scanning-domain synthesis of optical beams PAEM, which improves degraded transverse resolution caused by the light scattering in biological tissues. Additionally, we demonstrate a water-balloon-based boundary recognition technique to extract panoramic vascular networks layer-by-layer, and present in vivo experimental results suggesting its potential to provide clinicians with appropriate treatment protocols for colorectal diseases.

11:50-12:20 Invited Speaker | **Jun Qian** | Zhejiang University, China

Dr. Jun Qian received his bachelor and Ph.D. degrees from the Department of Optical Engineering of Zhejiang University in 2004 and 2009, respectively. He worked at Prof. Paras Prasad's Group in the University at Buffalo as a visiting scholar during the years 2006~2007. He visited Prof. Ben Zhong Tang's group in the Hong Kong University of Science and Technology at the end of 2016. He is now a professor in the College of Optical Science and Engineering, Zhejiang University. Dr. Qian's research work focuses on Biomedical-Photonics, especially deep-tissue and high-resolution in vivo multi-photon fluorescence microscopic bioimaging and NIR-II fluorescence bioimaging. He has published over 80 peer-reviewed SCI papers, and he is the first author or corresponding author of more than 50 papers (including 13 papers with IF>10 and 4 ESI highly cited papers). The published papers have been totally cited (by SCI papers) for more than 2000 times (one paper has been cited for over 250 times), and their H-index is 29. Dr. Jun Qian has given invited talks in international/domestic conferences for over 20 times. He has won 1 items of "first prize in Natural Science of Zhejiang Province". He is now a committee member of Society branch "Imaging Materials and Technology" in "Chinese Society for Biomaterials", and a vice-chairman of the youth working group in Society branch "Biomedical Optics" in "Chinese Society for Biomedical Engineering". He is the principle investigator of several research projects, including the Zhejiang Natural Science Funds for Distinguished Young Scholar, National Natural Science Foundation of China, sub-projects of the National Basic Research Program of China (973 Program) and the National High Technology Research and Development Program (863 Program).

NIR-II fluorescence in vivo functional bioimaging

Abstract. Fluorescence bioimaging in the second near-infrared spectral region (NIR-II, 900-1700 nm) can provide advantages of high spatial resolution and large penetration depth, due to low light scattering. In addition, since long-wavelength light with low photon energy is utilized as the excitation and less absorbed by the biological tissues, NIR-II fluorescence bioimaging also has low autofluorescence, as well as negligible photodamage towards biosamples. During the past few years, NIR-II fluorescence bioimaging has experienced rapid development. In this talk, I will introduce some recent research works about NIR-II fluorescence bioimaging, such as video-rate whole-body/brain/tumour angiography, organ imaging, as well as diagnosis and imaging guided treatment of tumour, on mice, monkeys and human beings.

Sept. 05, 2019 – Technical Session 12

T12 – Fiber-Based Technologies and Applications - B	
Invited Speeches (Lilin Yi; Yongkang Dong; Zhenggang Lian)	
Session Chair: Chi Chiu Chan, Shenzhen Technology University, China	
Time: 10:50-12:20	Venue: Lotus Hall 4

10:50-11:20 Invited Speaker | **Lilin Yi** | Shanghai Jiao Tong University, China

Lilin Yi, professor, vice head of Electronic Engineering Department, executive director of the State Key Laboratory of Advanced Optical Communication Systems and Network of Shanghai Jiao Tong University. His main research topics include high-speed optical communications, intelligent mode-locking fiber lasers, optical signal processing and machine learning based digital signal processing. Dr. Lilin Yi is the author or co-author of more than 160 papers in peer-reviewed journals and conferences, including invited papers/invited talks in JLT/OFC/ECOC. Dr. Yi has achieved the awards of “Young scholars of the Yangtze River in China”, and "National Science Fund for Excellent Young Scholars of China". He serves as the TPC member of OFC/OECC/CLEO-PR/ACP and TPC track/workshop/symposium co-chairs of OFC/ECOC/OECC/CLEO-PR/ACP. He is an associate editor of Optical Fiber Technology, and a guest editor of Applied Science.

Intelligent mode-locked fiber laser

Abstract. Programmable mode-locking is achieved in nonlinear polarization rotation (NPR) based mode-locking fiber laser enabled by mode-locking discrimination algorithm and fast polarization tuning algorithm. Q-switching, quasi mode-locking, fundamental, second-order and third-order harmonic mode-locking states can be automatically achieved in ~s level, recovered from failure in ~ms level and switched among different states in ~us level.

11:20-11:50 Invited Speaker | **Yongkang Dong** | Harbin Institute of Technology, China

Prof. Yongkang Dong was admitted into HIT in 1999 majored in Physical Electronics and received his bachelor and Ph.D. degree in 2003 and 2008, respectively. During 2008 to 2011, he was working as a Post-Doctoral Fellow in the Physics Department, University of Ottawa, Canada. In 2012, he re-joined HIT as a full professor. His current research interests involve nonlinear fiber optics and Brillouin scattering based optical fiber sensor and its applications in structural health monitoring. He has authored and coauthored more than 80 international journal papers. He is the recipient of the First Prize in Provincial Natural Science Award (2013), the Innovation Award of Chinese Society for Optical Engineering (2015), and the First Prize in Provincial Science and Technology Progress Award (2017). He is now the Chief Scientist of the National Key Scientific Instrument and Equipment Development Project of China.

Ultra-fast distributed Brillouin optical fiber sensing for dynamic strain measurement

Abstract. Recently, distributed optical fiber sensor systems based on Brillouin scattering have been extensively studied and discussed for structural health monitoring in diverse fields because they have the capacity for measuring the distributed strain and temperature. In several optical fiber sensing schemes, Brillouin optical time domain analysis (BOTDA) is widely concerned due to its good SNR, high spatial resolution and long-range sensing distance. However, due to the time-consuming averaging and frequency-sweeping processes, the classical BOTDA system is suitable for static or slow-varying strain measurements. In this paper, based on analyzing the operation principle of BOTDA, some main limiting factors for fast measurement are discussed. Then, some latest methods of dynamic measurement based on fast BOTDA are summarized and analyzed, including polarization compensation technique, frequency-agile technique, slope-assisted method, optical chirp chain technique, optical frequency comb technique.

11:50-12:20 Invited Speaker | **Zhenggang Lian** | Yangtze Optical Electronics Co., China

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 papers. 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. His research interests include design / optimizing specialty optical fibers and responsible for 10 national research projects; the main target applications are sensing, fiber laser and IR transmission. In industry, he has successful achieved total output value nearly 100 million RMB per year.

Development of fine diameter polarization - maintaining fiber and its potential application in miniaturized fiber optic gyroscope

Abstract. Fiber optics are small structure that is easy to deploy and install, thus has a profound impact in communications, sensing and laser fields. Considering a wide range of applications, the future development of optical fiber will be more complex in structures, more functions and the fiber-based devices are 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 of the report based on the developed ultra-fine diameter fiber, a fiber ring was fabricated, as small as 40mm in diameter. A tiny fiber gyroscope was assembled with an acceptable precision level. The opto-electronic sensing capability was demonstrated that combines multi- devices into a two-wheel mini balance car, include angle sensing, single line LiDar and even a vision function.

Sept. 05, 2019 – Technical Session 13

T13 – Fiber-Based Technologies and Applications - C	
Invited Speeches (Fei Xu; Xinyu Fan; Jun Yang)	
Session Chair: Xiangjun Xin, Beijing University of Posts and Telecommunications, China	
Time: 10:50-12:20	**Venue: Rose Hall 1**

10:50-11:20 Invited Speaker | **Fei Xu** | Nanjing University, China

Dr. Fei Xu received his Ph.D. in Optoelectronics in 2008 from the Optoelectronics Research Centre, University of Southampton, UK. He is currently a professor at the College of Engineering and Applied Sciences, Nanjing University, China. Dr. Xu's current research interests include developing novel fiber devices for ultra-small sensor and laser systems, the optomechanical effect in nano-scale waveguide systems. To date, he has authored or coauthored 8 book chapters, granted >30 patents (China and US), and >120 peer reviewed articles in academic journals in the previously mentioned areas. His papers have been cited more than 2500 times in Web of Science.

Flexible optoelectronic and optomechanical fiber devices based on two-dimensional materials

Abstract. All-fiber optoelectronic/ optomechanical devices have attracted great interest, however, most of those applications are severely limited because of the challenge of integrating optoelectronic materials (e.g., silicon and germanium) onto standard silica fibers. Here we will show several kinds of 1D and 3D TDM-microfiber-integrated devices and the optoelectronic and optomechanical applications (e.g., NEMS, modulator, detector and sensor) will also be discussed. In particular, an attachable and flexible smart sensor consisting of a hybrid TDM-microfiber resonator is demonstrated as ultrasensitive and wearable photonic sensor which covers the detection of strain and pressure.

11:20-11:50 Invited Speaker | **Xinyu Fan** | Shanghai Jiao Tong University, China

Prof. Xinyu Fan received his B.Sc. in Applied Physics (2000), M.Sc. in Optical Engineering (2003), from Shanghai Jiao Tong University, China, and a Ph.D. degree in Electrical Engineering (2006) from the University of Tokyo, Japan. In 2006, he joined NTT Laboratories as a research scientist. In 2012, he joined Shanghai Jiao Tong University as a professor in the Department of Electronic Engineering. His research interest focuses on optical fiber sensors, fiber applications, special optical fiber, fiber devices and systems, optical information processing. Prof. Fan has published over 100 journal articles and filed over 20 patents.

Dynamic strain measurement based on Brillouin backscattering signals in optical fiber

Abstract. This talk will present the advances on dynamic strain measurement based on Brillouin backscattering signals in optical fiber. Comparing to the measurement technologies based on Rayleigh backscattering signals in optical fiber, this technology enables to avoid the fading phenomenon caused by Rayleigh coherent signals. However, its disadvantage is the measurement speed since there is a necessary step of sweeping the frequencies to obtain the Brillouin gain spectrum. Recently, a slope-assisted method was proposed to skip this step and therefore significantly improved the measurement speed. In this invited talk, we mainly introduce two technologies of Brillouin optical time domain analysis (BOTDA) and Brillouin optical coherence domain analysis (BOCDA), and report the progresses on how to improve the system performance such as measurement speed, dynamic range, the accuracy on strain measurement, and the number of effective sensing points.

11:50-12:20 Invited Speaker | **Jun Yang** | Guangdong University of Technology, China

Jun Yang received the B.S. degree in optoelectronics, the M.Eng. degree in optical engineering, and the Ph.D. degree in optical engineering from Harbin Engineering University, Harbin, China, in 1999, 2002, and 2005, respectively. He is currently a Professor of Guangdong University of Technology.

His research interests include fiber optic sensors and optic interferometers. He has authored and co-authored over 280 technical articles mainly in the area of fiber optics and fiber optic sensors, including 250 Journal papers and 50 conference papers. He held 130 technique patents and published two books related to fiber optic technology. Moreover, he took on more than ten significant projects such as the National Key Scientific Instrument and Equipment Development Project, the National Natural Science Foundation of China, and the Key Fund Program. Besides, he was awarded the first prize of scientific and technological progress in Heilongjiang Province, the second prize of technological inventions by the ministry of education. In 2012, he was supported by the Program for New Century Excellent Talents in University. In 2014, he was supported by the Outstanding Youth Science Foundation.

High-precision optical polarization measurement and its application in gyro core device detection

Abstract. The report focuses on the latest advances in high-precision optical polarization measurement technologies and their applications in detection and diagnosis of gyroscope key components and light path. It includes the principles of polarization crosstalk measurement limit, dynamic dispersion compensation, and interferometric noise suppression as well as the methods of sensitivity enhancement, dynamic range improvement, and measurement length extension. The developed all-fiber optical coherent domain polarimeter (white light interferometer) and the high-precision measurement methods of gyroscope key components are successfully applied by organizations such as CASIC, CASC, CETC, CNIGC, and CSIC. For the research of high-precision fiber optic gyroscopes in China, they improve the test and R&D levels of the key components and provide key test technology and equipment.

Sept. 05, 2019 – Technical Session 14

T14 – Optoelectronic Devices and Applications - C	
Invited Speeches (Lin Yang; Xiaobo Xing; Xiangfei Chen)	
Session Chair: Xiangfei Chen, Nanjing University, China	
Time: 10:50-12:20	**Venue: Lotus Hall 2**

10:50-11:20 Invited Speaker | **Lin Yang** | Institute of Semiconductors, Chinese Academy of Sciences, China

Lin Yang received his Ph. D. degree in microelectronics and solid state electronics from Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China, in 2003. From 2003 to 2007, he was a postdoctoral fellow of Research Center for Integrated Quantum Electronics, Hokkaido University, Sapporo, Japan. In Sept. 2007, he received support from the "Hundred Talents" program of Chinese Academy of Sciences and joined the Institute of Semiconductors. He is currently a professor in State Key Laboratory of Integrated Optoelectronics, Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China. He received China National Funds for Distinguished Young Scientists in 2018. His research interests include silicon photonic devices and subsystems for optical interconnect, optical computing and optical communication. He is the author or co-author of more than 100 refereed scientific journal papers and over 30 patents. He has delivered more than 50 invited talks in the international conferences.

Silicon optical modulators for data centers and optical fiber communications

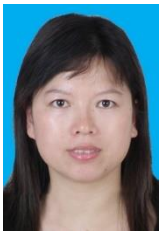
Abstract. Silicon photonics is considered as a promising technology to overcome the challenges of the existing data centers and optical fiber communications, such as explosively increased data stream and power consumption. Silicon optical modulator, as a device to transfer data from electronic domain to optical one, has attracted extensive attentions in the past decade. In this paper, I will review our efforts in developing high-speed silicon optical modulators for data centers and optical fiber communications.

Firstly, I will introduce how to optimize the modulation efficiency, optical loss, electro-optical bandwidth of the silicon optical modulator. The fabricated silicon optical modulator has an electro-optical bandwidth of up to 39.8 GHz. The device has the dynamic extinction ratios of 2.8 dB and 2.5 dB at the speeds of 90 Gb/s and 100 Gb/s for OOK modulation.

Secondly, I will introduce three types of silicon PAM-4 optical modulators. The first one is driven by a PAM-4 electrical signal. The second one is driven by two binary electrical signals with different peak-to-peak voltages. The third one is driven by a differential PAM-4 electrical signal, which has the modulation rate of 120 Gb/s and the bit error rate of 8×10^{-4}.

Finally, I will introduce a silicon 16-QAM optical modulator. The device can generates a 200 Gb/s 16-QAM optical signal with a bit error rate of 5.8×10^{-4}.

11:20-11:50 Invited Speaker | **Xiaobo Xing** | South China Normal University, China



Xiaobo Xing received the B. S. degree from Qufu Normal University, Qufu, China in 2002 and Ph.D. degree from Sun Yat-Sen University, Guangzhou, China in 2008. From 2009 to 2011, she was Postdoctor Fellow at Jinan University, Guangzhou, China. In 2011, he joined College of Biophotonics, South China Normal University, where she is presently a Professor. From 2015 to date, she was appointed Member of editorial committee from Scientific Reports. Prof. Xing was awarded a Second Class National Natural Science Award of China in 2015 and First Science and Technology Award of Guangdong in 2014. Her Doctoral Dissertation has been nominated as National Excellent Doctorial Dissertation in 2011 and awarded as Excellent Doctorial Dissertation of Guangdong in 2010. She has published 60 academic papers such Nano Letters, NPG Asia Materials, Applied Physics Letters, etc. Current Research Interests: Photonics, Optical Sensors and Instrumentation, Optofluidics, Lab-on-a-disc, Nano-materials

Optical Sensors Based on Nano-composite Film

Abstract. We developed optical sensors for real-time humidity detection, gaseous formaldehyde detection in room-temperature based on nanocomposite films. The sensing film of optical humidity sensor was fabricated by layer-by-layer assembly of CdTe quantum dots, gold film and sodium hydroxide. The humidity was detected by analyzing the green light absorption of sensing film in different humidity conditions. All experiments demonstrat the superior properties of the proposed optical humidity sensor, such as ultralow humidity detection level with fast response-recovery time, a high stability and reproducibility. We also developed an optical formaldehyde sensor based on CdSe@ZnS and gold nanoparticles. The fluorescence intensity which was enhanced by localized plasmon resonance of gold nanoparticles, was changed by the reaction between quantum dots and formaldehyde molecules. The experimental data indicates the designed optical formaldehyde sensor is highly sensitive to formaldehyde molecules with a detection range of 0.5-2.0 ppm with fast response and recovery times. The optical sensor with advantages as simplicity, low fabrication costs, highly stability and sensitivity paves the way for its application in environments, industry and so on.

11:50-12:20 Invited Speaker | **Xiangfei Chen** | Nanjing University, China

Xiangfei Chen received the Ph.D. degrees in physics from Nanjing University, Nanjing, China, in 1996. Form 1996 to 2000, he was a faculty member with the Nanjing University of Post and Telecommunication Technology. From 2000 to 2006, he has been with the Department of Electrical Engineering, Tsinghua University, Beijing, China, as an associate Professor. Now he is currently a Professor in Nanjing University. He has authored or coauthored more than 200 international technical papers and conference papers. He holds more than 20 patents. Now his research has focused on photonic integrated circuits (PICs), microwave photonics and fiber sensors. Prof. Chen is the senior member of Institute of electrical and Electronics Engineers (IEEE). In 2018, he won the second prize of the National Technology Invention Award.

The way to low-cost tunable lasers

Abstract. Tunable lasers have become important in future networks because they can help the optical network's increase in flexibility and capacity, with reductions in network complexity. However, the high cost of the tunable lasers is still a large challenge in the past and in the present time. The present presentation is to discuss the cost structure of different kinds of tunable semiconductor tunable lasers and describe a way to low-cost tunable lasers. It will very benefit for the future smart optical networks.

Sept. 05, 2019 – Technical Session 15

T15 – Laser Technology - C	
Invited Speeches (Chunxiang Xu; Luming Zhao; Xiaohui Li); Oral Presentation (C082)	
Session Chair: Tianye Huang, China University of Geosciences (Wuhan), China	
Time: 13:30-15:30	**Venue: Lotus Hall 6**

13:30-14:00 Invited Speaker | **Chunxiang Xu** | Southeast University, China

Professor Chunxiang Xu
Ph.D, Changchun Institute of Physics, CAS 1997
Have been Worked at School of EE, (1999-2009), School of BME (2010-present), Southeast University, School of EEE, Nanyang Technological University (2003-2005).
Research interests: Optoelectronic functional nanomaterials, devices and biosening.

Plasmon-enhanced WGM lasing and mode regulation

Abstract. Based on our systematical researches on ZnO WGM lasing, we mainly discuss (1) how to improve the lasing performance, and (2) how to controlling the modes, here.
1. By decorating metal nanoparticle and graphene on the cavity surface, spontaneous and stimulated emission of ZnO microcavities were improved dramatically due to surface plasmon coupling.
2. Lasing modes were regulated statistically through cavity size adjusting and Vernier coupling, even single-mode was realized. Moreover, the lasing modes were tuned dynamically by introducing piezoelectric or Kerr electro-optical effects.

14:00-14:30 Invited Speaker | **Luming Zhao** | Jiangsu Normal University, China

Dr. Luming Zhao received the B.S. and the M.S. degrees in engineering physics from Tsinghua University. He acquired his Ph.D. degree in electrical and electronic engineering from Nanyang Technological University, Singapore. Zhao serves as a full professor at the School of Physics and Electronic Engineering, the Jiangsu Normal University, China. His current research interests include ultrafast fiber laser and soliton dynamics. He has published more than 100 journal papers with a citation of more than 6000 times and H-index of 40. Dr. Zhao is an IEEE Senior member, an OSA Senior member, a SPIE Senior member.

https://scholar.google.com/citations?user=erHKLFcAAAAJ&hl=en

Properties of dissipative-soliton-resonance pulses in normal-dispersion fiber lasers

Abstract. Dissipative-soliton-resonance (DSR) pulses generated in normal-dispersion fiber lasers are promising for achieving higher pulse energy due to its pulse-breaking-free feature. General properties of DSR pulses are summarized: linearly pulse width increasing with pump power, unique chirp distribution, and distinct polarization distribution. Newly discovered pulse narrowing, period doubling, and pulse breaking of DSR pulses are presented. Practical route for achieving higher pulse energy is discussed.

14:30-15:00 Invited Speaker | **Xiaohui Li** | Shaanxi Normal University, China

Xiaohui Li received the Ph.D. degree from Xi'an Jiaotong University, Xi'an, Shanxi, China, in 2012. He work as a research fellow in Nanyang Technological University, Singapore from 2012 to 2015. He is with the School of Physics and Information Technology, Shaanxi Normal University, where he is currently a Professor. His current research interests include ultrafast photonics of 2D materials, passively mode-locked fiber laser, and solitons in fiber.

Novel 2D materials for high-order soliton molecules generation in Er-doped fiber resonator

Abstract. Recently, two-dimensional (2D) material, has favored by researchers because of its adjustable band-gap and good oxidation resistance. In this study, we apply different low-bandgap 2D materials in erbium-doped fiber laser (EDFL). Furthermore, the SA device is applied to EDFL system to obtain different order soliton molecules. In addition, 11 or even 14th order soliton molecules can be generated owing to the flexibility of parameters such as mode-locking techniques and dispersion control. In summary, the laser system proposed is helpful to explore the working mechanism of soliton, and provide a low-cost platform for study the dynamic of soliton.

15:00-15:15 Oral Presentation C082

Ultra-high-power and High-efficiency 905nm Pulsed Laser For LiDAR

Qiu Yuzhen, **Xie Yehua**, Hu Martin, Ho James, Wang Weimin, Liu Wenbin, Kuang Langxing and Bai Xue

Shenzhen Raybow Optoelectronics Inc., China

Abstract. We report the design, fabrication and characterization of ultra-high-power and high-efficiency 905-nm pulsed lasers with four epitaxially stacked emitters connected by tunnel junctions for LiDAR application. The P-side-up submounted multimode lasers produce as high as 150 W at the current of 35 A and environmental temperature of 25℃. At the output power of 111.5 W, the Wall-Plug Efficiency and slope efficiency reach 41.4% and 4.66 W/A, respectively. The measurement shows 284- m beam width and 12.6-degree horizontal far-field angle (95% power enclosure), indicating high brightness for this device, making it well -suited for long-distance and high-spatial-resolution range finding.

Sept. 05, 2019 – Technical Session 16

T16 – Optical Communication and Networks - C	
Invited Speeches (Jie Zhang; Xiaoguang Zhang; Bin Chen; Jianping Li); Oral Presentation (C004)	
Session Chair: Hongyan Fu, Tsinghua University, China	
Time: 13:30-15:45	**Venue: Lotus Hall 4**

13:30-14:00 Invited Speaker | **Jie Zhang** | Beijing University of Posts and Telecommunications, China

Jie Zhang received his Ph.D. degree in 1998 from Beijing University of Posts and Telecommunications (BUPT), China. He taught at BUPT after graduation and joined the School of Optical and Electronic Information in 2008. He is currently a full time professor, Dean of the School of Optical and Electronic Information and Vice Director of State Key Laboratory of Information Photonics and Optical Communications at BUPT.

He has published over 300 technical papers, authored 13 books, granted 40 patents, and submitted 17 ITU-T recommendation contributions and 10 IETF drafts. He has completed more than 20 research projects and gained 2 national science and technology awards. His research focuses on intelligence and security of optical networks.

Machine Learning based Intelligent Control Technology in Optical Networks

Abstract. As the capacity of optical networks continues to grow, the scale continues to expand, and the architecture becomes increasingly complex, optical networks face the challenge of improving the efficiency of network resource utilization and reducing the complexity of network operation and maintenance. Artificial intelligence technology represented by machine learning has the ability to solve complex state control, massive data analysis and emergency event processing. Therefore, the intelligent control technology based on machine learning is known as the next generation network intelligent control technology after the automatic switched optical network (ASON), path computation element (PCE), and software defined optical networks (SDON). This report analyzes the development trend of optical network intelligent control technology, and proposes a self-optimizing optical network (SOON) implementation mechanism based on edge computing and cloud computing. It solves the complex control of optical networks through artificial intelligence technology. The content includes self-optimizing optical network architecture based on edge computing and cloud computing collaboration, optical network node model with artificial intelligence self-learning capability which realizes the local analysis and processing capability of data information. Some typical uses cases have been demonstrated to improve the operating efficiency of optical networks.

14:00-14:30 Invited Speaker | **Xiaoguang Zhang** | Beijing University of Posts and Telecommunications, China

Xiaoguang Zhang received his BS and MS degrees in physics from Peking University, Beijing, China, in 1985 and 1988, respectively.

He received his PhD in physical electronics from Beijing University of Posts and Telecommunication, Beijing, China, in 2004. He is currently a professor in State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications. His research interests include

polarization effects in fibers, high-speed optical communication system, etc. He is a senior member of IEEE. He is also a member of OSA.

Kalman filter: a promising solution for the impairments equalization in coherent optical communications

Abstract. Kalman filter has been proved to be one of the effective equalization algorithm to deal with lots of the impairments like PMD, RSOP, CFO, and CPN in the coherent optical communication system. However, the Kalman filter based algorithms have not been widely accepted for some shortcomings. This talk will focus on how to overcome these problems and enable the Kalman filter based algorithm to be a promising solution for the impairments equalization in coherent optical communications.

14:30-15:00 Invited Speaker | **Bin Chen** | Shenzhen University, China

Bin Chen received the Ph.D. degree in Communication Engineering from Nanyang Technological University in 2007. He is now an associate professor in Shenzhen University. His research interests include optical networking and cloud computing.

A VNF Deployment Method based on DRL in IP over EON Networks

Abstract. The virtual network function (VNF) combined with the elastic optical network (EON) can significantly improve the network flexibility and reduce the operating expenses. In this work, we propose a VNF deployment method in IP over EON based on deep reinforcement learning (DRL). The simulation results show that the network energy consumption under the DRL method can reach 90% of that under ILP method in a six-node network topology. The DRL method is also compared with the Nearest Service Function first (NFF) method in 14-node NSFNET. The simulation results show that the network energy consumption under the DRL method is lower than that under the NFF method. The advantage of the DRL method over the NFF method increases as the number of service requests increases.

15:00-15:30 Invited Speaker | **Jianping Li** | Jinan University, China

Dr. Jianping Li, now is the Professor of Institute of Photonics and Technology, Jinan University, Guangzhou China. He got his BS in electronic science and technology from Jishou University, Jishou, in 2004, the MS degree in communications and information system from Southwest Jiaotong University, Chengdu, in 2007 and Ph. D degree in physical electronics from Beijing University of Posts and Telecommunication, Beijing in 2012. He is engaged in research on high-speed fiber communication system including optical frequency comb generation and optical interconnect based on mode division multiplexing, etc.

Vector-mode-multiplexing based transmission over few-mode fiber

Abstract. To break through the capacity bottleneck induced by the increasing demand of data traffic, multi-dimensional multiplexing techniques of optical signal have been studied widely. To relieve bandwidth requirements and satisfy ultra-high capacity, mode division multiplexing (MDM) technique has been proposed to achieve large-capacity transmission systems only based on low-cost and low power consumption direct detection (DD) technologies. As the eigen modes of the full vector electromagnetic wave equation with spatially variant states of polarization (SOP) in fiber, vector mode (VM), is also introduced lately as a new orthogonal multiplexing technique. In this talk, the studies based on the VMDM transmission over few-mode fiber link will be shown.

15:30-15:45 Oral Presentation C004

Demonstration of Inter-Cell Interference Mitigation in Multi-Cell VLC Systems Using Optimized Angle Diversity Receiver

Chen Chen, Xiong Deng, Pengfei Du, Helin Yang, Wen-De Zhong and Yanbing Yang
Chongqing University, China

Abstract. In this paper, we numerically and experimentally demonstrate an inter-cell interference (ICI) mitigation scheme for multi-cell visible light communication (MC-VLC) systems using optimized angle diversity receivers (ADRs). An ADR usually consists of a non-tilted top detector and several tilted side detectors. We optimize the performance of the ADR by choosing an optimal tilting angle of each side detector. In comparison to the conventional frequency allocation-based ICI mitigation schemes, the optimized ADR-based ICI mitigation scheme enjoys three main advantages: 1) high cell capacity; 2) improved signal-to-interference-and-noise ratio (SINR); 3) reduced SINR fluctuation. The feasibility of using optimized ADRs for ICI mitigation in indoor MC-VLC systems is verified by both numerical analysis and experiments. Experimental results show that a two-cell VLC system using an optimized ADR can achieve an SINR improvement of 18.6 dB and a 1-dB SINR fluctuation, compared with the same VLC system using a single-element receiver without angle diversity.

Sept. 05, 2019 – Technical Session 17

T17 – Infrared Technologies and Applications - C	
Invited Speeches (Zhichuan Niu; Zhenghua An; Kaikai Xu); Oral Presentations (C033; C070)	
Session Chair: Peng Wang, Shanghai Institute of Technical Physics, Chinese Academy of Sciences, China	
Time: 13:30-15:30	**Venue: Rose Hall 1**

13:30-14:00 Invited Speaker | **Zhichuan Niu** | Institute of Semiconductors, Chinese Academy of Sciences, China

Niu Zhichuan, Professor of the Institute of semiconductors, Chinese Academy of Sciences, Center of Materials Science and Optoelectronics Engineering, College of Materials Science and Opto-Electronic Technology, University of Chinese Academy of Sciences, Beijing 101408; Beijing Academy of Quantum Information Sciences, Beijing 100193, China. Prof. Niu is a famous and important semiconductor expert in China. He has been the scholar of “CAS 100 Talents Plan” , achieved “the National Science Fund for Distinguished Young Scholars”, selected into the first series of Millions of New Century National Talents, and granted the Laureate of State Council Government Special Allowance. He has a long research experience in semiconductor optoelectronics, infrared devices, semiconductor nanotechnology and quantum materials, and has published over 200 high quality papers in Nature, Advance Materials, Nano Letters, Phys. Rev. Lett. and etc., frequently praised by many important journals. Prof. Niu has won the second class of National Natural Science Prize and Beijing Science and Technology Prize.

GaSb based quantum well high performance single-mode laser diodes

Abstract. GaSb based antimony semiconductor quantum wells (QWs) are most promising lattice matched system for short infrared wavelength laser diodes. Among varied applications, one of the important requirements is the single mode operation with higher output power laser. The successful fabrication of high performance GaSb-based laterally coupled distributed feedback (LC-DFB) lasers emitting at infrared wavelength of 2 micron-meters are reported here.

The lasers are designed with the second-order Chromium-Bragg-gratings and fabricated alongside the ridge waveguide by lift off. Due to the introduction of gain coupling, the lasers exhibit a stable single mode operation [side-mode suppression ratio (SMSR) >40 dB] from 10°C to 50°C and the maximum SMSR is as high as 53 dB. At a heat-sink temperature of 10°C, the lasers emit more than 40 mW continuous-wave in a single longitudinal mode. A

high external quantum efficiency of 48% is obtained, resulting in a notable increase in power conversion efficiency peaking at 13%. The lasers achieve a comparable output power with that of the index coupled LC-DFB lasers, while maintaining a better single mode performance.

14:00-14:30 Invited Speaker | **Zhenghua An** | Fudan University, China

Dr Zhenghua An is a Full Professor (since 2014) at Department of Physics, Fudan University, China. Meanwhile, he is the deputy director of Fudan Nanofabrication Laboratory (since 2011). He got his bachelor degree in physics from Nanjing University in 1999 and received his Ph.D degree in solid state electronics from Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences (CAS) in 2004. He was then a Japan Science and Technology (JST) researcher at the University of Tokyo. Since 2007, he joined Fudan University as an associate professor (2007-2013) and was then promoted to full professorship (2014-now). His research interests include emerging materials and devices which hold promising applications in infrared and terahertz region. He invented a Charge Sensitive Infrared Phototransistor (CSIP) whose photo-responsivity is several orders higher than commercial ones. Using CSIP, his group collaborated with Shanghai Institute of Technical Physics (SITP) and built a custom-designed scanning near-field infrared microscope in passive mode (p-SNIM), which is proved to be a general tool for visualize directly hot electron distributions in nanodevices. With p-SNIM, they observed for the first time nonlocal energy dissipation of hot electrons in room temperature GaAs devices. This work has been published in Science and ranked as Top 10 Optical Progresses in China of 2018. So far, he has published over 80 scientific articles, including Science, Nano Letters and has given more than 10 invited conference talks.

Infrared Nanothermometric imaging of Nonequilibrium Dynamics in Operating GaAs Nano-devices

Abstract. Electrical current is fundamentally important for the operation, functionality and hence performance of any microelectronic devices. The associated electron dynamics in operating nano-devices, however, remains little explored due to extreme challenges in direct probing of hot electrons. Electrically agitated hot electrons generate near-field infrared emission, which provides tremendous insights to the hot electron kinetic behaviors. With a newly developed scanning near-field infrared microscope, we present here real-space nanothermometric imaging of hot carrier dissipation dynamics in GaAs operating nano-devices with various geometries and discuss the associated nonequilibrium relaxation mechanisms. Our work may provide useful hints to thermal management of microelectronic and optotoelectronic devices in general.

14:30-15:00 Invited Speaker | **Kaikai Xu** | University of Electronic Science and Technology of China, China

Kaikai Xu, Professor of University of Electronic Science and Technology of China. He 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.

Prof. Xu’s research interest includes semiconductor opto-electronic 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 (1-13μm) 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.

Chip-based Silicon light-emitting device

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.

15:00-15:15 Oral Presentation C033

Research on wavelength extended InGaAs detector materials

Jian Zhang, Wei-Guo Huang, Hua Huang, Gui-Xiang He, Yong-Gang Zhang, Ying-Jie Ma, Qian Gong, Yi Gu
Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, China

Abstract. The wavelength extended $In_xGa_{1-x}As/InP$ (x>0.53) photodetectors (PDs), with cutoff wavelengths beyond 1.7 μm, have attracted much attention owing to their broad applications in earth resource observation, environmental monitoring, and night vision. However, with the response wavelength extended to longer than 1.7 μm, the increasing lattice mismatch between the $In_xGa_{1-x}As$ ($0.53 \le x \le 1$) and the InP substrate will result in poorer material quality with respect to $In_{0.53}Ga_{0.47}As$. In order to overcome this limitation, the $In_xAl_{1-x}As$ metamorphic buffer layer has been introduced to alleviate the impact of lattice mismatch and accommodate the strain in the high indium （In）InGaAs layer.

The generation and distribution of dislocations in buffer layers of different structures are different. For example, the distribution of dislocations in fixed component buffer layers and continuous graded buffer layers is quite different. For the fixed component buffer layer, due to the sudden change of the lattice constant of the material at the hetero interface close to the InP layer, a larger number of dislocations are generated at the heterointerface than the gradient buffer structure. Therefore, there is theoretically a "step + continuous" gradient buffer layer that combines a fixed component with a continuous gradient buffer layer. At the beginning of the buffer layer, a layer of InAlAs with an In composition greater than 0.52 is grown, and then gradually changed to $In_{0.74}Al_{0.26}As$. This "step + continuous" buffer layer may have a better buffering effect than a traditional gradient buffer layer. In addition, theoretical studies have shown that if a local stress field is formed in the buffer layer, it will contribute to the slip of the dislocation line and the interaction of dislocations, which will reduce the upwardly extending dislocations. Based on the above ideas, we have grown a set of 2.2 μm $In_{0.74}Ga_{0.26}As$ PD samples with different buffer layer structures by gas source molecular beam epitaxy (GSMBE). All samples were of p-on-n type detector structure and the thickness of the buffer layer was uniform. Sample A uses a conventional component gradient buffer layer. Sample B used a "step + continuous" gradient buffer layer with an initial composition of 0.64, wherein the initial large component $In_{0.64}Al_{0.36}As$ had a thickness of 0.18 μm. Sample C was based on sample B. Insert a thin layer of InAs layer into the $In_{0.74}Al_{0.26}As$ layer above the “step + continuous” gradient buffer layer. It is hoped that the "local stress field" will be created in the buffer layer by "stress engineering", and it is hoped that the dislocations can be further prevented. Figure 1 shows the room temperature photoluminescence (PL) spectra of three samples. It can be seen from Fig. 1 that the PL intensity of the sample B is significantly enhanced compared to the strengths of the sample A and the sample C. It indicates that the non-radiative recombination center of the $In_{0.74}Ga_{0.26}As$ absorption layer of sample B is less, and the quality of the absorption layer is better. Fig. 2 shows the high-resolution X-ray ω-2θ curve of three samples. It can be seen from Fig. 2 that the full width at half maximums (FWHMs) of the absorption layers of samples A and B hardly change, and the FWHM of the absorption layer of sample C is slightly larger. It indicates that the "step +

continuous" gradient buffer layer with an initial composition of 0.64 can better reduce the non-radiative recombination center in the material. This also indicates that the structure of insert a thin layer of InAs layer into the $In_{0.74}Al_{0.26}As$ layer above the “step + continuous” gradient buffer layer requires further optimization.

15:15-15:30 Oral Presentation C070

Antimony-rich digital alloys for InSb QDs mid-infrared lasers aiming for gas sensing

Xin Guan, Sheng Ye, Zhiming Jin, Christopher Redman, Qi Lu and Qiandong Zhuang
Lancaster University, UK, IFFS, University of Electronic Science and Technology of China, China

Abstract. Infrared spectroscopy based gas analyzer is powerful to detect and monitor gases that are relevant to several important fields including pollutants monitoring (NOx, SO2 and O3), industrial process control, agriculture monitoring and vertical farming (water, CO2, ethylene). InSb / InAs quantum dots (QDs) laser is one of the promising candidates as the light source for gas analyzer because of its mid-infrared operating wavelength and several advantages such as low threshold current density and the relatively simple device fabrication process in comparison with quantum cascade lasers, arising from their delta-shaped density of states and reduced Auger recombination.
InSb / InAs QDs are capable to emit wavelengths longer than 3 μm, hence can serve ideally as the laser source integrated in the gas analyzer (Figure 1a). Furthermore, its type II broken band gap alignment leads to a spatially indirect radiative recombination between electrons localized in the InAs matrix and holes in the confined states of the InSb QDs, consequently provides larger lasing tunability which is important for the use. However, the lack of a lattice-matched cladding layer restricts the resulting laser performance. Here we report the success of high quality AlxGa1-xSb / AlxGa1-xAs digital alloys (DAs) that act as perfect cladding layers for InSb / InAs QD lasers on InAs substrates. Both lattice-matched conventional alloy (CA) $Al_xGa1_{-x}Sb_yAs1_{-y}$ and $Al_xGa1_{-x}Sb$ / $Al_xGa1_{-x}As$ DA are attempted as the cladding layer of InSb QD laser structures to optimize the device performance (Figure 1b). This study shows that DA displays improved optical characteristics than that of CA. This improvement is attributed to the suppression of the drawbacks of CA, in particular the accuracy and the reproducibility of the ratio of As / Sb compositions, that come from the wide miscibility gap in $Al_xGa1_{-x}Sb_yAs1_{-y}$ alloys in a wide range of Sb concentration.

Sept. 05, 2019 – Technical Session 18

T18 – Precision Optics - A	
Invited Speeches (Yaocheng Shi; Guijun Li; Xiahui Tang; Jingping Zhu)	
Session Chair: Daoxin Dai, Zhejiang University, China	
Time: 13:30-15:30	**Venue: Lotus Hall 2**

13:30-14:00 Invited Speaker | **Yaocheng Shi** | Zhejiang University, China

Yaocheng Shi received the B.Eng. degree from the Department of Optical Engineering, Zhejiang University, Hangzhou, China, in 2003 and the Ph.D. degree from the Royal Institute of Technology (KTH), Stockholm, Sweden, in 2008. Then he joined in Zhejiang University as an assistant professor and became a professor in Dec. 2016. His research activities are in the design and fabrication of photonic integrated devices.He has authored more than 100 refereed international journal papers.

Design, fabrication and characterization of Silicon photonic devices based on sub-wavelength gratings

Abstract. The sub-wavelength grating (SWG), which is a one-dimensional array of deeply sub-wavelength nano-strips, can provide strong anisotropy and flattened dispersion, showing great potentials in photonic integrated devices. In this talk, we will introduce the design, fabrication and characterization of several kinds of devices based

on subwavelength gratings, including the polarization beam splitters, multimode waveguide bending, Maxwell fisheye lens based multimode crossing.

14:00-14:30 Invited Speaker | **Guijun Li** | The Hong Kong Polytechnic University, China

Dr. Guijun Li, received his B.Sc. degree in Physics from Nanjing University, and Ph.D. degree in Electrical and Electronic Engineering from The University of Hong Kong. Currently, he is a Research Assistant Professor in Department of Industrial and Systems Engineering, and a member of State Key Laboratory of Ultra-precision Machining Technology at The Hong Kong Polytechnic University. He is a Senior Member of IEEE.

Advanced Laser Manufacturing of Functional Materials

Abstract. Advanced laser manufacturing is a key technology of the Industrial 4.0. By combining the strength of optics and robotics, advanced laser manufacturing can fabricate functional objects at high precision. With optimized laser parameters, a series of functional materials, such as graphene, metallic nanoparticles, and metal-organic frameworks can be photothermally or photochemically fabricated. This talk will introduce our recent progresses of using advanced laser manufacturing for functional materials processing, and their wide applications including energy storage, energy conversion, and biomedical sensing, etc.

14:30-15:00 Invited Speaker | **Xiahui Tang** | Huazhong University of Science and Technology, China

Born in Nov. 1963, Dr. Tang Xia hui is now a professor and Ph.D. supervisor at School of Optical and Electronic Information, and vice director of National Engineering Research Center for Laser Processing , HUST. He is also the executive member of Laser Processing Committee of the COS, standing director of Hubei Machine Engineering Society, vice president of Hubei Laser Society and editor of Laser Technology.

Application of Precise Laser Processing

Abstract. The latest applications of small and medium power lasers in automotive parts, electronics, electrics and light industry are introduced. The main lasers used in precision micro-processing are also introduced. Precise Laser Processing includes welding of automobile airbag, automobile lamp, automobile plastic parts and automobile electronics; scribbling, scribbling and doping of silicon wafer and film of solar cells; precise cutting, welding and punching of electronic and electrical parts; punching and cutting of circuit boards and flexible circuit boards.Finally the pulse, frequency doubling and ultraviolet laser used in Precise Laser Processing are introduced.

15:00-15:30 Invited Speaker | **Jingping Zhu** | Xi'an Jiaotong University, China

Professor Zhu Jingping received her PhD from Xi'an Jiaotong University. She is a full professor at Xi'an Jiaotong University. Her research filed include multi-dimension optical imaging, micronano functional devices. She's been working on polarization imaging, spectral polarization imaging, optical transmission and detection in turbid medium, optical waveguide devices for fiber communication in recent years.

Polarization Imaging Technology for Marine Disaster Monitoring

Abstract. Frequent marine disasters, such as oil spills and red tides, have caused serious damage to the marine environment, national economy and people's livelihood. Unfortunately, under the disturbance of seawater, sun flares and sea fog, ocean monitoring has the problems of "unclear", "undistinguishable" and "near-sighted". The key to achieve accurate monitoring based on the development of monitoring mechanism. We proposes a "spectral + polarization + intensity" multi-dimensional high-resolution imaging mechanism to monitoring these kind of marine disaster. It has advantages of high-resolution, high-contrast, multi-dimensional optical information acquisition simultaneous.

Sept. 05, 2019 – Technical Session 19

T19 – Optoelectronic Devices and Applications - D	
Invited Speeches (Yu Yu; Tianye Huang; Jianjun He)	
Session Chair: Yu Yu, Huazhong University of Science and Technology, China	
Time: 16:00-18:00	**Venue: Lotus Hall 6**

16:00-16:30 Invited Speaker | **Yu Yu** | Huazhong University of Science and Technology, China

Yu Yu received the B.S. degree and Ph.D. degree in 2003 and 2009, respectively, both from Huazhong University of Science and Technology (HUST), Wuhan, China. From 2008 to 2010, he was with the Centre for Photonic Systems, Department of Engineering, University of Cambridge, U.K., as a Research Associate. Dr. Yu is currently with Wuhan National Laboratory for Optoelectronics (WNLO), HUST, as a Professor. His research interests include Silicon Photonics, all-optical signal processing and related integrated devices.

Integrated silicon multifunctional modedivision multiplexing system

Abstract. Chip-scale optical interconnects have been widely investigated using the wavelength-division multiplexing (WDM) and mode-division multiplexing (MDM). A flexible and reconfigurable WDM and MDM network is highly desired. Here, we proposed and demonstrated a 4 × 4 chip-scale multifunctional MDM system, which integrates fundamental components such as high-speed modulator arrays, multimode switches, and large-bandwidth photodetector arrays, in addition to various multimode devices.

16:30-17:00 Invited Speaker | **Tianye Huang** | China University of Geosciences (Wuhan), China

Tianye Huang received his Ph.D degree from Huazhong University of Sciences and Technology in 2012. From 2013 to 2016, he is with the Nanyang Technological University as Research Fellow. Currently, he is with China University of Geosciences (Wuhan). His research interests include integrated photonic devices and nonlinear optics.

Design of Fundamental Phase-matched Waveguide for second/third harmonic generation

Abstract. On-chip second harmonic generation (SHG) and third harmonic generation (THG) have attracted much interest in the last decade. In such nonlinear process, phase matching condition (PMC) which must be satisfied. However, material dispersion usually prevents the PMC between input pump and generated radiation when they are both guided in the fundamental modes. In this talk, a dielectric-loaded waveguide based on fundamental mode photon-plasmon coupling is designed for efficient THG and SHG. The potential of the harmonic waveguide for up-conversion gas sensing is discussed as well.

17:00-17:30 Invited Speaker | **Jianjun He** | Zhejiang University, China

Dr. Jian-Jun He, received the Ph.D. degree in semiconductor optoelectronics from the University of Paris VI, France, in 1989. From 1989 to 2006, he worked in university, government laboratory and industry in Canada on semiconductor optoelectronic devices. He joined Zhejiang University in 2006 as a Changjiang Chair Professor. He has published over 300 scientific papers, holds 20 US patents and over 50 Chinese patents. He is a Fellow of OSA and SPIE.

Electro-Absorption-Modulated Widely-Tunable V-Cavity Laser

Abstract. We present a widely tunable V-cavity laser monolithically integrated with an electro-absorption modulator (EAM). The device shows 41-nm wavelength tunability covering 51 channels at 100GHz spacing on the ITU-T grid,

with a side mode suppression (SMSR) higher than 47 dB. Error-free transmission over 50 km standard single-mode fiber at 10 Gb/s is demonstrated at all wavelengths over the tuning range. The integrated EAM exhibits a dynamic extinction ratio higher than 12.5 dB and an excellent bit-error-rate performance with the power penalty less than 3 dB for 50-km transmission. The results confirm the suitability of this ultra-compact, grating-free and regrowth-free electro-absorption modulated tunable laser for use as a cost-effective DWDM transmitter for metropolitan, access and 5G networks.

Sept. 05, 2019 – Technical Session 20

T20 – Optical Communication and Networks - D	
Invited Speeches (Chongjin Xie; Fan Zhang; Zhi Liu; Aiqun Liu); Oral Presentation (C012)	
Session Chair: Anhui Liang, Guangdong University of Technology, China	
Time: 16:00-18:15	**Venue: Lotus Hall 4**

16:00-16:30 Invited Speaker | **Chongjin Xie** | Alibaba Group, China

Chongjin Xie is a senior director and chief communication scientist in AIS, Alibaba Group, leading an optical network team to develop datacenter optical technologies to support Alibaba online platform and cloud services. Prior to joining Alibaba in 2014, Dr. Xie was a Distinguished Member of Technical Staff at Bell Labs, Alcatel-Lucent, doing research on optical communication systems and networks. He did his postdoctoral research at Chalmers University of Technology in Sweden from 1999 to 2001, and received his M.Sc. and Ph.D degrees from Beijing University of Posts & Telecommunications in 1996 and 1999, respectively. Dr. Xie has published one book, 4 book chapters and over 200 journal and conference papers. He was a program chair of OFC'2019, an associate editor of Journal of Lightwave Technology, and has been serving as chairs, TPC chairs or TPC members in many conferences. Dr. Xie is a Fellow of OSA and a senior member of IEEE.

Open Datacenter Interconnect Technologies

Abstract. We will present the development of inter-datacenter interconnect technologies in recent years, and discuss the characteristics, requirements and challenges of open optical transport technologies for inter-datacenter interconnects.

16:30-17:00 Invited Speaker | **Fan Zhang** | Peking University, China

Fan Zhang is currently a full professor, with the School of Electronics Engineering and Computer Science, Peking University. He has been actively engaged in the field of optical communication with emphasis on advanced modulation formats, digital signal processing, optical interconnect, direct detection and coherent detection optical communication. He served as members of the technical program committees of international conferences such as Optical Fiber Communication Conference (OFC), IEEE Photonics Conference (IPC), Asia Communications & Photonics Conference (ACP), and OptoElectronics and Communications Conference (OECC). He is a senior member of IEEE and a senior member of The Optical Society.

Fiber nonlinearity mitigation in High baud rate optical communication systems

Abstract. We review techniques of fiber nonlinearity mitigation with emphasize on high baud rate optical communication systems. Both intra and inter-channel fiber nonlinearity are discussed for high baud rate and high-order modulation formats. Different methods such as digital back propagation, Kalman Filtering and machine learning are investigated for beyond 400G optical transmission.

17:00-17:30 Invited Speaker | **Zhi Liu** | Changchun University of Science and Technology, China

Liuzhi, professor, PhD director, major research interest includes free space laser communication technology, photoelectronic dynamic measurement technology and SLAM&AR in Mobile platform.

Equalizer for Free Space Optical Communication

Abstract. Free Space Optical communication (FSOC) in atmosphere, is a communication pattern in which laser is used as the information carrier in atmosphere environment. Inter-symbol interference caused by the atmospheric turbulence will bring decoding error, it needs to adopt appropriate techniques to remove or reduce this kind of interference. Equalization is an effective way to suppress the inter-symbol interference (ISI), which is caused by atmospheric channels. In order to improve the performance of the communication system, we study the equalization technology at the receiver. Aiming at decreasing the ISI and reducing the bit error rate (BER) of the FSOC system.

The signal adaptive equalization technique and the blind equalization technique are seriously studied, two basic algorithms of adaptive equalization technique are introduced: least mean square (LMS) algorithm and recursive least squares (RLS) algorithm. Then, the blind equalization techniques based on Bussgang are studied, the constant modulus algorithm (CMA), MCMA and SAG-CMA algorithms are analyzed. A cascaded equalization algorithm is proposed based on CMA. The adaptive equalization algorithm and the blind equalization algorithm are simulated also. The effects of different parameters on the convergence performance of the equalization algorithm are analyzed.

The simulation results show that, the convergence of the algorithm has been improved, and the BER is also reduced.The research can be very helpful in improving the performance of FSOC system.

17:30-18:00 Invited Speaker | **Aiqun Liu** | Nanyang Technological University, Singapore

Professor Ai-Qun Liu (A. Q. Liu) (http://nocweba.ntu.edu.sg/laq_mems/) received his PhD degree from National University of Singapore (NUS) in 1994. Currently, he is a Professor at the School of Electrical & Electronic Engineering, Nanyang Technological University (NTU). He serves as an editor and editorial board member of several journals. He is the co-author about 200 publications including peer-reviewed journal papers and two books.

He is a SPIE Fellow, OSA Fellow and RCS Fellow.

Silicon Nanophotonic Fabrication Processes and Devices

Abstract. In the past twenty years, silicon nanophotonic technology and waveguide integrated device are greatly stimulated extensive research in semiconductor microsensors and microactuators. Silicon nanophotonic and waveguide integrated device are very significant breakthrough for traditional photonic device and system, which is not only advantage of batch processing to address the manufacturing, but also make impact in the research of quantum integrated circuits and sensors.

This talk will introduce design and fabrication of continuous variable quantum key distribution (CV-QKD) in different components related to splitter, tunable MZI, switches and photodetector will be discussed. Various design and fabrication issues will be introduced to explain the make of these devices using silicon nanofabrication processes. This talk will be concluded with the future trends and research directions in quantum integrated circuits and silicon nanophotonic integration technologies

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18:00-18:15 Oral Presentation C012

Spectrum and routing allocation method for Elastic Optical Networks based on posterior blocking probability Measurement

Qiang Sun, **Haoran Li,** Yang Zhou

Beijing Jiaotong University, China

Abstract. With the rapid growth of traffic in today's society, the original optical network based on wavelength division multiplexing is more and more difficult to meet the current traffic demand because of its large spectral granularity, so the elastic optical network came into being. In elastic optical networks, the most important research issue is the allocation of spectrum and routing. This paper proposes a joint allocation method of spectrum routing based on access blocking rate. The value of spectrum slot is measured by the access blocking rate of spectrum slot, and it is converted into the weight of the link. The weighted shortest path algorithm is used to find the appropriate allocation Path; and find the best allocated spectrum slot on the assigned path by a posteriori access blocking rate. Then considering the shortcomings of the above algorithm without considering the peripheral link, a spectrum routing joint allocation algorithm that considers the neighboring link a posteriori access blocking rate is proposed. Finally, the above two algorithms are compared through experiments. Compared with the classic first fit algorithm, more than 10% service blocking rate is reduced in both USNET and NSFNET network topologies.

Sept. 05, 2019 – Technical Session 21

T21 – Fiber-Based Technologies and Applications - D	
Invited Speeches (Shuhui Liu; Chi Chiu Chan); Oral Presentations (C016; C072; C084)	
Session Chair: Yongkang Dong, Harbin Institute of Technology, China	
Time: 16:00-18:00	**Venue: Rose Hall 1**

16:00-16:30 Invited Speaker | **Shuhui Liu** | Shenzhen University, China

Dr. Shuhui Liu received his B. S. degree in optoelectronic Engineering at Beijing Institute of Technology in 2010, and Ph. D degree in Optics at Huazhong University of Science and Technology in 2015, respectively. His research interests are femtosecond laser micromachining and optical fiber sensors.

Femtosecond laser introduced holey fiber Bragg gratings and its sensing applications

Abstract. The inscription of fiber grating in the air holes of the holey optical fibers, gives the possibility of direct contact between analyte and the grating itself, and also increases the interrogation level of the sensor device. In this talk, I will report our research progress on hollow core fiber Bragg grating (FBG) and holey fiber Bragg grating fabricated with femtosecond (FS) laser. Through careful control of the laser parameter, periodic groove structure is introduced to the walls of the air holes in the fibers, which acts as Bragg reflector. The spectra property and the sensing performance of the hollow core based FBG is characterized. Meanwhile, I will also report the work of holey fiber with large side channel introduced with FBG structure by FS laser. The optofluidic sensing performance is revealed.

16:30-17:00 Invited Speaker | **Chi Chiu Chan** | Shenzhen Technology University, China

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 Senior Life Member and SPIE Senior 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.

Optical fiber sensing by combining with chemical coatings

Abstract. Material science research has been developed rapidly in this decade and has been attracted a lot of other research areas to investigate of how to combine with this to develop a new research direction. Optical fiber is one kind of material which offers a lot of advantages for sensing applications. Therefore, the combination of new developed materials with optical fiber have received a great attention in the field of sensing technology in recent years. To exhibit desired sensing behaviors, the functionalized sensing polymers (sheet or film form) are utilized as an integral part of optical fiber sensing devices for the measurement of various quantities such chemical and biological measurands. In this presentation, we explore the possibilities of integrating different kinds of materials with silica optical fiber for different kinds of chemical and biological sensing applications.

17:00-17:15 Oral Presentation C016

Sensing Characteristics of a Grating-based Fabry-Perot Structure in a Biconical Tapered Fiber

Aayush Madan, Varghese Paulose, Wonkeun Chang, Perry Ping Shum and Jianzhong Hao
Nanyang Technological University, Singapore

Abstract. In this article, we present the sensing characteristics of a fiber Bragg grating (FBG) based Fabry-Perot (FP) structure in an acrylate coated biconical tapered fiber. The diameter of the fiber was tapered down to 70 micrometers using flame
brushing technique followed by point-by-point writing of the FP structure within the fiber core using infrared femtosecond laser pulse irradiation. The sensing structure consists of two identical gratings separated by a small gap. The strain characteristics, ranging up to 3400 microstrains, and the temperature characteristics, ranging up to 225 degC, have been investigated. The strain and temperature sensitivities of the device were found out to be 2.32 pm/microstrain and 8.86 pm/degC, respectively.

17:15-17:30 Oral Presentation C072

A stable fiber-optic ultrasound detector based on heterodyne detection

Liuyang Yang, Yanpeng Li, Fang Fang, Liangye Li, Qizhen Sun,
Huazhong University of Science and Technology, Wuhan, China

Abstract. Ultrasound sensors play an important role in the high-resolution photoacoustic tomography and microscopy, clinical ultrasound imaging and non-destructive testing techniques. At present, commonly used ultrasound sensors are based on piezoelectric material, which limits their applications in electromagnetic environment (EMI) and narrow space due to electromagnetic sensitive and large size. Therefore, small size and flexible ultrasound sensors are still in great demand. To solve this problem, many methods based on optical fiber have been proposed for ultrasound detection, such as Fiber Fabry- Perot cavity, Fiber Bragg grating, etc. However, these sensors need a complex system to stabilize the interrogation laser wavelength at the Q point of the transfer function, which is challenging for practical applications.
In this abstract, a flexible and stable fiber-optic ultrasound sensor based on heterodyne detection is proposed and experimentally demonstrated for ultrasound detection. The schematic diagram of the fiber-optic ultrasound sensor is depicted in Fig. 1(b). The fiber-optic ultrasound sensor is fabricated by coating the PDMS (polydimethylsiloxane) film on a flattened standard single-mode fiber (SMF-28) end face, using a dip-coating process and heat curing method. Then, a layer of silver is deposited on the PDMS to increase reflectivity. After that, the sensor is covered with a thin

layer of PDMS for protection. The fiber-optic ultrasound sensor has a small acoustic element size because the interrogate laser spot diameter is only several micrometers, so the fiber-optic ultrasound sensor offers a broadband acoustic frequency response in theory. When an ultrasound signal is applied to the sensor, the thickness of the PDMS film changes accordingly. The phase of reflected light will be modulated. Here, to obtain the phase change of reflected light caused by the ultrasound signal, heterodyne detection method is used to interrogate the fiber-optic ultrasound sensor, the system schematic diagram is show in Fig. 1(a). The narrow linewidth laser with a wavelength of 1550 nm is split into probe light and reference light by a 99:1 coupler. The probe light is frequency shifted by 200MHz through an acoustical optical modulator (AOM). A circulator is used to launch the probe light into the sensor. The reflected light from the sensor carries ultrasound signal and interferes with the reference light. The generated beat signal is received by a balanced photo detector (BPD) and recorded by a digital oscilloscope.
In order to verify the ultrasound detection capability of the fiber-optic ultrasound sensor, ultrasound pulse signals generated by a series of unfocused ultrasound transducers with different center frequency are normally applied to the sensor. As shown in fig. 1(c), the sensor shows an acoustic frequency response up to 10MHz. To illustrate the stability of the sensor, continuous measurement of ultrasound signal over 1 hour, and the output signal of the sensor is almost no change.

17:30-17:45 Oral Presentation C084

Ultra-sensitive detection of heavy metal using a fiber grating-assisted plasmonic electrochemical sensor

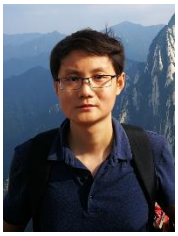
Xia Chen, Ying Si and Tuan Guo
Jinan University, China

Abstract. It is necessary that real-time and continuous monitoring of heavy metal ions in solution. Traditional electrochemical methods have security issues and background interference. To solve these problems, a new method based on surface plasmon resonance (SPR) electrochemical optical fiber sensor has been proposed. Combined with anodic stripping voltammetry for electrochemical measurement, SPR is used for detection of heavy metal ions simultaneous by coating metal ion lead onto the surface of the optical fiber sensor while recording the electrochemical signal, the characteristic is that SPR is highly sensitive and excludes electrochemical background interference. The gold-coated film optical fiber works as both a sensor and a working electrode, allowing real-time monitoring of heavy metal ions in solution. The advantages of optical fiber sensor, such as compact size, flexible shape and remote operation capabilities, opens a new way for high sensitive electrochemical detection.

Sept. 05, 2019 – Technical Session 22

T22 – Biophotonics and Biomedical Optics - C	
Invited Speeches (Tianxun Gong; Aaron Ho); Oral Presentations (C053; C075)	
Session Chair: Sihua Yang, South China Normal University	
Time: 16:00-18:00	**Venue: Lotus Hall 2**

16:00-16:30 Invited Speaker | **Tianxun Gong** | University of Electronic Science and Technology of China, China



Tianxun Gong obtained his Ph.D degree from Nanyang Technological University on 2015. He also worked in Singapore Bioimaging Consortium, A*STAR from 2012 to 2016. Tianxun Gong is currently a lecturer from University of Electronic Science and Technology of China, his research focus is nanomaterials and its applications for bio detections.

Surface Enhanced Raman Spectroscopy for Diseases Detection

Abstract. Surface Enhanced Raman Spectroscopy (SERS) is able to provide “finger prints” information of the

molecules in bio-samples, even in ultra-low concentration. Due to the different characteristic of the samples, various platforms need to be developed. In may talk, I will introduce our research results on fiber and substrate based SERS platforms which designed for cell or bio-fluid samples. Moreover, I will introduce their applications on disease detections, such as vascular disease and colorectal cancer.

16:30-17:00 Invited Speaker | **Aaron Ho** | The Chinese University of Hong Kong, China

Professor Ho 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 (CUHK), he has been with the Department of Electronic Engineering and held positions as Associate Dean of Engineering, CUHK; Assistant Professor in Department of Physics and Materials Science, City University of Hong Kong; Senior Process Engineer for semiconductor laser fabrication in Hewlett-Packard. His service to the professional and academic community includes Chairman of Hong Kong Optical Engineering Society; Chairman of IEEE Electron Device/Solid-State Circuits (ED/SSC) Hong Kong Chapter, Admission Panel member of Technology Business Incubation Programme (IncuTech) operated by Hong Kong Science and Technology Parks Corporation (HKSTP); Council Member of The Technological and Higher Education Institute of Hong Kong (THEi). Started as a compound semiconductor materials scientist, his current academic interests focus at 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 400 peer-reviewed articles, 33 Chinese and 6 US patents. He is a Fellow of SPIE and HKIE.

Single-step Cell Trapping and In Situ Nucleic Acid Amplification Through Heat Generation with Plasmonic Absorption Effects

Abstract. We have previously demonstrated that plasmonic absorption induced localised heating can be used for manipulation and trapping of living cells and optofluidics. The forces that lead to the observed trapping effect are due to fluidic convection and a theromphoretic force field associated with the temperature distribution surrounding the optically heated spot. In this paper, we report a complete application of plasmonic localised heating in which one can perform trapping of a single cell in a micro-well and perform in situ screening of genetic markers. The targeted cell was first steered into a micro-well through varying the incident laser power. With the use of the same laser spot at higher incident power, the targeted cell was lysed to expose its nucleic acid contents and subsequently isothermal nucleic acid amplification through replacing the contents of the micro-well. The entire process, including the detection of nucleic acid amplification through fluorescence detection, was performed and monitored under an optical microscope. The reported method paves way for rapid screening of genetic markers at the single cell level within a 2-dimensional micro-cell array platform.

17:00-17:15 Oral Presentation C053

In vivo NIR-II phototheranostics via two kinds of cyanine dyes: ICG and IR-820

Zhe Feng, Xiaoming Yu, Gonghui Li, Jun Qian
Zhejiang University, China

Abstract. Fluorescence bioimaging in the second near-infrared spectral region (NIR-II, 900-1700 nm) has the advantages of high spatial resolution and large penetration depth. Hence its related imaging-guided therapy based on biocompatible fluorescence dyes has become a promising theranostics method. In our work, two low-biotoxicity cyanine dyes, indocyanine green (ICG) and IR-820, have been verified to emit considerable NIR-II fluorescence. Based on FDA-approved ICG, NIR-II fluorescence wide-field microscopic imaging was performed, achieving noninvasive through-skull and high-resolution imaging of cerebral vasculatures. In addition, ICG-assisted NIR-II fluorescence confocal microscopy was further executed to observe cerebral vasculature, presenting optical sectioning capability and higher spatial resolution. Similarly, IR-820 has excellent capabilities for NIR-II fluorescence

angiography. Due to its good photothermal effect, free IR-820 was employed for NIR-II imaging-guided photothermal therapy of tumor in vivo, and the subcutaneous tumors were inhibited obviously or even eradicated completely. Both ICG and IR-820 have high biocompatibility and desirable NIR-II fluorescence brightness, holding great potentials for functional angiography and cancer theranostics in clinical practice.

17:15-17:30 Oral Presentation C075

A Centrifugal Chemiluminescence Detection platform and Its Application for Nucleic Acid Virus (H7N9)

Kangkang Liu, and Hongpan Xu, Zhiyang Li and Guanghui Wang
Nanjing University, China

Abstract. Chemiluminescence detection has been used to determine the concentration of nucleic acid virus. At present, chemiluminescence detection is mostly a large, immovable chemiluminescence detection instrument, and some steps to extract supernatant still need to be completed manually. To solve this problem, a centrifugal chemiluminescence detection system was established. The CMOS detector with high sensitivity and small volume was combined with centrifugal force micro-fluidic platform to realize the integration process of sample reaction and detection. The system has been successfully applied to the detection of nucleic acid virus (H7N9). The detection process of nucleic acid virus (H7N9) completed in the original laboratory was designed on a microfluidic chip. The flow direction of liquid is driven by centrifugal force platform, and the whole reaction process is controlled by logic components on the chip. Finally, the luminous intensity is detected by CMOS detector.

Sept. 06, 2019 – Technical Session 23

T23 – Infrared Technologies and Applications - D	
Invited Speeches (Weidong Wu; E Wu); Oral Presentations (C025; C054)	
Session Chair: You Wang, Southwest Institute of Technical Physics, China	
Time: 9:00-10:30	**Venue: Lotus Hall 6**

9:00-9:30 Invited Speaker | **Weidong Wu** | Research Center of Laser Fusion, China Academy of Engineering Physics, China

Wu Weidong, male, born on November 14th, 1967, is a senior researcher and doctoral supervisor. He is currently working in Laser Fusion Research Center of China Academy of Engineering Physics and has been selected as one of "Double Hundred Talents" of China Academy of Engineering Physics. Currently, he is the Vice-Chairman and Secretary-General of Material and Devices under Extreme Conditions, a sub-branch of Material Research Society. In June 1989, he graduated from the Department of Civil Engineering of Hunan University with a bachelor's degree in engineering. In June 1994, he graduated from the Department of Physics of Lanzhou University with a master's degree in science. In June 2007, he achieved a doctor's degree in science from the College of Physics of Sichuan University. From 1994, he has been working in China Academy of Engineering Physics.

Prof. Wu Weidong has been engaged in thin-film physics, thin-film preparations and photoelectric functional film. He has rich experience in preparing and analyzing thin films and photoelectric functional film. He is responsible for or participates in four projects from National Natural Foundation. He is responsible for two sub-projects of the Ministry of Science and Technology, and is currently participating in a national project and responsible for a sub-project. 29 invention patents have been obtained, and one excellent project of dual-use technology development has been obtained. More than 60 SCI papers have been published as the first author and correspondent in core SCI journals at home and abroad, such as Nature, Nanoscale, Applied Surface Science, Optical Materials Express and AIP Advances.

Material Growth, Device Fabrication and Application of Terahertz Quantum Cascade Lasers

Abstract. It is worthwhile to get high power sources in terahertz research field. A variety of devices generating

terahertz radiation have been fabricated and reported. Since the first terahertz quantum cascade laser (THz QCL) device was invented in 2002, THz QCL devices with different frequencies and powers have been successfully fabricated. Until now, the maximum output power arrives about 230 mW for CW mode and greater than 2.4 W for PW mode. Much research on applications can be done based on these devices. For example, our group design a digital holographic instrument based on 2.5, 2.9, 3.1 and 4.3 THz QCLs. In this report, the material growth of active region is introduced and the output characteristics of typical THz QCLs are presented. Based on these devices fabricated by our group, a digital holographic instrument has been manufactured and some results using this instrument are exhibited.

9:30-10:00 Invited Speaker | **E Wu** | East China Normal University, China

E Wu was born in Shandong Province, China, in 1979. She received the Ph.D. degree in optics from East China Normal University, Shanghai, China, and Ecole Normale Supérieure de Cachan, France in 2007. She is a professor in State Key Laboratory of Precision Spectroscopy, and the associate dean of the School of Physics and Material Science, East China Normal University. Her current research interest includes single-photon generation, frequency conversion and detection. She has won the 2nd class Prize of the Progress in Science and Technology of Shanghai

Infrared single-photon detection via nonlinear optics

Abstract. Highly efficient single-photon detection in infrared, specifically at telecom wavelength of 1.55 um has attracted a lot of research interest in quantum optics because of its application for the quantum key distribution (QKD) in the standard telecommunication fiber. Since the typical return signals are quite weak, Lidar and deep space communication systems are always in need of highly sensitive receivers. And medical diagnosis technology also necessitates an extremely sensitive method of detection because it is usually based on very weak Raman scattering of light from very few molecules. And highly efficient single-photon detection in infrared can provide a solution to these questions. In this talk, I'll present our recent progress on the infrared single-photon detection via sum-frequency generation and two-photon absorption, which will be promising and robust photon counters with ultrahigh sensitivity for the infrared regime.

10:00-10:15 Oral Presentation C025

High performance infrared photodetectors based on low-dimensional materials at room temperature

Peng Wang, Man Luo, Fang Wang, Xiaoshuang Chen, and Weida Hu
Chinese Academy of Sciences, China

Abstract. Natural objects in the world where the temperature exceeds absolute zero are radiating IR rays outward. Every object has its own IR radiation characteristic which contains a wealth of information. For thousands of years, people have studied the visible light as the sensory spectrum of the human eye is only 380-740 nm. But for the invisible IR, people didn't know it until the British astronomer Herschel discovered it with a blackened mercury thermometer over 200 years ago, since then the IR technology had developed slowly because people were not aware of the importance of IR in the next 100 years. During World War II, the first IR detectors based on PbS were applied on battleships as a "top-secret" instrument, thus people began to focus research on IR technology. Nowadays, most high-performance IR photodetectors are operating in a low-temperature environment, which is hard to be widely used in civilian applications due to the huge volume and weight of supporting cooling components with a sharp increase in power consumption, thus reducing the stability and reliability of detection system. To solve the problem, increasing the operating temperature to reduce the cooling requirements and extend the operating life of the IR photodetectors are very important, which is an essential part of "SWaP3" (Size, Weight, Power, Performance and Price) technology.
In view of the above mentioned, the development of IR photodetectors operating at room-temperature enables to

realize a technology with extensive application foreground. Room temperature IR photodetectors can be divided into thermal detectors and photon detectors based on the working principles. Thermal detectors have a lower performance limit of D^*=1.98×1010 cm·Hz1/2·W-1, which is the basic performance limit for all kinds of thermal detectors at room temperature. For the photon detectors with selective spectral responses, the room temperature background photon flux density is comparable with thermal generation and the recombination rate is so low that the detectivities are much larger than that of thermal detectors in the range of short wavelength infrared (SWIR), mid-wavelength infrared (MWIR) and long-wavelength infrared (LWIR) at room-temperature. Meanwhile, limited by the thermal capacity of the detector and the thermal coupling with surroundings, the typical response time of thermal detectors are on the order of milliseconds and are rather slower than those of photon detectors. In this context, the photon detector has higher theoretical performance limitation and faster response time and is more in line with the demand for high performance IR technology for civilian requirements.

In recent years, the latest discovery of low-dimensional materials, represented by two-dimensional (2D) material, exhibit many characteristics that absence in conventional bulk or thin-film materials. Interlayer van der Waals force combinations can efficiently reduce the lattice mismatch induced inside or interlayer trap densities, extremely thin thickness of the channel enables the background carriers easily suppressed by local electric field and provides a performance enhancement way by introducing local light field with artificial micro-nano structures, thickness dependent physical and optoelectronic properties enable a new kind of tunable IR detection, which dramatically reduce the dark current and associated noise of device and provide new ideas for IR photon detections at room temperature.

In this report, the progress and challenges of IR photon detectors operating at room temperature are introduced. Firstly, we will introduce some typical low-dimensional materials which can be fabricated as high-performance IR photon detectors working at room temperature in details; then, the device structure innovations and physical effects that have underpinned in performance improvements are illustrated; and the detail reasons for optical absorption enhancement ability of artificial photonic structures induced optical local field are explained; at last, we will present the advanced progress in applications.

10:15-10:30 Oral Presentation C054

Wavelength-tunable passively mode-locked fiber laser at 1.5 um

Peng Wu, Yunru Fan, Si Shen, Yueqi Wang, Guangwei Deng, You Wang, and Qiang Zhou
University of Electronic Science and Technology of China, China

Abstract. Wavelength-tunable passively mode-locked fiber laser, which delivers femtosecond or picosecond laser pulses at different central wavelengths without inserting any modulators in the cavity, has always been used in nonlinear optics as a pump source to pump different nonlinear processes such as spontaneous four wave mixing (SFWM). In our study, we experimentally demonstrate a wavelength-tunable passively mode-locked fiber laser at 1.5 μm based on Erbium doped fiber amplifier (EDFA), semiconductor saturable absorber mirror (SESAM), and birefringence Sagnac filter. The lasing wavelength can be contiuously tuned from 1544.1 nm to 1560.8 nm by adjusting the pass band of birefringence Sagnac filter, and the period of mode-locked pulse train is 215 ns. During 10 hours, the mode-locked laser works stably. Owing to such advantages as the simple structure, stable work, and easy assembly, such a laser can provide short laser pulses with high quality for applications in nonlinear optics at the 1.5 μm band.

Sept. 06, 2019 – Technical Session 24

T24 – Laser Technology - D	
Invited Speeches (Chengbo Mou; Jianfeng Li)	
Session Chair: Guiyao Zhou, South China Normal University, China	
Time: 9:00-10:30	**Venue: Lotus Hall 4**

9:00-9:30 Invited Speaker | **Chengbo Mou** | Shanghai University, China

Chengbo Mou obtained his B.Eng degree in electronic science and technologies from Tianjin University in 2004. In 2005, he received M.Sc in photonics and optoelectronic devices from the University of StAndrews in Scotland. He received his Ph.D degree in photonics from the Aston Institute of Photonic Technologies at Aston University in 2012. He then worked as an industrial research fellow at Aston University. From 2016, he joined in the Key Laboratory of Specialty Fiber Optics and Optical Access Networks as a full professor. He is the recipient of National “Young 1000 Talent” programme of China, he is also the recipient of Young Eastern Scholar Fellowship from the Shanghai Institute of Higher Learning. His research interests are nanophotonics, nanomaterial based nonlinear photonic devices, ultrafast fiber lasers, novel type of mode locked lasers, nonlinear applications of advanced fiber grating devices.

GHz harmonic mode locked erbium doped fiber lasers with high signal to noise ratio

Abstract. The development of GHz repetition rate ultrashort pulse fiber lasers has attracted considerable attentions over the past few decades. Various techniques have been developed to obtain GHz repletion rate fiber laser cavities including short cavity, dissipative four wave mixing etc. Harmonic mode locking is one of the popular ways to generate high repetition rate ultrashort pulses. In this report, we present our recent experimental results on achieving GHz repetition rate ultrashort pulses using meters long optical fiber laser cavity. Inspiring by the soliton area theorem, we designed erbium doped fiber laser with optimized dispersion mapping. With the low cost carbon nanotube composite film saturable absorber, by tuning the intracavity birefringence properly, we could achieve GHz repetition rate with over 30 dB side mode suppression ratio. The operation mechanism could contribute to both C band and L band.

9:30-10:00 Invited Speaker | **Jianfeng Li** | University of Electronic Science and Technology of China, China

Jianfeng Li (Outstanding Youth Foundation, IEEE senior member, EU Marie Curie International Incoming Fellow) received his BS degree in applied physics from Sichuan University in 2003, and MS and PhD degrees in Optical Engendering from Sichuan University in 2005 and 2008, respectively. Since 2008, he began to work in the School of Optoelectronic Science and Engineering, University of Electronic Science and Technology of China (UESTC). In 2011, he joined the Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS) at University of Sydney as a visiting scientist. In 2013, he joined the Aston Institute of Photonic Technologies (AIPT) at the Aston University (UK) as a Marie Curie International Incoming Fellow funded by the European Commission's Seventh Framework Program (FP7). He has been promoted to a full professor at UESTC from 2015. His current research interests focus on mid-infrared fiber laser technology, and ultrafast & nonlinear fiber optics. He is current an editorial member of Scientific Reports and has published over 100 papers.

Progress on pulsed mid-infrared fiber lasers

Abstract. 3~5 μm is an important mid-infrared spectral region that is an atmospheric transmission window while containing characteristic vibrational transitions of many molecules. Thus, the laser in this band have potential applications in such as biomedicine, material processing, free-space communication, infrared countermeasures, etc. In the recent years, mid-infrared fiber laser is being developed towards longer wavelength, higher power, high energy, and ultrafast pulse generation with the more and more mature fabrication technique of infrared glass fiber

and active/passive fiber device. This presentation introduced our recent progress on mid-infrared fiber lasers at 3-4 μm. Based on 2D PbS nanoparticles saturable absorber (SA), we demonstrated tunable passive Q-switching from a Dy3+-doped ZBLAN fiber laser at the range of 2.71~ 3.08 μm that is the current tuning record from a pulsed rare-earth doped fiber laser. Based on dual-wavelength (1981 nm+976 nm) pumped ~3.5 μm Er3+-doped ZBLAN fiber laser platform, we demonstrated the first watt-level (i.e., 1.04 W) gain-switching output by ultilizing μs-scale 1981 nm pulses as the pump, which mitigated the power quenching happened during one pump pulse. Then the wavelength tuning of passive Q-switching based on this transition was presented using Fe^{2+}:ZnSe crystal at the range of 3.4~3.7μm, representing the first tunable pulsed report in this band. Moreover, we proposed the Technical dual-wavelength pumping (DWP) method (655nm+1981 nm) to demonstrate efficient power scaling of the ~3.5 μm Er3+-doped ZBLAN fiber laser. In contrast to the common cascade DWP method (976 nm+1981 nm), the direct experimental comparison implied that at a same 1981 nm pump power, a lower pump power of 655 nm (than 976 nm) was required to yield higher ~3.5 μm emission. At last, we will make a prospect on the future of mid-infrared fiber lasers.

Sept. 06, 2019 – Technical Session 25

T25 – Fiber-Based Technologies and Applications - E	
Invited Speeches (Fufei Pang; Bo Lin; Baishi Wang)	
Session Chair: Xuping Zhang, Nanjing University, China	
Time: 9:00-10:30	**Venue: Rose Hall 1**

9:00-9:30 Invited Speaker | **Fufei Pang** | Shanghai University, China

Prof. Fufei Pang has received Ph.D. in optical engineering from Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences at 2006. He has joined in the Key Laboratory of Specialty Fiber Optics and Optical Access Networks in Shanghai University since 2006. In 2010, he has visited the Fiber Research Center of the University of New South Wales, Australia for one year. His research interest focuses on special fiber optics and fiber sensing. He has received the National Science Fund for Excellent Young Scholars at 2014, and been supported by Key projects of the National Natural Science Foundation of China at 2017. He has published more than 100 papers indexed by SCI/EI. He is the associate editor of journal of optical communication technology.

The Orbital Angular Momentum Modes for Magnetic Field Sensing

Abstract. The orbital angular momentum (OAM) beams have attracted much attention in many fields recently including telecommunications, atom trapping, tweezers, quantum information science, etc. The Faraday-rotation-effect based magnetic field measurement is one of the most typical and important applications for OAM modes. Our group has achieved the use of the compositing two OAM beams in a Sagnac configuration comprising a $Bi_4Ge_3O_{12}$ (BGO) magneto-optic crystal to realize the magnetic field sensing. Moreover, we have proposed and demonstrated a vortex fiber with the superposition of OAM modes for magnetic field sensing for the first time. The theoretical studies and the experimental investigation of OAM for magnetic field sensing will be discussed in this talk.

9:30-10:00 Invited Speaker | **Bo Lin** | China Academy of Electronics and Information Technology, China

Prof. Dr. Bo Lin, from China Academy of Electronics and Information Technology, China, focuses on fiber optics sensors and fiber optics communications. He has published a series of refereed journal papers and conference papers in the related research areas. He is a reviewer of Optics Letters, Optics Express, IEEE Photonics Technology Letters and so on.

Fiber Bragg Grating Sensors for Perimeter Intrusion Detection Applications

Abstract. A type of specially designed fiber Bragg grating sensors will be introduced for perimeter security applications, particularly for fence and wall intrusion detection. The proposed technique can be used for certain places such as airport, ammunition depot, museum, prison, nuclear power plant and so on.

10:00-10:30 Invited Speaker | **Baishi Wang** | Thorlabs Vytran Division, USA

BAISHI WANG is currently with Thorlabs Vytran Division in New Jersey, USA. He received his Ph.D from SUNY at Stony Brook on Engineering in USA. His research focus is on fiber lasers and amplifier, rare-earth doped specialty fibers, specialty fiber glass processing, fused component fabrication, fiber sensing, and precision fiber optics instrumentation. Prior to joining Vytran, he was a member of technical staff in Specialty Fiber Division at Lucent Technologies and then OFS. He has published many papers in referred journals and conferences and has filed several US and world patents. He has frequently provided invited talks in SPIE, OSA and other conferences. He is a short course lecturer in SPIE Photonics West Conference for last 10 years. He was a technical committee member for SPIE/OSA conferences and is a regular paper reviewer for leading photonics journals. He is a senior member of SPIE and member of OSA.

Latest advance of specialty fiber glass processing techniques for applications in fiber laser and sensing

Abstract. Specialty fibers glass processing plays an important role in inter-connecting dissimilar fibers and fabricating all-fiber fused fiber components and devices for both R&D and productions. In this paper, we discuss latest advance of fiber glass processing techniques based on CO2 laser and filament fusion methods. We illustrate underlying fundamental fiber processing optics associated with each technique and show some practical examples. We describe applications of these techniques for different applications in fiber laser, photonics lantern, and fiber sensing.

Sept. 06, 2019 – Technical Session 26

T26 – Precision Optics - B	
Invited Speeches (Zhihua Li; Jianwen Dong; Nan-Kuang Chen)	
Session Chair: Yaocheng Shi, Zhejiang University, China	
Time: 9:00-10:30	Venue: Lotus Hall 2

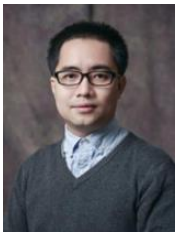
9:00-9:30 Invited Speaker | **Zhihua Li** | Institute of Microelectronics, Chinese Academy of Sciences, China

Zhihua Li, a professor from the Institute of Microelectronics, Chinese Academy of Sciences(IMECAS), is the director of Silicon Photonics Platform of IMECAS. He received the B.S. and M.S. degrees in material science from Central South University in 1998 and 2002 respectively. He received the Ph.D. degree in condensed matter physics from Institute of Physics, CAS in 2006. Based on 8 inch CMOS process line, he developed the silicon photonics platform and provides MPW services for domestic and foreign researchers. At present, Zhihua Li is focusing on the silicon photonics platform development and the research of new silicon-based optical materials, process and device.

MPW Fabrication for Silicon Photonics

Abstract. Silicon photonics is poised to revolutionize many application areas, such as telecommunication, date centers, biosensing, Lidar, etc. Multi-project wafer (MPW) fabrication allows new players to enter the silicon photonics field at a modest expense, and accelerated the pace of research and development. This report introduces the MPW service of the Silicon Photonics Platform of Institute of Microelectronics, Chinese Academy of Sciences(IMECAS), In which silicon photonics process, device library and design ruler will be shared with the audience of this session.

9:30-10:00 Invited Speaker | **Jianwen Dong** | Sun Yat-sen University, China



Dr Jian-Wen DONG, Professor of Cheung Kong Scholar Youth Professor, NSFC Excellent Young Scientists. He 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 metaphotonics, topological photonics, photonic crystal and metasurface, and holography. Dr. Dong has published several original works in high impact journals including Nature Materials, Physical Review Letters, Nature Communications, Light: Science & Applications, two of which are selected as ESI highly-cited papers, and one of which is selected the "top ten progress of Chinese optics in 2017 - basic research".

Metalens array for white-light 3D integral imaging

Abstract. Integral imaging is a promising three-dimensional (3D) imaging technique that captures and reconstructs light field information. The concept was subsequently verified by using a suitable microlens array in 1948, and recently, the possibility of merging integral imaging into a smart phone has been reported by utilizing a matching microlens array. Integral imaging displays encode 3D objects with computational algorithms but reconstruct optical images experimentally in free space; thus, the workflow is somewhat opposite to that of a light-field camera. Here, we realize a silicon nitride metalens array in the visible region that can be used to reconstruct 3D optical scenes in the achromatic integral imaging for white light. The metalens array contains 60×60 polarization-insensitive metalenses with nearly diffraction-limited focusing. The nanoposts in each high-efficiency (measured as 47% on average) metalens are delicately designed with zero effective material dispersion and an effective achromatic refractive index distribution from 430 to 780 nm. In addition, such an achromatic metalens array is composed of only a single silicon nitride layer with an ultrathin thickness of 400 nm, making the array suitable for on-chip hybrid-CMOS integration and the Technical manipulation of optoelectronic information. We expect these findings to provide

possibilities for full-color and aberration-free integral imaging, and we envision that the proposed approach may be potentially applicable in the fields of high-power microlithography, high-precision wavefront sensors, virtual/augmented reality and 3D imaging.

10:00-10:30 Invited Speaker | **Nan-Kuang Chen** | Liaocheng University, China

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.

Off-axis fiber optic interferometric sensors with nanoscale resolution

Abstract. Optical interferometry is featured with a best spatial resolution of 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 microsensing in nanoscale applications. In contrast, we propose a new off-axis optical interferometry with the best spatial resolution of 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 precision optical ruler with nanoscale resolution and molecular microsensing with high accuracy.

Sept. 06, 2019 – Technical Session 27

T27 – Infrared Technologies and Applications - E	
Invited Speeches (You Wang; Zhenzhou Cheng)	
Session Chair: Guangwei Deng, University of Electronic Science and Technology of China, China	
Time: 9:00-10:30	**Venue: Lotus Hall 5**

9:00-9:30 Invited Speaker | **You Wang** | Southwest Institute of Technical Physics, China

Prof. You Wang was born in China, in 1966. He received the B.S. degree in laser technology from Zhejiang University, Hangzhou, China, in 1986, and the M.Sc. degree in optics from Chinese Academy of Science (registered in Hefei University of Technology), Hefei, China, in 1991, respectively. He received the Ph.D. degree in electronics/communication from Tohoku University, Sendai, Japan, in 1997. After then, he worked as an assistant professor of Tohoku University, a researcher of the major institutes of RICOH Co. Ltd, and a laser scientist of both the Center Laboratory of HPK Co. Ltd and Institute of Physical and Chemical Research of Japan (RIKEN) for more than 15 years. He is currently a national distinguished professor of China with Southwest Institute of Technical Physics, Chengdu, Sichuan, China. He is also involved in various aspects of theory and practice of several types of lasers as well as their industrial applications. His current research interests include kinetic processes, molecular and atomic physics, solid-state lasers, semiconductor lasers, gas lasers, image processing, micro laser processing, special waveguides and optoelectronic technology. These works have been published in more than 150 refereed scientific papers (reviews) in the scientific journals and

academic conferences. He has also applied 38 patents in the Unite States, Japan, China, and Europe Union.

Infrared Laser, an Entry Point for Remote Detection

Abstract. In the recent year, the mid-infrared spectral region between 2 micrometers and 5 micrometers has been paid more and more attention due to the presence of a lot of enabling applications in the field of environmental monitoring, gas sensing, medical examination, and defense applications. In such a mid-IR spectral region, some kinds of lasers are the most common light sources for remote detection (RD) such as high-resolution spectroscopy and high-resolution infrared laser radars, which are effective sensors for the use of remote detection. In this report, we will introduce several kinds of solid-state lasers and fiber lasers which have been utilized in remote detection in the mid-infrared region. These lasers can be employed in remote detection such as gas leakage at specific locations and explosives as well as their traces on contaminated surfaces, which have recently gained much interest. By using these mid-infrared lasers, some novel detection methods ensuring safe and green operation have been well established in the applications for counterterrorism because they facilitate analyses without contact between human beings and hazardous materials.

9:30-10:00 Invited Speaker | **Zhenzhou Cheng** | Tianjin University, China

Dr. Zhenzhou Cheng is currently a professor at Tianjin University. He received his B.S. degree in Physics and M.S. degree in Optics both from Nankai University. He received his Ph.D. degree in Electronic Engineering from the Chinese University of Hong Kong. In 2015, he joined Goda Lab in the Department of Chemistry at the University of Tokyo as an assistant professor. In 2018, he was selected in Thousand Talents Program and then joined School of Precision Instrument and Opto-Electronics Engineering at Tianjin University. His research interests focus on novel photonic integrated circuits and nanophotonic devices for applications in sensing, spectroscopy, and nonlinear optics. He published over 60 peer-reviewed papers in top-tier academic journals, namely, Nature Photonics and Nature Communications, and received several academic awards such as Second-Class Award in Research Achievements, Ministry of Education, China (2014), Young Scientist Award, Hong Kong Institute of Science (2013), Young Scholar Thesis Award, the Chinese University of Hong Kong (2013).

Novel germanium platform for mid-infrared integrated optics

Abstract. Mid-infrared silicon photonics has tremendous applications in biochemical sensing and spectroscopy. However, traditional silicon platforms cannot cover the fingerprint spectral region, which spans approximately 8-14 μm. Here I report our research progress in mid-infrared germanium photonics to overcome the above limitation. Specifically, I discuss our progress in developing novel suspended membrane germanium photonic integrated circuits for mid-infrared photonics, which includes focusing subwavelength grating couplers, suspended membrane waveguides, and high-Q micro/nano cavities. This study opens a new way of developing chip-integrated mid-IR applications in biochemical sensing and spectroscopy.

Sept. 06, 2019 – Technical Session 28

T28 – Infrared Technologies and Applications - F	
Invited Speeches (Guangwei Deng; Andrey Generalov); Oral Presentations (C031; C055)	
Session Chair: Weidong Wu, China Academy of Engineering Physics, China	
Time: 10:50-12:20	**Venue: Lotus Hall 6**

10:50-11:20 Invited Speaker | **Guangwei Deng** | University of Electronic Science and Technology of China, China

Guang-Wei Deng was born in Sichuan Province, China, in 1987. He received the Ph.D. degree in physics from University of Science and Technology of China, Hefei, China in 2016. He is a professor in Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China . His current research interest includes quantum opt-mechanics, defects in diamond or SiC, and quantum applications in 2D materials.

1D/2D NEMS for Quantum Information applications

Abstract. In this talk, I will introduce our recent works on 1D and 2D NEMS, including carbon nanotube and graphene resonators. First, I will show our efforts on scaling 2D quantum dot chips with a microwave resonator, where the resonator served as the quantum bus. Then we tried to explore nano-electromechanical resonators as phonon buses. I will introduce some works about strongly coupled nano-mechanical resonators based on carbon materials, such as carbon nanotube and graphene. These resonators have very high resonant frequencies and are highly tunable. We have experimentally realized the strong coupling between charge transport and mechanical motions, and also observed strong coupling between different modes of one mechanical resonator. Moreover, we realized the coherent phonon Rabi operation using the strong coupling and we further implement a tunable distant strong coupling between two mechanical resonators. These results have shown that the strongly coupled nano-mechanical resonators can provide a platform for the coherent electron-phonon interactions, the long distance phonon (electron) interactions and entanglement state generation, and we can exploit them as future quantum buses for solid state qubits, such as quantum dot based qubits.

11:20-11:50 Invited Speaker | **Andrey Generalov** | Aalto University, Finland

Dr. Andrey Generalov received the M.Sc. degree in solid-state physics from Moscow Institute of Physics and Technology in 2010, and the Ph.D. degree in electrical engineering from Aalto University, Finland in 2015. He is currently at the Department of Electronics and Nanoengineering, Aalto University, Finland. His research interests include THz detectors and sources, as well as implementation of novel materials in THz electronics and photonics.

Graphene THz photodetectors

Abstract. Many applications such as bio sensing, medical diagnostics and security screening can significantly benefit from THz technologies. However, state of the art THz detectors are typically based on cryogenically cooled systems or expensive semiconductor technologies. Graphene is one of the most promising material for future affordable high-performance room-temperature THz detectors. In the recent years the graphene technology has been significantly pushed, offering large scale devices with its relatively simple, flexible and cost-effective fabrication and integration technologies.

11:50-12:05 Oral Presentation C031

Dark Current Characteristic of p-i-n and nBn MWIR InAs/GaSb Superlattice Infrared Detectors

Yang Li, Wenliang Xiao, Liyuan Wu, Xiumin Xie, Pengfei Lu, Shumin Wang
Beijing University of Posts and Telecommunications, China

Abstract. The theoretical dark current model of InAs/GaSb type II superlattice (T2SL) p-i-n and nBn photodetectors is presented. The nBn structure was designed to suppress generation-recombination (G-R), surface leakage and tunnel currents. 8 band k·p model including the conduction and valence band mixing was applied to calculate the band structure and optical transition of InAs/GaSb T2SL. Theoretical calculations are performed for different doping level of p-i-n and nBn detectors. For p-i-n detector, dark current was studied for different p-contact layer doping and different absorber layer doping. For nBn detector, different contact doping concentration and absorb doping concentration was studied. At low temperature, dark current of p-i-n detector was dominant by generation-recombination and tunnel current, nBn structure can inhibit tunnel and generation-recombination current. At high temperature, the dark current of p-i-n detector and nBn detector have the same order of magnitude and are both dominated by diffusion current. Quantum efficiency and resistance-area product of p-i-n and nBn detectors were also calculated at 120 K, quantum efficiency of p-i-n detector is a bit larger than nBn detector, but dark current and resistance area product of nBn detector are better.

12:05-12:20 Oral Presentation C055

Emerging Quantum Optics Technologies Employed in Laser Metrology Fields

Si Shen, Guangwei Deng, Yunru Fan, Bin Li, Qiang Xu, Peng Wu, Yong Wang, Hao Li, Lixing You, You Wang, and Qiang Zhou
University of Electronic Science and Technology of China, China

Abstract. By introducing quantum optics technology including quantum correlation, quantum superposition, quantum non-cloning theorem and quantum entanglement to laser metrology fields, it is helpful to break the limits of traditional laser metrology. In this paper, we study the potential applications about quantum correlation and HOM interference employed in the lidar and photon counting employed in the traditional Optical Time-Domain Reflectmetry (OTDR). On the one hand, we prepared the correlated two-photon source based on dispersion-shifted fiber, the maximum of two-photon generation rate and coincidence count to accidental coincidence count ratio is about 8000 Hz and 15, respectively. We assembled a HOM interferometer for weak coherent light interference experiment, the visibility of interference fringe is more than 0.4. HOM interference can improve the time measuring precision of lidar to 0.93 ps, and the corresponding spatial resolution is 280 μm. On the other hand, we develop a photon-counting OTDR, overcoming the trade-off between the large bandwidth and high sensitivity in the classical photodetector, and increasing the spatial resolution of the OTDR to a level of less than 9 cm. These results lay a foundation for further research of laser metrology fields.

Sept. 06, 2019 – Technical Session 29

T29 – Biophotonics and Biomedical Optics - D	
Invited Speeches (Junle Qu; Zhilin Xu); Oral Presentation (C038)	
Session Chair: Junle Qu, Shenzhen University, China	
Time: 10:50-12:20	**Venue: Lotus Hall 4**

10:50-11:20 Invited Speaker | **Junle Qu** | Shenzhen University, China

Dr. Junle Qu is a professor in the Center for Biomedical Photonics & College of Physics and Optoelectronic Engineering, Shenzhen University. His research interests include nonlinear multimodal optical imaging, super-resolution optical imaging, imaging guided optical therapy and nanobiophotonics technologies for bio-sensing, imaging and therapy. He has published over 230 papers in peer-reviewed journals including Nature Photonics, Nature Communications, Chem, Chemical Society Reviews, Advanced Materials, Nano Letters. He is the Fellow of SPIE and the director of Biomedical Photonics Committee of Chinese Optical Society. He serves in the editorial boards of several journals including JIOHS, Frontiers of Optoelectronics, etc..

Advances in super-resolution optical microscopy

Abstract. Super-resolution optical microscopy has made great progress in recent years, providing a powerful tool for biology. Super-resolution imaging allows for the observation of fine structures of cells, cellular dynamics and cellular functions at nanometer scale, which greatly promotes the development of life science and many other fields. However, some challenges still exist with super-resolution, which limits its applications.

In this talk I will present our recent work in super-resolution optical microscopy. (1) To improve imaging depth of STED microscopy, we implemented adaptive optics (AO) in STED to circumvent scattering and aberration effect for thick and scattering samples. We proposed to use time-gating based phasor plot analysis, modulation of fluorophore lifetime, or depletion efficiency digital enhanced method to further improve spatial resolution of STED or lower STED power at same spatial resolution. We also developed novel STED probes, such as perovskite QDs, carbon dots and CdSe@ZnS QDs to improve the spatial resolution and photo-stability, or lower STED power. (2) With optimized reconstruction algorithm and new probes, we could perform STORM imaging of mitochondrial dynamics without adding any imaging buffer or thiols to live cells, which allows for the observation of mitochondrial fusion, fission, dynamic tubulations and tubule interconnection. STORM imaging has also been combined with PDT treatment using a novel nanoliposome NPs co-encapsulating PDT photosensitizer and STORM probes. We also developed new method for multi-color, multi-layer 3D-STORM imaging of biological thick samples. (3) To increase imaging speed of super-resolution, we developed a virtual single-pixel imaging microscopy which provides two-fold higher spatial resolution and nine-fold higher imaging speed compared with SIM.

11:20-11:50 Invited Speaker | **Zhilin Xu** | Huazhong University of Science and Technology, China

Zhilin Xu received the B.Sc. degree in Optical Information Science and Technology from Nanchang University, China, in 2011, and the Ph.D. degree in Optical Engineering from Huazhong University of Science and Technology (HUST), China, in 2016. Then she joined the Centre for Optical Fibre Technology at Nanyang Technological University, Singapore, as a postdoc research fellow in June 2016. Since August 2018, she has been the Associate Research Professor at School of Physics in HUST. Her research spans micro-structured optical fiber devices, optical fiber precision displacement sensors, accelerations and relative gravimeters.

Theta-shaped microfiber resonator for light controlling, lasing and sensing

Abstract. Due to the properties of compact size, tight confinement, large evanescent field and low transmission loss,

optical microfibers have become an excellent platform for miniature fiber-optic devices. In this paper, our recent progress in design, theory and fabrication of a theta-shaped microfiber resonator (θ-MR) and its applications in light controlling, lasing and sensing are discussed.

Firstly, we present the basic optical properties and fabrication method of the θ-MR. The special θ-shaped physical configuration endows the θ-MR with bidirectional output, and enables two degenerate counter-propagating resonant modes to coexist in the cavity. Because of the destructive interference between the two modes, the θ-MR exhibits EIT-like effect and multiple filtering functions.

Then, the light velocity control ability benefiting from the EIT-like effect of the θ-MR is investigated. Theoretical analysis reveals that the group delay could be extensively tuned from -1400ps (fast light) to 600ps (slow light) by micro-mechanical adjustment of the resonator structure. Experimentally, fast light up to 60ps and slow light up to 200ps are achieved.

Finally, since the θ-MR is a reflective all-fiber device with comb spectrum under weak coupling condition, by cascading it with a fiber Fabry–Pérot interferometer, Vernier effect can be generated. Due to the Vernier effect, a single-longitudinal mode fiber laser with thermally switchable wavelength is obtained. In addition, sensitivity tuned from 311.77nm/RIU to 2460.07nm/RIU for refractive index detection is experimentally realized by adjusting the cavity length of the θ-MR, which can be widely used for chemical and biological detection, etc.

11:50-12:05 Oral Presentation C038

Multiscale confocal photoacoustic dermoscopy: translation from bench to bedside

Haigang Ma, Zhongwen Cheng, Zhiyang Wang and Sihua Yang
South China Normal University, China

Abstract. Imaging plays an indispensable role in clinical diagnosis and assessment of dermatological conditions by providing high-dimensional physiological, pathological and phenotypic information with clinical relevance. However pure optical or non-optical imaging techniques are either limited to imaging depth (~1 mm in human skin) arising from biological light scattering or lack functional contrast and spatiotemporal resolution to image pathophysiological mechanisms in detail. Here, we demonstrate that multiscale confocal photoacoustic microscopy (MC-PAM) equipped with an opto-sono objective can bridge the high spatiotemporal resolution (1.5 μm in-plane resolution) and the deep penetration (at least 1.8 mm in human skin) and functional contrasts in clinical dermatology. Using the multiscale adjustable mode and variable focus objective to coordinate spatial-resolution and depth capabilities, we showcase how skin morphology and vascular patterns obtained by MC-PAM from epidermis to dermis with comprehensive clinical indexes, enabling quantification of vascular malformations and other biomarkers of skin disease without the need for contrast agents. The method can serve as a great potential tool for the diagnosis and curative effect evaluation of human skin disease.

Photoacoustic dermoscopy (PAD), a promising branch of optical-absorption based photoacoustic microscopy (PAM), can provide manifold morphologic and functional information in clinical diagnosis and assessment of dermatological conditions. It is complementary to the sophisticated optical microscopic technologies, such as confocal microscopy, multiphoton microscopy, and optical coherence tomography. Through focusing photoacoustic (PA) illumination onto skin tissue with a PA objective, the hybrid imaging modality of optical excitation and acoustic detection allows PAD to provide penetration beyond the optical diffusion limit with high resolution. However, the PA objective in most PAM setups is insufficient for clinical application of dermatology due to its single scale mode, resulting in poor depth resolution and low signal-to-noise ratio. Additionally, Conventional PAM imaging uses a narrow band ultrasonic transducer, which limits axial resolution and image capability of the whole system.

Multiscale imaging systems, recognized as an important future direction in biomedical engineering, needs the support of multiscale imaging technology with simultaneous high spatial resolution and deep penetration depth. In this work, the MC-PAD by being equipped with a multifunction opto-sono objective can bridge the spatiotemporal resolution and depth when applied in clinical dermatology. The opto-sono objective is mainly composed of the

multiple objective lenses, multiscale adjustable configuration and a broadband Polyvinylidene Fluoride (PVDF) ultrasound transducer (5-90 MHz), which can adjust the magnification and depth position of focus, finally realizes axial resolution of 1.5 micron and lateral resolution of 34 micron to depths of several millimeters for MC-PAD. Using the opto-sono objective to coordinate spatial-resolution and depth capabilities, MC-PAD can noninvasively obtain pathophysiological biomarkers and vascular morphology from epidermis to dermis with comprehensive clinical indexes, enabling quantification of skin abnormal degree without the need of exogenous contrast agents for human skin. This unique design can provide flexible and accurate skin imaging to obtain quantitative information of skin structure and components, which can serve as a great potential tool for revealing subsurface skin pathophysiology and longitudinal observations to assists in making scientific classification, optimizing therapy regimen, and quantifying and evaluating therapies.

Sept. 06, 2019 – Technical Session 30

T30 – Fiber-Based Technologies and Applications - F	
Invited Speeches (Songnian Fu; Yixin Zhang; Xuping Zhang)	
Session Chair: Baishi Wang, Thorlabs Vytran Division, USA	
Time: 10:50-12:20	**Venue: Rose Hall 1**

10:50-11:20 Invited Speaker | **Songnian Fu** | Huazhong University of Science and Technology, China

Songnian Fu received the B.Sc. and M.Sc. Degree from Xiamen University, Xiamen, China, in 1998 and 2001, respectively. He received the Ph.D. degree from Beijing Jiaotong University, Beijing, China, in 2005. From 2005 to 2011, he was with Network Technology Research Center (NTRC), Nanyang Technological University, Singapore, as Research Fellow. Since Feb, 2011, he has been a Professor in the School of Optical and Electronic Information, and Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, Wuhan, China. His current research interests include fiber optical transmission and fiber wireless convergence.

Specialty few-mode fibers

Abstract. We review the design, fabrication and characterization of several specialty few mode fibers (FMFs) including elliptical-core FMF (e-FMF), panda type FMF (P-FMF), and panda type e-FMF (PE-FMF).

11:20-11:50 Invited Speaker | **Yixin Zhang** | Nanjing University, China

Yixin Zhang received his BS degrees from the University of South East, Nanjing, China, in 2006. And he received his PhD degrees from the Nanjing University in 2011. In the same year, he joined Nanyang Technological University in Singapore as a postdoctoral researcher. Currently, he is an associate professor in the College of Engineering and Applied Sciences, Nanjing University. His research interest focus on the distributed optical fiber sensing technology and its engineering application. In recent years, over 100 papers and 84 patents have been published. 3 technology advancement awards from the ministry of education and Jiangsu Province were obtained.

Performance Enhancements for Phase-sensitive Optical Time Domain Reflectometry Based on Frequency Division Multiplexing

Abstract. The last years have witnessed the wide application of Phase-sensitive Optical Time Domain Reflectometry (Φ-OTDR) systems in many fields. However, it is also well-known that the traditional Φ-OTDR system suffers from Rayleigh backscattering (RBS) fading effects, which induce dead zones in the measurement results. Worse still, in practice it is difficult to achieve the optimum matching between spatial resolution and signal to noise

ratio (SNR). Further, the overall frequency response range (FRR) of the traditional Φ-OTDR is commonly limited by the length of the fiber in order to prevent RBS signals from overlapping with each other. Additionally, it is usually difficult to reconstruct high frequency vibration signals accurately for long range monitoring. In this paper, we introduce frequency division multiplexing (FDM) that makes it easier to improve the system performance with less system structure changes. Experimental results showed that the proposed sensing system offers a promising solution for the performance enhancement of Φ-OTDR systems that could achieve high SNR, broadband FRR and dead zone-free measurement.

11:50-12:20 Invited Speaker | **Xuping Zhang** | Nanjing University, China

Prof. Xuping Zhang received the B.Eng. degree, Master degree and Ph.D. degree in Electrical Engineering from Southeast University, China in 1983, 1986 and 1995, respectively. She was a Research Fellow in University of Texas at Austin from 2000 to 2002. Zhang worked in ETH-Zurich as a visiting professor in 1999. She is director of the Key Laboratory of Intelligent Optical Sensing and Manipulation, Ministry of Education and the Dean of Institute of Optical Communication Engineering of Nanjing University since 2002. So far, she has authored or co-authored more than 200 articles and 100 patens.

On-line Monitoring for External Damage of Power Transmission Line Based on Distributed Optical Fiber Sensing Technology

Abstract. The causes of these electrical transmission line anomalies, such as external damage, icing and galloping, are very complicated. In order to make good evaluation on the structure health condition of electrical transmission lines, the weather conditions, temperature, strain and the frequency of vibration must be taken into consideration synthetically. The conventional optical fiber sensing technology commonly rely on single parameter, which may lead to low reliability and high false alarm rate. To solve the above problems, a multi-parameter distributed optical fiber sensing system has been proposed for on-line monitoring on the icing, galloping and thunder striking, making it possible to do preparedness on these anomalies of a transmission lines.

Sept. 06, 2019 – Technical Session 31

T31 – Optical Communication and Networks - E	
Invited Speeches (Shanguo Huang; Tianshu Wang); Oral Presentations (C026; C032)	
Session Chair: Zhaoyu Zhang, Chinese University of Hong Kong, China	
Time: 10:50-12:20	**Venue: Lotus Hall 2**

10:50-11:20 Invited Speaker | **Shanguo Huang** | Beijing University of Posts and Telecommunications, China

Shanguo Huang received the Ph.D. degree in 2006 from Beijing University of Posts and Telecommunications (BUPT), Beijing, China, where he is currently a Professor and Deputy Director in the State Key Laboratory of Information Photonics and Optical Communications (IPOC). He is currently the Executive Dean of school of science in BUPT. He published 4 books and more than 150 journals and refereed conferences, and authorized 30 patents. He was awarded the National Science Fund for Excellent Young Scholars in 2016. His current research focuses on microwave photonics and optical networks.

Generation, detection, and applications of RF OAM beams

Abstract. The orbital angular momentum (OAM) has attached more and more attentions recently, due to its potential of the application in communication and detection. Our focus are on the radio frequency (RF) OAM, and a series of works have been conducted. We realize the system for the generation of RF-OAM beam, in which the optical controlled circular antenna array (CAA) is used and optical true-time delay (OTTD) theory is utilized. We

propose the method for mode detection for OAM beam with dual-mode. In the experiment, the phase gradient function of a circle around the OAM beam axis is gathered, the average value and peak/valley factor is calculated. We study the method for steering an RF-OAM beam. Different steering angles in 2-dimension can be achieved. We realize an optical-controlled system for fast mode switching of RF-OAM beams with different radiation direction. The system is based on a programmable controlled optical switch integrated into an optical controlled CAA, and mode switching is achieved within 20ms. We successfully measure the rotational Doppler frequency shift and rotational velocity of a spinning object from reflected RF OAM beams.

11:20-11:50 Invited Speaker | **Tianshu Wang** | Changchun University of Science and Technology, China

Professor Tianshu Wang is working in the National and Local Joint Engineering Research Center of Space Optoelectronics Technology, Changchun University of Science and Technology. His current research interests include space laser communications, fiber laser and applications. He has published over 120 papers and a book, and more than 18 inventions.

Propagation Characteristics of Partially Coherent Laser Communication in Atmospheric Turbulent Channel

Abstract. In recent years, free-space optical (FSO) communication has attracted a lot of attention because of its large channel capacity, no spectrum license requirements and low cost. However, the intensity scintillations caused by atmospheric turbulence is the main factor affecting FSO, which limits the application of FSO. The theoretical research and numerical simulation show that partially coherent beams (PCBs) are less susceptible to turbulence than fully coherent beams (CBs). In the latest two years, we have done several researches on the PCBs application in high speed FSO communication and its further development including the optimization of PCBs and optical time division multiplexing (OTDM) FSO communication system based on PCBs.

11:50-12:05 Oral Presentation C026

The Optimization Control of Model-Based Friction Compensation and Experimental Test for the Laser Communication System

Min Zhang, Yunjie Teng
Changchun University of Science and Technology, China

Abstract. Axis friction of the communication terminal mechanical system can influence the accuracy of the terminal motion control system. Friction can cause the steady state error and making the system response slow. Communication terminal will benefit from the friction compensation in the servo system. The performance of the servo system using the LuGre friction model for compensation is better than the same system without friction compensation. The high performance requirements for the terminal control system can be achieved. This paper describes the nonlinear friction mathematical model, the estimation of the model parameters and reports and analyzes the conclusions of the model-based friction compensation experiment. For an actual terminal motor drive system, the nonlinear friction characteristics of the terminal control system based on the friction compensation is presented. The effectiveness of this control technique is discussed and investigated.

12:05-12:20 Oral Presentation C032

EMD based Noise Suppression Technology for Indoor Visible Light Communication System

Jingyuan Feng, Chunyong Yang
South Central University for Nationalities, China

Abstract. EMD based noise suppression technology is introduced to alleviate the influence of solar noise and artificial light source noise for indoor visible light communication system. Both simulation and experiment are adopted to compare the performance with different EMD denoising methods. The results show that the noise

suppression technology based on EMD can relieve the effect of noise effectively, improving the stability and reliability of indoor visible light communication system.

Sept. 06, 2019 – Technical Session 32

T32 – Infrared Technologies and Applications - G	
Invited Speeches (Zaixing Yang; Jun Zhao); Oral Presentations (C046; C065; C074)	
Session Chair: E Wu, East China Normal University, China	
Time: 13:30-15:30	Venue: Lotus Hall 6

13:30-14:00 Invited Speaker | **Zaixing Yang** | Shandong University, China

Zaixing Yang is a full professor of School of Microelectronics at Shandong University. He received his Ph.D. degree in condensed matter physics in 2012 from School of Physics, Nanjing University. From 2012 to 2016, he worked as a postdoctoral fellow at Department of Physics and Materials Sciences, City University of Hong Kong. He joined Shandong University in 2016. His research interest mainly focuses on the controlled fabrication of low-dimensional semiconductor nanostructures for electronic and optoelectronic devices applications including field-effect-transistors, CMOS invertor, photodetector, and photovoltaic devices.

Ultrahigh hole mobility of GaSb nanowires for high speed infrared photodetectors

Abstract. Owing to the relatively low hole mobility, the development of GaSb nanowire (NW) electronics and photoelectronics devices was stagnant in the past decade. During a typical catalyst-assisted chemical vapor deposition (CVD) process, the adopted catalyst of metals can incorporate into the NW body to act as a slight dopant, regulating the electrical property of NW. In this work, we demonstrate the use of Sn as catalyst and dopant for GaSb NWs in the developed surfactant-assisted CVD growth process. The Sn-catalyzed zinc-blende GaSb NWs are thin, long, and straight with good crystallinity, resulting in a record peak hole mobility of 1028 cm2 V-1 s-1, which is attributed to the slight doping of Sn atom from catalyst tip into NW body, and verified by the red-shifted photoluminescence peak of Sn-catalyzed GaSb NWs (0.69 eV) in comparison with that of Au-catalyzed NWs (0.74 eV). Furthermore, the parallel array NWs also show high peak hole mobility of 170 cm2 V-1 s-1, high responsivity of 61 A W-1 and smart rise and delay times of 195.1 μs and 380.4 μs, respectively, to 1550 nm infrared light. All of the results demonstrate the promising applications of the as-prepared Sn-catalyzed GaSb NWs in next-generation electronics and infrared photodetection.

14:00-14:30 Invited Speaker | **Jun Zhao** | Kunming Insititute of Physics, China

Zhao Jun, Male, Ph.D., Professor, currently working in Kunming institute of physics, the vice-director of the infrared detector center, member of the technical committee for infrared and optical appliances belong to the Chinese optical society, and editor of the journal of infrared technology. He is mainly engaged in the research and development of photoelectric materials and devices for infrared detector.

The staring focal plane array detectors for infrared imaging seekers

Abstract. In this paper, the history and state of the art in infrared detectors for infrared imaging seekers is presented, and the basic parameters of IR-FPAs for infrared imaging seekers are discussed such as infrared wavelength band, array structure, format, F-number and so on. Finally, considering the various kinds of applications and developing technologies of infrared staring imaging sensors, the future trend of infrared focal plane array detectors is predicted.

14:30-14:45 Oral Presentation C046

Theoretical Evaluation of a Pulsed Mid-Infrared Ho^{3+}:BaY_2F_8 Laser

Kepeng Rong, He Cai, Xiaoxu Liu, Juhong Han, Wei Zhang, Guofei An, Hongyuan Wang, Lei Wang, and You Wang

Southwest Institute of Technical Physics, China

Abstract. In this study, we construct a theoretical model to analyze the output characteristics of a pulsed Ho^{3+}:BaY_2F_8 (Ho^{3+}:BYF) laser by taking both energy transfer up-conversion (ETU) and cross relaxation (CR) processes into account. The influences of the pump energy, pulse width, reflectance of an output coupler (OC), crystal length, and Ho^{3+} doping concentration on the physical performances are investigated in detail for an end-pumped structure. The calculation results reveal that the proper length of a Ho^{3+}:BaY_2F_8 crystal is from 5 to 10 mm for the Ho^{3+} doping concentration of 10-40 at.%. We also deduce that a high output can be obtained when the Ho^{3+} doping concentration is selected as 30 at.%. It has been demonstrated that the relaxation oscillation of a Ho:BYF laser can be observed for a pulsed pump source. We can see that the threshold peak power of a pump light source decreases with the increase of the pulse width. The conclusions might be useful for the realization of a pulsed mid-infrared Ho^{3+}:BYF laser.

14:45-15:00 Oral Presentation C065

On-orbit Star Observation Geometric Calibration and Its Applications to Correct the Positioning Error of Geostationary Cameras

Xiaoyan Li, Zhuoyue Hu, Xinyue Ni and Fansheng Chen

Key Laboratory of Intelligent Infrared Perception, Shanghai Institute of Technical Physics, Chinese Academy of Sciences, China

Abstract. Geometric calibration of remote sensing cameras is one of the most crucial technologies for the accurately quantitative applications involving on-orbit geometric positioning of remoting sensing cameras, depth measurement from stereoscopy, and target tracking and recognition from images of the geostationary satellite data. However, affected by the measurement errors of the internal and external orientation parameters, the centroid extraction error of the star points, the pointing error of the boresight caused by the shock and jitter of the satellite platform, and the positioning error caused by the spatial thermal deformation, the accuracy of the geometric positioning model of the cameras, inevitably, cannot meet the demand of high-precision measurements corresponding to the laboratory calibration before launch.

Here, in order to correct the positioning error caused by spatial thermal deformation, we propose a novel star observation correction method, which overcomes the drawbacks associated with current stabilization methods that involve shutting down the camera to reduce spatial thermal deformation effects, to modify the geometric positioning error of geostationary optical payloads. Experimental results show that the positioning error of short-wavelength infrared images corrected by the proposed method can be within ±1.9 pixels (2σ) at a 95% confidence level and better than the ±18 pixels before correction. In addition, an improved distortion correction method for large aperture infrared tracking cameras is also proposed to address the distortion model and the principle point and distance with high-precision measurement points in the focal plane. Associated experimental results show that the distortion errors corrected by the proposed method were 0.26 pixels in a near-infrared image and 0.19 pixels in a short-wavelength infrared image. These corrected distortion errors are better than that corrected by the two-dimensional Lagrange interpolation method of 0.36 pixels in a near-infrared image and 0.29 pixels in a short-wavelength infrared image, and the conventional distortion model of 0.54 pixels in a near-infrared image and 0.64 pixels in a short-wavelength infrared image, respectively.

15:00-15:15 Oral Presentation C074

Effect of Structure Imperfection on Si/SiO2-InP micropillar cavities as 1.55-μm Single Photon Sources

Shuai Huang, Qi Xi, Xiumin Xie, Qiang Xu, Shihai Wei, Si Shen, Qiang Zhou, Guangwei Deng, You Wang, and Hai-Zhi Song

Southwest Institute of Technical Physics, China

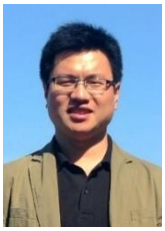
Abstract. Optical microcavities are widely studied for their prospects in optical communication, nonlinear optics, optoelectronics and quantum information processing. In the field of solid-state quantum information processing, microcavities containing semiconductor quantum dots (QDs) have been demonstrated effective as indispensable single photon sources (SPSs). As an efficient QD-containing micropillar-cavity SPS at telecommunication band is specifically required for fiber-based quantum communication, we have designed S_i/S_iO_2-InP hybrid micropillar cavities for 1.55-μm efficient and coherent single photon emission. However, the model of micropillar cavity may be different from a producible SPS because the processing technique never yield an ideal structure. In this work, we study the effect of structure imperfection on the cavity quality to ensure the feasibility of S_i/S_iO_2-InP hybrid micropillar cavities as 1.55-μm QD SPSs.

The micropillar cavity consists of Si/SiO_2 distributed Bragg reflectors (DBRs), adiabatic S_i/S_iO_2 DBRs on both the upper and lower sides of an InP spacer layer. InAs/InP QDs are embedded in the InP layer. With a sub-micrometer diameter and a height of ~7 μm, this cavity shows a quality (*Q*) factor of 8×10^4 at 1.55 μm, highly satisfying the strong coupling requirement for a coherent SPS. When the thicknesses and/or diameters of the DBR layers are not uniform any longer, the *Q* factor degrades and distributes in a larger and larger range. Nevertheless, the average *Q* can be still more than 10^4, sufficiently remaining the strong coupling effect, if the layer thickness and/or diameter vary within 5%. Fluctuation of 5% corresponds a 40 nm difference in diameter and a 10 nm difference in layer thickness, which are not a difficult processing precision in current fabrication techniques at all. When the micropillar becomes cone-shaped with side wall angle of -3 - ~1°, the *Q* factor remains higher than 8×10^4. Together with the weakly fluctuated mode wavelengths and almost invariant mode volumes, our results suggest the robustness against processing imperfection and the application feasibility of the hybrid S_i/S_iO_2-InP adiabatic micropillar cavities as 1.55 μm QD SPSs to be applied in silica-fiber-based quantum information processing.

Sept. 06, 2019 – Technical Session 33

T33 – Fiber-Based Technologies and Applications - G	
Invited Speeches (Zhifang Wu; Chao Wang; Nicolas Joly; Guiyao Zhou)	
Session Chair: Chao Wang, University of Kent, UK	
Time: 13:30-15:30	**Venue: Lotus Hall 4**

13:30-14:00 Invited Speaker | **Zhifang Wu** | Huaqiao University, China



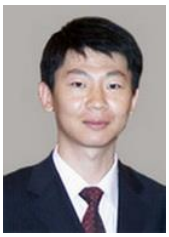
Dr. Wu received the B.S., M.S. and Ph.D. degrees from Nankai Univeristy, Tianjin, China, in 2002, 2005, and 2013, respectively. From 2013 to 2017, he worked in School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, as a postdoctoral Research Fellow. Then, he joined Huaqiao University as an Associate Professor.

Design and fabrication of helical-structured fiber sensors

Abstract. Optical fiber sensor has been widely used in many areas due to its intrinsic advantages such as lightweight, compact size, high sensitivities, immunity to electromagnetic interference, corrosion resistance, and so on. Recently, a new processing method, i.e., twisting optical fibers into helical shapes, attracts increasing attention due to the unique properties of helical-structured fibers. Such special structure fibers have been demonstrated great

potentials for both communication and sensing applications. In this talk, we will introduce some of our recent works on helical-structured multicore fiber based sensors. By using CO2 laser processing system, we fabricated different types of helical-structured multicore fibers (HSMCFs) and then constructed HSMCFs based sensors with different configurations for strain, torsion and temperature measurements.

14:00-14:30 Invited Speaker | **Chao Wang** | University of Kent, UK



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)

In-fiber Diffraction Grating for Wavelength Encoded Applications

Abstract. Optical diffraction elements (ODEs) are key components for innovative applications based on spectral encoding. 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, and high coupling loss between free-space diffraction gratings and optical fibres in the system. We report the use of a 45° tilted fiber grating (TFG) as a highly efficient, low cost and compact in-fiber diffraction grating device, featuring 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.

14:30-15:00 Invited Speaker | **Nicolas Joly** | University of Erlangen Nuremberg, Germany

Nicolas Joly is an associate professor at the University of Nüremberg-Erlangen, where he works on photonic crystal fibers. His domain of research includes nonlinear optics as well as quantum-optics in PCF. In particular he is very interested in the nonlinear generation of new frequencies like supercontinuum generation or the generation of non-classical states of light using PCF.

Pressure assisted generation of tunable non-classical light in engineered optical fibre

Abstract. Nonlinear optics in photonic crystal fibre requires phase-matching, which relies on the opto-geometrical properties of the waveguide. We overcome the stringent fabrication tolerances by using gas-pressure so as to finely adjust the dispersion properties of the fibre and efficiently create tunable correlated twin beam of non-classical light. The same strategy is used to perform third harmonic as the first step toward the generation of photon-triplet state.

15:00-15:30 Invited Speaker | **Guiyao Zhou** | South China Normal University, China

Guiyao Zhou received his Ph.D. degree in Optical Engineering from Yanshan University, China, in 2007. In 1998, he joined the School of Information Science and Engineering, Yanshan University as an Associate Professor and Professor. In March 2008, Professor Zhou worked as a postdoctoral at Department of Electrical Engineering, The Hong Kong Polytechnic University. In July 2010, he joined the School of Information and Optoelectronic Science and Engineering, South China Normal University as a Professor and is currently Director of Guangzhou Key Laboratory for Special Fiber Photonic Devices and Applications. His current research interests include fabrication of special optical fibres and Mid-infrared optical fiber, fiber lasers, and special optical silica fibre devices. He has

published more than 200 technical papers and awarded/applied about 30 patents.

Fabrication and Applications of Microstructure optical fibers

Abstract. After two decade development, Micro-structured Optical Fibers (MOF) have been recognized as vital optical devices and have played an increasingly important role in many fields, such as optical communication, fiber sensing, high power laser propagation, and fiber laser etc. However, due to the fine micro-structures inside the MOF, the technical difficulties in the fabrication of Micro-structured Optical Fibers still exist, which prohibits the MOF being widely used. This presentation introduces the progress achieved in the fabrication and applications of MOF as well as discussions on the technical challenges and promising prospects in the future.

Sept. 06, 2019 – Technical Session 34

T34 - Optoelectronic Devices and Applications - E	
Invited Speeches (Shangjian Zhang; Hau Ping Chan; Jianji Dong); Oral Presentations (C027; C061)	
Session Chair: Shangjian Zhang, University of Electronic Science and Technology of China, China	
Time: 13:30-15:30	**Venue: Rose Hall 1**

13:30-14:00 Invited Speaker | **Shangjian Zhang** | University of Electronic Science and Technology of China, China

Dr. Zhang is a full professor with the School of Optoelectronic Science and Engineering, University of Electronic Science and Technology of China (UESTC), Chengdu, China. He was involved in the New Century Talent Programme of Ministry of Education of China, and in the Distinguished Young Scholars of Sichuan Province of China. He was ever with City University of Hong Kong, Eindhoven University of Technology (TU/e), the Netherlands, University of Electro-Communications (UEC), Tokyo, Japan, and University of California, Santa Barbara (UCSB), as a visiting scientist. His research interests include high-speed microwave photonic devices and ultrafast optical signal processing in optical communication systems.

Self-calibrated microwave characterization for wafer-level integrated optoelectronic devices

Abstract. Heterogeneous silicon photonic integration enables fully integrated lasers, modulators and photodetectors, and promises large-scale photonic integration circuits (PICs) for future Exascale performance computers and datacenters. This dense integration, however, raises challenges for automatic testing. Particularly, a wafer-level and fiber-coupling-free microwave testing of modulators and photodetectors is highly desired.

The conventional discrete measurement with swept-frequency method allows measuring frequency responses of a modulator or photodetector with a vector network analyzer (VNA) combined with an opto-electrical (O/E) or electro-optical (E/O) transducer. It requires either intense calibrations to de-embedding the transducers, or the calibrated E/O and O/E transducers. When used for wafer-level devices, the PIC has to be broken down to individual devices to be probed with calibrated transducers, through the power-lossy and time-consuming optical coupling off chip.

In this talk, we will present recent progress on the self-calibrated RF characterization of high-speed optoelectronic devices and the on-wafer RF characterization of a silicon photonic integration transceiver. Fiber-coupling-free operation can be achieved for on-wafer extraction of frequency responses of modulators and photodetectors in the transceiver circuit, without any extra O/E or E/O calibration. The on-wafer and full-electrical test nature of probing kit significantly advances performance monitoring of PICs during chip fabrication, and promisingly offers predictable outcome and yield analysis before device packaging.

14:00-14:30 Invited Speaker | **Hau Ping Chan** | City University of Hong Kong, China

Dr. Andy Hau Ping CHAN is currently an Associate Professor of the Department of Electrical Engineering, City University of Hong Kong. His research interests are in the design, fabrication and characterization of integrated optical devices, waveguide materials and processing, photonic and electronic packaging, reliability and failure analysis, design and fabrication of polymer optical fibers for THz applications. He has published more than 200 papers in the internal conferences and journals such as Opt. Lett. Opt. Express, J. Light. Technol., and co-own 3 patents

Self-assembled Ferromagnetic Micro-structures for Optical Sensing

Abstract. Optical sensors normally demand either material choices or micro/nano strucrtural designs. However, the choice of materials or complex designs boosts the cost and limits their deployment in many sensing applications. Appart from that, these techniques are strongly wavelength and/or polarization dependent. In this talk, we review our recent proposed a low-cost versatile platform that uses the broadband evanescent-wave scattering for optical sensing. The principle is to scatter the propagating evanescent field of a planar waveguide by ferromagnetic micro-structures. These micro-structures are self-assembled by aggregation of ferromagnetic iron particles under magnetic field stimulation. The tip of the cantilevers structure is placed close to the surface of a liquid-cladded waveguide. When the tip is moving, the output power of the waveguide will be modulated accordingly due to scattering effect. To facilite the sensing, we demonstrate the proposed platform for applications including current sensing, displacement sensing and vibration sensing. Characterizations and optimizations were performed with respect to the sensing needs. The proposed platform show faborable signal reversibility, stability, broadband operation and real-time response.

14:30-15:00 Invited Speaker | **Jianji Dong** | Huazhong University of Science and Technology, China

Dr. Jianji Dong is professor in Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology (HUST), Wuhan, China. He is working on the silicon photonics, photonic computing, and microwave photonics. He is an Editorial Board Member of “Scientific Reports”. He received the National Best Dissertations Award in 2010 and the first award of Natural Science of Hubei Province in 2013.

Smart signal processor on silicon platform

Abstract. In this talk, we will present the recent progress on smart photonic signal processors with silicon integrated circuits, including MIMO, optical switches, polarization processors, and so forth.

15:00-15:15 Oral Presentation C027

On-Chip Narrowband Plasmonic Bolometer for MIR-IR Gas Sensing

Li Liang, Long Wen, Chunping Jiang and Qin Chen
Suzhou Institute of Nano-Tech and Nano-Bionics, China

Abstract. Air pollution is becoming a serious environment and society issue. Gas sensors with high sensitivity, high selectivity, portability and low cost are highly demanded. Although, electrochemical sensors are widely used in market, such sensors strongly suffer from poor selectivity and large power consumption and hysteresis. Infrared gas sensing is an alternative technique that relies on the optical absorption of gas molecular. It has high selectivity due to the spectral finger print of specific gas molecules and instant response at low power consumption as an optical technique. However, the conventional infrared IR gas sensors usually need centimeter long optical interaction length to achieve a high sensitivity due to the weak light-matter interaction. Moreover, to obtain the spectral finger print of the target molecule, spectrometer has to be used, which is bulky, expensive and has strict requirements on the

working environment.

In this paper, we proposed a novel surface sensitive plasmonic bolometer working in the Mid-IR range for gas sensing. The main idea is to integrate narrowband plasmonic absorber with a VO2 bolometer to enhance the thermoelectric efficiency and simultaneously provide a highly sensitive surface for the environment refractive index. Variation of the gas component changes the resonant absorption wavelength of the plasmonic absorber and thus induces a thermoelectric signal. The resonant wavelength of the plasmonic absorber can be tuned by the size of the microstructures. As a result, a series of narrowband plasmonic absorbers working at different wavelengths can be fabricated in single step lithography and aligned onto the bolometer array to form an on-chip spectrometer. Unlike the conventional optical method relying on the external spectroscopy, the proposed sensors enable independent on-chip gas sensing.

The plasmonic bolometer consists of silicon gratings covered by VO2, dielectric and metal multilayers. By optimizing the structure dimensions, a single absorption peak at 3.3μm with a FWHM of 12nm is obtained with the absorption close to 100%. The resonance peak has a remarkable shift with the refractive index variation of the gas environment, resulting in sensitivity up to 3300nm/RIU. The similar performance can be achieved in other wavelength range, for example 8-14μm, by simply changing the structural parameters. Using a typical membrane structure in bolometer design, a 0.7 degree variation can be induced by a refractive index change as small as 10-4 RIU. Considering the temperature detectivity of conventional bolometer, the refractive index detection limit reaches 7×10-6RIU. By constructing an array of the narrowband plasmonic bolometer, spectral resolution up to 10nm can be predicted based on the bandwidth of the plasmonic absorber.

15:15-15:30 Oral Presentation C061

Drastically Intensified Electric Fields by Exciting Localized with Extended Surface Plasmons for Sensitive Biosensing

Anran Li, Sachin K. Srivastava, Sivan Isaacs, Ibrahim Abdulhalim, Shuzhou Li

Beihang University, China

Abstract. Excitation of localized surface plasmons (LSPs) of metal nanoparticles (NPs) residing on a flat metal film has attracted great attentions recently due to the enhanced electromagnetic (EM) fields found to be higher than the case of NPs on a dielectric substrate. In the present work, we show that even much higher enhancement of EM fields is obtained by exciting the LSPs through extended surface plasmons (ESPs) generated at the metallic film surface using the Kretschmann-Raether configuration. We show that the largest EM field enhancement and the highest surface-enhanced fluorescence intensity are obtained when the incidence angle is the ESP resonance angle of the underlying metal film. The finite-difference time-domain (FDTD) simulations indicate that excitation of LSPs using ESPs can generate 1-3 orders higher EM field intensity than direct excitation of the LSPs using incidence from free space. The ultrahigh enhancement is attributed to the strong confinement of the ESP waves in the vertical direction. Combining FDTD simulations and the surface-enhanced Raman scattering experiments, we further show that the EM fields in LSP-ESP coupling configuration can be optimized with respect to the Au particle sizes, the vertical gap between the NP and the metal film, and especially the interparticle distance between adjacent NPs. Our work offers an important guidance for designing LSP-ESP coupling configurations with drastically intensified EM fields for highly sensitive biosensors and efficient optoelectronic devices.

Sept. 06, 2019 – Technical Session 35

T35 – Fiber-Based Technologies and Applications - H	
Invited Speeches (Minghong Yang; Xiaopeng Dong); Oral Presentations (C076; C081)	
Session Chair: Minghong Yang, Wuhan University of Technology, China	
Time: 13:30-15:30	Venue: Lotus Hall 2

13:30-14:00 Invited Speaker | **Minghong Yang** | Wuhan University of Technology, China

Minghong Yang is now a senior researcher (professor) of National Engineering Laboratory of Fiber Optic Sensing Technology (NEL-FOST) in Wuhan University of Technology, the guest professor of Friedrich-Schiller-Universität Jena (FSU Jena) and Technische Universitaet München (HM Munich), Germany. His current research interests include optical fiber sensors, optical fiber measurement and fiber micro-machining and sensitive materials for fiber optic sensing technologies. He has authored or coauthored more than 170 journal and conference papers and invited speaker of more than 20 top international conferences in recent 5 years. He holds more than 20 patents. He has served as the General Chair of the 4th Asia-Pacific Optical Sensors Conference (APOS 2013) and the 11th Conference for Optical Fiber Sensor in China (OFSC2019), and Technical Program Committee chair or Co-Chair for 5 times. He is a member of the Institute of Electrical and Electronics Engineers (IEEE), the international society for optics and photonics (SPIE), the Optical Society of America (OSA) and the German Society of Physics (DPG). He is Associate Editor of IEEE Sensors Journal. He was awarded Distinguished Lecturer of the IEEE Sensors Council in 2018.

Distributed Acoustic Sensing based on ultra-week fiber Bragg grating array

Abstract. A distributed acoustic sensing (DAS) system based on ultra-weak fiber Bragg grating (UWFBG) array fabricated by draw tower is proposed and experimentally demonstrated. The precise of the spacing between each adjacent UWFBGs is less than 1 mm, which is suitable for precise positioning and rapid demodulation such as gas and oil exploration. The system is capable of measuring vibrations of up to 5 kHz over 5 km with 2.5 m spatial resolution.

14:00-14:30 Invited Speaker | **Xiaopeng Dong** | Xiamen University, China

Xiaopeng Dong received Bachelor degree from Shandong University in 1983 and Master degree from University of Science and Technology of China (USTC) in 1986, respectively. After his graduation in 1986 he joined the faculty of USTC in the Department of Electronics Engineering and Computer Science. In 1998 he transferred from USTC to the Department of Electronics Engineering, Xiamen University, and became Full Professor in 2000.

Prof Xiaopeng Dong's research interests include: special fibers and optical waveguides; fiber gratings based components and sensors; single frequency optical fiber lasers; optical fiber current sensor; optical fiber gas sensor, etc. He was Senior Visiting Scholar in the Optoelectronics Research Center (ORC) in Southampton University from Feb. 1992 to May 1993, Department of Electronics Engineering of City University of Hong Kong from Jan. 1996 to Jan. 1997, and visiting Professor in the Department of Engineering Physics of McMaster University, Canada, in 2004, respectively. He has published over 100 journal and conference papers and obtained more than 10 patents.

Optical fiber sensors based on the mode interference in special few mode fiber

Abstract. Fibre optic mode interferometers have been intensively studied due to their merits of small and compact size, high sensitivity and flexibility, immunity to electromagnetic interference, and durability in harsh and corrosive environments. Various types of optical sensors have been proposed to measure different physical parameters including temperature, strain, bending or curvature, displacement, incline, pressure, moisture, etc. In this talk we will

give the principle and design examples of a class of optical fiber sensors based on the mode interference with a special few mode fiber possessing the so called critical wavelength (CWL) or the equalization wavelength. Therefore the measurement can be carried out either from the shift of CWL or from the changes of peak/dip wavelength located on the both sides of the CWL. Optimization and improvement of the property of the special few mode fiber for sensor applications are also discussed in the talk.

14:30-14:45 Oral Presentation C076

A Smart Fiber Optics Mattress for Multiple Vital Signs Monitoring

Senmao Wang, Liangye Li, Qizhen Sun
Beijing Jiaotong University, China
Abstract. Heart rate (HR) and respiration rate (RR) are two important indicators to reveal the human health status of cardiac and respiratory system. To achieve measurement of human vital signs, the fiber optics sensors based on photonic crystal fiber, fiber Bragg grating (FBG), hetero-core fiber, and plastic optical fiber have been reported. However, those optic fiber sensors are suffered from low cost. Here, a low-cost smart mattress system based on standard optical fiber Mach-zender interferometer (OFMZI) for simultaneously monitoring heart rate (HR) and respiration rate (RR) is developed.

14:45-15:00 Oral Presentation C081

Nuisance Alarm Rate Reduction Using Pulse-width Multiplexing φ-OTDR with Optimized Positioning Accuracy

Xiang Zhong, **Shisong Zhao**, Huaxia Deng, Dongliang Gui, Jin Zhang, Mengchao Ma
Hefei University of Technology, China
Abstract. High nuisance alarm rates and missing alarm rates in phase-sensitive optical time-domain reflectometers (φ-OTDRs) greatly restrict their practical application. In this paper, an asynchronous sampling pulse width multiplexing φ-OTDR is proposed to reduce both of these rates. Intersection and inclusion relationships among multiple positioning intervals are used to optimize the positioning accuracy. We construct an eight-pulse-width multiplexed φ-OTDR system and adopt a multisensor information fusion algorithm to verify the feasibility of the method. The experimental results show that this method can reduce the missing alarm rate by 93% and the number of nuisance alarms by 97%. The average positioning accuracy of the system is 21.4 m, which is equivalent to the spatial resolution level corresponding to the minimum pulse width in the optical pulse sequence. The positioning accuracy of some groups was as low as 6.4 m, far less than 20m. The proposed method provides a simple and feasible new approach for reducing nuisance alarm and missing alarm rates and optimizing the positioning accuracy of φ-OTDRs.

Sept. 06, 2019 – Technical Session 36

T36 – Optoelectronic Devices and Applications - F	
Invited Speeches (Changzheng Sun; Liangming Xiong); Oral Presentations (C024; C067)	
Session Chair: Qin Chen, Jinan University, China	
Time: 16:00-18:00	**Venue: Lotus Hall 6**

16:00-16:30 Invited Speaker | **Changzheng Sun** | Tsing Hua University, China

Changzheng SUN received the B.E., M.E. and Ph.D. degrees in electronic engineering from Tsinghua University, P.R.China, in 1995, 1997 and 2000, respectively. He became a faculty member of the Dept. of Electronic Engineering, Tsinghua University, China, in 2000, and was promoted as a full professor in 2010. His research interests include physics and fabrication technologies of high-speed photonic integrated circuits, nonlinear dynamics in semiconductor lasers and nonlinear optics in optical micro-resonators. Up to now, he is the author or co-author of over 80 scientific papers.

Integrated semiconductor lasers

Abstract. In this talk, some recent results in integrated semiconductor lasers will be presented. Firstly, 4x25 Gb/s electroabsorption modulated laser (EML) arrays for 100GbE applications are implemented based on identical epitaxial layer (IEL) scheme. Gain coupling is incorporated by adopting absorption gratings to improve the single-mode yield. Secondly, we present an integrated orbital angular momentum (OAM) laser operating at telecom wavelengths. Vortex beam is generated by monolithically integrating an optical vortex emitter with a distributed feedback (DFB) laser on the same InGaAsP/InP epitaxial wafer.

16:30-17:00 Invited Speaker | **Liangming Xiong** | State Key Laboratory of Optical Fiber and Cable Manufacture Technology (YOFC), China

Dr. Ansion LM Xiong received the Ph.D. degree from Shanghai Institute of Ceramics, CAS, in 2005, and then was devoted into R&D on Silica-based optoelectronic glasses and optical fibers in Nagoya Institute of Technology, Toyota Technological Institute and Hokkaido University subsequently in Japan. In 2011, he joined YOFC as a “3551 OVC Talent” and continued the R&D on both ultra-low-loss and rare-earth-doped fibers. Now Dr. Xiong is the executive deputy director of the State Key Laboratory of Optical Fiber and Cable Manufacture Technology (YOFC) and the leader of Department of SKL & Sci-Tech Development and being engaged in R&D on new optoelectronic materials, components and their applications.

New Optical-coupling, Thermal-conducting, and Multi-parametric Sensing Components for Optoelectronic Applications

Abstract. In the 5G era, high-speed or high-power optoelectronic devices will play a very important role, but they will also have to meet big challenges in the efficiency improvement of optical coupling, thermal conducting, thermal management, or sensing and monitoring. This work focuses on some recent progress in those functional components, in particular the R&D progress of new optical-coupling, thermal-conducting, and multi-parametric sensing components and their applications in optoelectronic devices.

17:00-17:15 Oral Presentation C024

The comparative study of using Si and Te doping tunnel junction of vertical hetero-structure laser photovoltaic cell

Chenggang Guan, **Yuzhen Deng**, Xiaomei Chen

Accelink Technologies Co., Ltd., Wuhan Research Institute of Post and Telecommunication, China
Abstract. Heavy doping of epitaxial tunnel junction layers is of interest in vertical hetero-structure laser photovoltaic cell in recent years. In this paper, the performance characteristic of AlGaAs/GaAs tunnel junctions with silicon(Si) and tellurium (Te) doped were presented, respectively. Compared to Si doping, the tunnel junction diode doped with Te doping revealed lower tunneling resistance and better performance. A comparative study using both Si and Te doping in the AlGaAs/GaAs tunnel junction of six junctions monochromatic laser photovoltaic cells also showed a higher photoelectric efficiency for Te doping. Therefore, the tunnel junction with Te doping can be considered to improve the performance of monochromatic laser cells.

17:15-17:30 Oral Presentation C067

A low-cost portable optical fiber-based sensor for water turbidity measurement

Ying Yao, Yong Wang, Jun Yan, Dianhong Wang
China University of Geosciences, China
Abstract. This paper presents a low-cost portable turbidity sensor using optical fiber. The system composition is described in detail, including the design of the sensor probe, signal conditioning module and data processing. In our solution, support vector regression (SVR) and temperature compensation are combined to model the relationship between the turbidity and the voltages (transmitted voltage and side-scattered voltage). Besides, we provide direct user accessibility via operation interface on an application (APP). The performance of the turbidity sensor has been verified in the laboratory. Experiments are conducted using standard turbidity solution, and the results demonstrate that the proposed sensor is feasible and effective.

Sept. 06, 2019 – Technical Session 37

T37 – Fiber-Based Technologies and Applications - I	
Invited Speeches (Changjian Ke; Xinyong Dong); Oral Presentation (C083)	
Session Chair: Xinyong Dong, Guangdong University of Technology	
Time: 16:00-18:00	**Venue: Lotus Hall 4**

16:00-16:30 Invited Speaker | **Changjian Ke** | Huazhong University of Science and Technology, China

Prof. Dr. Changjian Ke received his Ph.D. degree in physical electronics from HUST, China, in 2007. Then he was a visiting scholar in Prof. Alan Willner's group at University of Southern California in 2011. Now he is involved in fiber-based technologies and applications: highly nonlinear fibers, Brillouin fiber and devices, high-resolution spectroscopy, and 3D curve reconstruction. He is currently the director of the Institute of Optical Communication at HUST.

Brillouin gain spectrum tailoring in optical fibers: methods and applications

Abstract. We manipulate optical and acoustic modes related to the stimulated Brillouin scattering (SBS) process in optical fibers. Thus the Brillouin gain spectrum (BGS) can be tailored as desired. And several applications with different tailored BGS of optical fibers are presented, such as high resolution optical spectrum measurement, distributed multi-parameter sensing and 3D curve reconstruction.

16:30-17:00 Invited Speaker | **Xinyong Dong** | Guangdong University of Technology, China

Xinyong Dong received PhD degree in optics from Nankai University in 2002. He worked in the Hong Kong Polytechnic University (HKPU) and Nanyang Technological University (Singapore) from 2001 to 2008. He joined China Jiliang University as a full professor in 2008, and then moved to Guangdong University of Technology in Feb. 2019. He is a senior member of both IEEE and OSA, member of SPIE, MEKO-TC2, Chinese Optical Society (COS) and China Instrument and Control Society (CIS). He is serving in editorial board of "Photonics Sensors" and served as general chairs of 2018 Asia Communications and Photonics Conference (ACP) and ICOCN2019, and TPC chairs of ICOCN2016 &2017. His research interest covers fiber-optic sensors, optical fiber gratings, fiber amplifiers and lasers. To date, he has published 3 book chapters and over 400 technical papers with citation time over 5000 and H-index of 37.

Random lasers based on Erbium-doped fibers and fiber gratings

Abstract. Optical fiber based random lasers have attracted lots of research interest in recent years. Some of these lasers show very low pump threshold and high efficiency by using erbium-doped fibers as gain media and fiber gratings as random feedback media. In this talk, we will review the basic principle and our recent research results in this subject.

17:00-17:15 Oral Presentation C083

Wavelength Switchable All-fiber Passively Mode-locked Yb-doped Laser Based on a 45°Tilted Fiber Grating

Yanlv Lin, Zinan Huang, Qianqian Huang, Huabao Qin, Zhijun Yan and Chengbo Mou
Shanghai University, China

Abstract. Wavelength switchable passively mode-locked Yb-doped fiber lasers have attracted a lot of attentions due to their wide applications in sensing, optical signal processing and spectroscopy. The Lyot filter, composed of a piece of birefringence fiber sandwiched between two polarizers, is an effective way to achieve wavelength switching in fiber laser. Since nonlinear polarization rotation (NPR)-based mode-locked laser is usually a ring structure, there is no need for a second polarizer, and the first polarizer delivers the function of additional polarizer at the end of one roundtrip. In addition, the filter is a crucial component in all-normal-dispersion laser because of the need for strong spectral filtering to achieve stable mode locking.

45filted fiber grating (45°-TFG) with low insertion loss, all-fiber structure and high polarization dependent loss (PDL) can convert the unpolarized light into polarized light, which is an ideal in-fiber polarizer. The 45°-TFG we have used in this experiment has a maximum PDL of ~24 dB at 1060 nm. It means that the 45°-TFG is an effective polarizer. Here we demonstrate a simple and all-fiber wavelength switchable mode-locked fiber laser based on the 45°TFG.

The experimental setup is as follows. The pump power required by the laser is injected into the cavity by a commercial 980 nm bench-top pump source (OV LINK) through a 980/1060 nm wavelength division multiplexer. A 33.2 cm Yb-doped fiber (Yb1200-4/125, LIEKKI) acts as the gain medium. A 10:90 coupler is placed after the gain medium to draw 10% of the laser out of the cavity. The 45°-TFG sandwiched between two polarization controllers (PC1 & PC2) forming an artificial saturable absorber provides the NPR effect to achieve mode locking. The isolator is used to ensure the unidirectional transmission of light. A 10 cm long PMF as a birefringence medium provides ~24.1 nm filter bandwidth. The total cavity length is ~10 m and the estimated total dispersion of the laser cavity is ~ 0.228 ps2 at 1060 nm.

When the pump power reaches to 320 mW, stable mode locking can be obtained by adjusting the PCs appropriately. The center wavelength is located at 1065.92 nm with the 3-dB bandwidth of ~8.3 nm. The signal-to-noise ratio is

about 47 dB, which means the mode-locking operation is stable. Increasing the pump power continuously without adjusting the PCs, the wavelength switching can be realized. When the pump power is 359 mW, the operation wavelength is switched to a shorter wavelength. The center wavelength of spectrum at this time is 1039.86 nm. When the pump power is continuously increased to 577 mW, the operation wavelength is switched back to the longer wavelength of 1066.15 nm. The difference between the center wavelengths matches the bandwidth of fiber filter. The obvious sidebands in spectrum are induced by the periodical filtering of the birefringence fiber filter. When the pump power exceeds 577mW, the mode locking becomes unstable.

In conclusion, we report a wavelength switchable all-fiber passively mode-locked laser based on a 45°-TFG which can act as an ideal in-fiber polarizer. By introducing a birefringence fiber into the cavity to form a Lyot filter, stable mode locking can be obtained. The center wavelength switching between ~1040 nm and ~1066 nm can be observed by simply increasing the pump power without adjusting PCs.

Sept. 06, 2019 – Technical Session 38

T38 – Biophotonics and Biomedical Optics - E	
Invited Speeches (Donghyun Kim; Hongbao Xin); Oral Presentations (C050; C066)	
Session Chair: Hongbao Xin, Jinan University, China	
Time: 16:00-18:00	**Venue: Rose Hall 1**

16:00-16:30 Invited Speaker | **Donghyun Kim** | Yonsei University, South Korea

Donghyun Kim received B.S. and M.S. degrees in electronics engineering from Seoul National University in 1993 and 1995, and Ph.D. degree in electrical engineering in the area of novel multidimensional display technologies and smart optical filters from Massachusetts Institute of Technology in 2001. He was with Corning Inc., Corning, NY, as a Senior Research Scientist and with Cornell University, Ithaca, NY, as a Postdoctoral Associate. Since 2004, he has been with the School of Electrical and Electronic Engineering, Yonsei University, Seoul, as a Professor. He is jointly affiliated with the Program for Nanomedical Science and Technology and is currently the Director of the Yonsei Institute of Medical Instrumentation Technology. His research interests include biomedical applications of optics and optoelectronics focused on nanophotonic technology and applications in biomedical engineering based on plasmonic techniques.

Optoelectronic Applications of Plasmonic Nanostructured Surface for Multiscale Biomolecular Dynamics

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 metasurface 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 metasurfaces, 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 metasurfaces 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 metasurface patterns performed. To be also described in this presentation is the 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.

16:30-17:00 Invited Speaker | **Hongbao Xin** | Jinan University, China

Dr. Hongbao Xin is currently a professor in the Institute of Nanophotonics, Jinan University, Guangzhou, China. He is a researcher in bionanophotonics with a Ph.D degree in Optical Engineering from Sun Yat-sen University in China. After graduation, he continued his research at the University of California, Berkeley and the National University of Singapore. He has extensive experience in optical trapping and manipulation using optical fiber tweezers, he also works on nanoplasmonic optical antennas for cellular exploration. Dr. Xin has published more than 30 peer-reviewed journal articles, including Nature Reviews Materials, Nature Communications, Light: Science & Applications, Nano Letters, etc. His doctoral dissertation was selected as the National Excellent Doctoral Dissertation in Optics of China."

Optical probes for cell manipulation, biophotonic device assembly and intracellular exploration

Abstract. The rapid development of biophotonics has improved our better understanding of the biological world. Optical probes, such as optical tweezers and nanoplasmonic optical antennas, have constantly uncovered mysteries and provided new insights throughout cellular society. Outside the cell, optical tweezers act as a smart touch, enabling the precise and flexible capture, manipulation, and analysis of single cells and biomolecules. Particularly, optical fiber tweezers allow us to form biocompatible and implantable optical components to explore the biological world. Inside of the cell, plasmonic nanoparticles act as smart optical antennas, enabling the exploration of intracellular world. In this talk, I will present some recent developments using optical probes, such as optical fiber tweezers (OFTs) and plasmonic optical antennas, to explore the biological world. Using OFTs, we realized the stable trapping and flexible manipulation of single particles, bacteria, and cells. The trapping and multifunctional manipulation is demonstrated using different samples varying from mammalian cells to bacteria, nanotubes and to biomolecules, with sizes changing from several tens of micrometer to a few nanometer. The OFTs is also used for the stable trapping and patterning of multiple particles and cells, with the ability of biophotonic waveguides formation based on bacteria. In addition to the trapping and manipulation of cell individuals, we also demonstrated plasmonic optical antennas are capable of intracellular exploration and quantum electron tunneling imaging inside living cells.

17:00-17:15 Oral Presentation C050

Single-Molecular NIR-II Theranostic System: Ultrastable AIE Nanoparticles for Long-Term Tracing and Efficient Photothermal Therapy

Alifu Nuernisha, Qian Jun and Zebibula Abudureheman
Zhejiang University and Xinjiang Medical University, China

Abstract. Early-diagnosis, therapy/surgery and long-term tracing are the three core components of cancer treatment. Fluorescence imaging techniques are of great benefit to the diagnosis and treatment of cancer. Among them, second near-infrared (NIR-II, 1,000-1,700 nm) fluorescence bioimaging with advantages of high spatial resolution, deep tissue penetration and low autofluorescence, is becoming a promising imaging method in the increasingly demanding clinical field of precision medicine. NIR-II emissive fluorescence probes such as carbon nanotubes, rare-earth doped nanoparticles (NPs) and organic dyes have been applied to many biomedical researches. However, because of their low quantum yield and aggregation-caused quenching (ACQ) phenomenon, their application are still limited. Moreover, as far as we know, organic NIR-II fluorescent probes for in vivo photoinduced imaging and synchronous therapy, as well as long-term tracing of specific biological objects, are still very rare. In this work, we designed an NIR-II emissive aggregation-induced emission luminogen (AIEgen, named BPN-BBTD) molecular, and encapsulated it by an FDA-approved amphiphilic polymer Pluronic F-127. The as synthesized AIE NPs showed broad emission ranging (800 nm - 1,300 nm) and a high quantum yield (QY) in the

NIR-II window. Thus, the AIE NPs with these merits are qualified in in vivo NIR-II fluorescence bioimaging. The AIE NPs exhibited high-efficient targeting ability on both subcutaneous and orthotopic tumours after intravenous injection due to the enhanced permeability effect. Simultaneously, deep-tissue penetration and high-resolution NIR-II fluorescence images were clearly observed. At the same time, the remaining non-radiative decay in the AIE NPs allows excellent photothermal conversion capacity at 785 nm with high photothermal efficiency, which endowed the AIE NPs an optimal theranostic agents for photothermal therapy. By utilizing in the NIR-II fluorescence imaging-guided photothermal therapy, we found that the AIE NPs could completely eradicate the subcutaneous bladder tumour without regrowth or recurrence, and inhibit the growth of orthotopic bladder tumour as well. AIE NPs have enhanced retention effect, high photo-chemical stability, and long-term tracing ability for both subcutaneous and orthotopic tumours. The NIR-II fluoresence signals both in the subcutaneous and orthotopic tumour site can still be captured even 32 days after injection of AIE NPs. In addition, the organic AIE NPs had excellent biocompatibility. We found no detectable abnormalities, inflammation or lesions in the main organs (heart, liver, spleen, lung, kidney and brain) of the mice at 48 hours, 7 days and 100 days after intravenous injection. The single-molecular NIR-II AIE NPs shows good performance of diagnosis, efficient photothermal therapy and long-term tracing for subcutaneous and orthotopic bladder tumours in vivo, and provideds a promising approach to construct an efficient theranostic platform for clinical applications.

17:15-17:30 Oral Presentation C066

Cellular-level structure imaging with micro-optical coherence tomography (μOCT) for kidney disease diagnosis

Chi Hu, Xiaojun Yu, Qianshan Ding, Zeming Fan, Zhaohui Yuan, Juan Wu1and Linbo Liu
School of Automation, Northwestern Polytechnical University, China

Abstract. Chronic kidney disease (CKD) is one of the public health threats around the world, which may cause serious health problems like kidney failure, cardiovascular disease or even premature death. Although chronic kidney disease usually could be managed by general internists, such a way of treatment can be applied only when significant symptoms appear, which is very slow. It has also been reported that CKD could be characterized by means of glomeruli, and classified by the stages of disease severity for early treatment. However, due to lack of reliable method to detect the cellular-level microstructures for disease severity characterization, the diagnosis is troublesome, and thus, the treatments might be delayed while the best treatment time could be missed. For early detection of CKD, it is imperative to develop reliable tools to detect and characterize the disease at an early stage with minimal or noninvasiveness. In this study, we evaluate the feasibility of micro-optical coherence tomography (μOCT) as a cellularlevel structure imaging tool for kidney disease diagnosis at an early stage. Specifically, by measuring the number of glomeruli within a volumetric kidney tissue, a new diagnostic criteria is also established. Imaging results of the kidney specimens as compared their corresponding histology show that the cellularlevel glomeruli structures could be identified clearly, and as a basic functional unit of kidney, it could be utilized as a reliable parameter to access the severity of the CKD.

Sept. 04, 2019 – Posters

Posters: C002; C005; C008; C009; C011; C017; C018; C020; C021; C028; C039; C057	
Time: 16:00-18:00	**Venue: Lounge**

C002

A surface plasmon resonance sensor based on D-shaped all-solid photonic crystal fiber

Xueyu Wang, **Huixian Zhang**, Tiesheng Wu, Yiping Wang, Yiying Wang and Weiping Cao

Guilin University of Electronic Technology, China

Abstract. A numerical analysis of a novel D-shaped fiber surface plasmon resonance (SPR) sensor model based on all-solid birefringent photonic crystal fiber (PCF) is presented in this paper. This fiber biosensor configuration utilizes two large media rods in the x-axis to introduce birefringence into the structure and solves analyte filling problems in PCF-based SPR sensor by side-polishing fiber. We investigate the effect of the radius of the big media rods and the polishing depth on the SPR sensing performance, and identify the SPR fiber sensor sensitivity on wavelength and phase. This work allows us to determine the feasibility of using the all-solid D-shaped PCF to develop high sensitivity SPR sensors for chemical, biological, and biochemical sensing.

C005

Microwave Photonic Sub-Harmonic Downconverter with Image Rejection Capability

Yu Qiao, Hao Li, Xuedong Hu, Caili Gong, Kai Sun, Yongfeng Wei

Inner Mongolia University, China

Abstract. A microwave photonic downconverter with the capability of simultaneously realize sub-harmonic frequency down conversion and intermediate frequency (IF) signal image rejection is presented. Radio frequency (RF) carrier suppressed double-sideband (CS-DSB) modulation and local oscillator (LO) double-sideband (DSB) modulation can be generated by the two sub Mach-Zehnder modulators (MZMs) in an integrated dual-Technical MZM (DPMZM). Then RF and LO signal upper sidebands and lower sidebands can be separated and selected using a two-channel wavelength division multiplexer (WDM). After photodetector (PD) two down converted signals with same frequency of $\omega_{RF} - 2\omega_{LO}$ and opposite phase are obtained respectively. As can be seen from the simulation results, upper and lower channel suppression of spur is 22.2 dB and 22.37 dB, respectively. System phase deviation is less than 2o. Benefiting from the all optical and phase-cancellation, excellent image rejection exceeding 45 dB over 20-30 GHz working band is demonstrated.

C008

Three-dimensional radiation field reconstruction of engine tail flame based on optical computed tomography

Jiaming Zhang; Yang Shang; Cong Sun; Tao Li; Fang Sun

National University of Defense Technology, China

Abstract. Flame optical tomography is an indispensable part of rocket engine tail flame diagnostic technology. This paper proposes a method for reconstructing the three-dimensional radiation field of flame by optical tomography. When using the optical tomography to measure the three-dimensional radiation field of the flame, we need to use multiple array detectors, and at the same time, we must get the projection data of the three dimensional radiation field along the same direction. In order to obtain a high resolution flame three-dimensional radiation field, we did the following work. First, we perform high-precision calibration on telecentric camera sets. Then, we ensure alignment of the two-dimensional images in multiple directions by polar line correction. Finally, we reconstruct the 3D radiation field of each layer using the 2D flame image slices. We superimpose the radiation field of each layer to reconstruct the complete high precision flame three-dimensional radiation field. We conducted experiments on flame optical chromatography. We used six cameras to

shoot the experiment platform from different directions. The reprojection error of the telecentric camera group calibration result is significantly better than the total station. Finally, we obtained a high-precision flame three-dimensional radiation field. We analyzed the experimental results and summarized them at the end of the paper.

C009

Quality Assessment of 980 nm GaAs based Laser Diodes with Use of Low-frequency Noise Measurements

Xiaojuan Chen, Chang Qu

Changchun university of Science and Technology, China

Abstract. Low-frequency noise has always been a fast and non-destructive tool to characterise the performance and quality of materials and electrical devices. In this paper, a non-destructive method of predicting reliability was introduced for 980 nm GaAs based semiconductor laser diodes. Measurement and analysis were carried out for the noise and transport characteristics of forward voltage biases. The results demonstrated a close relationship between LD quality and the characteristic parameters of low-frequency noise such as frequency exponent, noise intensity and amplitude.

C011

Study of Extended cycle Restriction based P-Cycle Construction Algorithm

Qiang Sun, **Min Dong**, Yang Zhou

Beijing Jiaotong University, China

Abstract. P-Cycle protection technology is an important technology in optical network protection. This paper proposes a new P-Cycle construction algorithm ERPA (Extended cycle Restriction Based P-Cycle Construction Algorithm), which is based on the variance, mean and redundancy of unprotected working capacity on all candidate cycles. In the process of cycle expansion, the algorithm chooses the extended candidate cycle whose variance, mean and redundancy satisfy the conditions as the final candidate cycle of the current round, which can guarantee the quality of the extended cycle and limit the number of P-Cycle cycles that complete the protection; When the values of unprotected-links(UPL), the redundancy, mean and the parameter n satisfy the stop condition, the cycle expansion is stopped, so that the number of cycles and the cycle length can be effectively balanced. In the simulation process, the ERPA algorithm is simulated by using the COST293 European Optical Network (EON) topology model, and the performance under different n values is compared and analyzed. The simulation results show that ERPA algorithm needs fewer cycles, has higher protection capacity efficiency and lower total time consumption under the same resource and work capacity, which makes the proposed algorithm more feasible and effective.

C017

Infrared transmission spectrum broadening in metallic gratings with gradual thickness

Xiumin Xie, Qiang Xu, Jian Chen, Qian Dai, Wei Zhang, Weiying Hu, Jie Deng and Hai-Zhi Song

Southwest Institute of Technical Physics, China

Abstract. Transmission properties of transverse magnetic mid-infrared through sub-wavelength metallic gratings with gradual thickness are studied by finite-difference-time-domain method. The result shows that the infrared transmission spectrum is broadened, but also the maximum transmission is weakened. This is attributed to the positive coupling between the incident wavelength and the slits. Any incident wavelength has a match with the gratings where corresponding thickness stands. On the other hand, unlike the case in conventional gratings, optimal coupling cannot be gained in every slit at the same time, resulting in weakened maximum transmission. Such transmission broadening effect may be applied in these fields where wide spectrum response is required.

C018

Effect of deposition strategy on fatigue behavior of laser melting deposition 12CrNi2 alloy steel

Wei Yi, Hui Chen, Ying Wu, Yong Chen, Hongyu Li

Southwest Jiaotong University, China

Abstract. In this paper, the 12CrNi2 alloy steel parts were fabricated by laser melting deposition (LMD) using two kinds of deposition strategies, which were single direction scanning(SDS) and cross direction scanning(CDS). The microstructure and fatigue behavior of LMD 12CrNi2 alloy steel samples were investigated. Thy typical microstructure of both deposition strategy were ferrite and can be divided into two zones: remelted zone and non-remelted zone. The non-remelted zone showed typical columnar crystal morphology while the structure of remelted zone was homogenized. Compared with SDS deposition strategy, the microstructure of CDS deposition strategy had shorter columnar grains and finer grains. The relative densities of SDS and CDS deposition strategies were 98.1 and 97.3, respectively, indicating that SDS had lower porosity. The fatigue strength of SDS deposition strategy was higher than that of CDS deposition strategy, which were 320 MPa and 200 MPa. There were more defects in CDS deposition strategy, which accelerated the initiation and propagation of cracks. CDS deposition strategy had longer interlayer interval time, which will reduce the penetration depth of laser, affect the degree of previous layer remelting, and eventually lead to unmelted powder, porosity and other defects in the lap zone.

C020

Simulation of Partially Coherent Optical Atmospheric Turbulent Transmission Based on LC-SLM

Zhang Jie, Liu Zhi, **Zhang Xiaoqi**, Ning Xiaolong, Cong Minghui, Gao Siyuan,

Changchun University of Science and Technology, China

Abstract. In this paper, liquid crystal on Silicon Modulator (LC-SLM) is applied to laser transmission system. The beam parameters of the initial light source are adjusted by the phase modulation principle of LC-SLM to simulate the propagation of partially coherent light with different coherence in atmospheric turbulence. The centroid drift of a partially coherent beam propagating in turbulent atmosphere is studied. By comparing the drift of beams with different coherent lengths in turbulence, the results show that the drift of partially coherent beams is less affected by turbulence disturbance.

C021

Preparation and sensing application of metal nanoparticles elaborated microfiber

Jin Li, Ning Gao and Fanli Meng

Northeastern University, China

Abstract. The metal nanoparticles elaborated microfibers were proposed by one-step heating-drawing technique and one-step dip-drawing using silica capillary and polymer gel, respectively. The corresponding microfibers have been demonstrated as the refractive index and hydrogen sensors, respectively. The silver microparticles have been doped in the silica capillary to prepare the composite microfiber with the diameter of 2.3μm， resulting in a refractive index sensitivity of 19.2nm/RIU; one cut of amorphous polymer microfiber with the length of 728μm and diameter of 28μm was obtained from the poly (methyl methacrylate)-chloroform gel, where the Pd nanoparticles were successfully elaborated in and contributed to the high hydrogen sensitivity of 5.2×10-4 nm/ppm. Instead of surface coating technique, by internally doping or elaborating the metal particles will facilitate the development of novel optical devices with miniature, stable, compact structures.

C028

Fliter-based Portable Low-Frequency Raman Spectrometer down to 25cm-1

Xinru Guan, Meng Jiang, Yongai Yu, Juan Chen and Fu Yang

Donghua University, China

Abstract. With the development of Raman spectroscopy, low frequency Raman detection has become increasingly important in drug analysis. In order to realize the detection of the low-frequency Raman spectral region of the

pharmaceutical raw materials and make the Raman spectrometer portable, our designed a portable low-frequency Raman spectrometer based on the Raman optical probe system. We have completed the assembly of the prototype, the instrument size is about 260mm×185mm×60mm, with high portability. The Raman spectrometer is based on a single monochromator, using two beam splitters for laser beam alignment, combined with a single Longpass filter realized down to 25 cm-1 Raman signal measurement. The system successfully detected the low-frequency Raman spectra of the pharmaceutical raw materials hydroxychloroquine sulfate and TiO2, and realized the discrimination of four crystal forms by low-frequency Raman spectroscopy of four different crystal forms of aripiprazole. The practicability of the Low Frequency Raman spectrometer was verified by drug detection.

C039

Biophotonic devices based on spider silks

Zhiyong Gong and Yuchao L

Jinan University, China

Abstract. Nanobiophotonics refer to research and development that intersects with photonics, biomedicine, and nanotechnology. Its main application is biomedicine, and one of the research is the application of various traditional photonic devices of biological organisms. At present, the main method is to construct bio-nanophotonic devices using fiber optic probes, polymer materials, etc. However, their poor biocompatibility and biodegradability limit their further development in the biomedical field. Therefore, improving the biocompatibility and biodegradability of the prepared materials is of great significance for the development of nanophotonic devices in the field of biomedicine.

We propose a method for constructing bio-nanophotonic devices using natural spider silks. Spider silks are obtained from the silk glands of spiders and readily available in nature. Its composition is protein, which not only has good toughness and strength, but also has excellent optical properties. The refractive index of the spider silks are larger than air, water and biological tissue, which make good optical guiding property. Moreover, the spider silks constructed from protein composition not only have little damage to the organism, but also can be degraded by proteases and microbe in the living body. Therefore, spider silks can construct into various photonic devices with good biocompatibility and biodegradability. By controlling the speed of drawing spider silk, we can make spider silks of different thicknesses which have different toughness, strength, and optical guiding property. The spider silks were used to construct a variety of nanophotonics such as the simplest optical belts, the beam splitter at any angle, the ring resonator, and the sensors. We have theoretically and experimentally verified the optical guiding property of various photonic devices composed by spider silks. The feasibility of the optical guide constructed with spider silks were proved. We have further studied the temperature sensor constructed with spider silks. We modified the surface of spider silks with the upconversion fluorescent nanoparticles (UCNPs) using the laser of 980 nm excitation wavelength. The UCNPs are a rare earth doped silica microsphere with a diameter of about 35 nm, which can convert near-infrared wavelength light into visible light. The conversion efficiency and the intensity of the excitation light will change with the change of external temperature. The sensitivity is so high that can be used as a sensitive component of the temperature sensor. The difference in the spectrogram of UCNPs at different temperatures can be used to measure the temperature around the cells, and the sensitivity is very high. Minimum temperature change of 0.1K can be monitored. Further, we can also modify the surface of spider silks with a variety of other functionalized nanoparticles by photothermal collection.

C057

Effect of pulse duration and polarization on femtosecond filament-induced fluorescence of combustion intermediates

Huailiang Xu, **Mengyao Hou** and Siqi Wang

Jilin University, China

Abstract. Femtosecond laser filamentation is an attractive phenomenon that can generate a long plasma channel at a far distance with an almost constant intense laser fields inside the filament core, which is promising in a variety of applications such as atmospheric sensing and weather control. In recent years, femtosecond filament-induced

fluorescence (FIF) spectroscopy has demonstrated a high potential in application to combustion diagnostics, showing the possibility to realize simultaneous detection of multiple combustion intermediates. However, the effect of the pump laser parameters such as the pulse duration and polarization on the FIF of the combustion intermediates in combustion field has not been reported yet. Since laser parameters are important factors in FIF, it is of significance to explore the influence of laser parameters on the FIF, which would provide more insights into understanding the physical mechanism of FIF in combustion flames and optimizing the spectral signals. In this paper, we investigate the effect of the laser pulse duration and polarization on the FIF of combustion intermediates in combustion fields. We show the variations in the FIF signals of the combustion intermediates, OH, CH, CN, C2 and C under different laser pulse width and polarization conditions, and find that with the increase of laser pulse width, the fluorescence intensities of all the observed combustion intermediates decrease; meanwhile with the increase of the pulse ellipticity, they all decreases. After careful analysis, we find that the above observations result from the variations of the clamped intensities and plasma densities inside the filament core which are strongly dependent on the pulse duration and polarization, leading to the change in the multiphoton-excited signals of the combustion intermediates.

Sept. 05, 2019 – Posters

Posters: C051; C056; C058; C059; C062; C071; C073; C077; C078; C079; C080; C086	
Time: 16:00-18:00	**Venue: Lounge**

C051

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 and Junle Qu

Shenzhen University, China

Abstract. Serum albumins play an important role in the transportation and delivery of small molecules in the blood. Among the serum albumins, bovine serum albumin (BSA) has a wide range of physiological functions involving the binding, transportation and delivery of fatty acids, porphyrins, bilirubin, steroids, etc. Here, we found that a small squaraine dye (SD) we reported previously can selectively detect BSA with high sensitivity based on fluorescence lifetime imaging microscopy (FLIM). We utilized FLIM to monitor the endocytosis of BSA in living ovarian cancer OVCAR-3 cells dyed with SD. With adding different concentrations of BSA into the cell culture medium, the proportion of the relative long lifetime component (interaction of BSA and SD) was increased gradually at different rates and tended to be constant within 2 h. We used a chemotherapeutic drug paclitaxel (PTX) to influence endocytic process of BSA in OVCAR-3 cells. The results demonstrated that the endocytic rate was reduced obviously after the treatment of 400 nM PTX for 4 h.

C056

Influence of Different Laying Methods on Monitoring Transformer Winding Temperature with Distributed Optical Fibre

Yunpeng Liu, **Junyi Yin**, Xinye Li, Xiaozhou Fan

North China Electric Power University, China

Abstract. In order to apply distributed optical fibre sensing technology to transformer winding temperature monitoring, the temperature detection of transformer windings based on different laying methods was studied. The slotted and pasted transformer winding wire models were designed and fabricated respectively. The electromagnetic wire structure and the winding process had been correspondingly improved. The local temperature rise test was carried out and the temperature distribution was monitored and evaluated. The results show that the distributed optical fibre measurement results of the slotted wire have larger errors, the engineering implementation is more complicated and the original structure of the winding has been changed greatly, whereas the measurement result of the pasted wire is more accurate. The pasted wire is more suitable for transformer winding temperature monitoring.

C058

Development of the spectral imaging ellipsometer for line measurement

Sangseon Lee and Hojae Lee

KITECH, South Korea

Abstract. As the technology on manufacturing a multilayer stacked structure is advanced, the performance of semiconductor and display panel is steadily improving. Since these devices are affected by properties such as reflectivity, transmittance and absorptivity depending on thickness and refractive index of each layer, it is very important to analyze the structure of multi-layered thin films. Therefore, studies are being actively conducted on the development of optical instruments, such as an ellipsometer or reflectometer, etc., which can be measured without damaging the sample. In particular, the ellipsometer is mainly used to analyze the properties of thin films for each layer in the process of deposition. In this paper, we propose a spectral imaging ellipsometer which is possible to measure a specimen by a line, unlike a typical ellipsometer based on a point measurement. The proposed device is structurally similar to the ellipsometer of a typical PSA type, however it is equipped with an imaging spectrometer behind the analyzer. A two-track analysis method can be applied to the proposed device to minimize the error of rotation angle when analyzing the sample because of the properties of the imaging spectrometer.

In this method, it is possible to complementally analyze the changes in intensity of light on the horizontal and vertical directions of the area sensor. The horizontal and vertical intensity in the area sensor correspond to the thickness of the specimen and the refractive index of the wavelength, respectively. Therefore, the variations(I)in the intensity of polarized light can be expressed as a parameter for variables for the position (x) and the spectrum (λ) with respect to the rotation (θ).

$$I(x_i,\lambda_j,\theta_n) = I_0[1 + \alpha_{ij} \cdot \cos(2\theta_n) + \beta_{ij} \cdot \sin(2\theta_n)] \quad (1)$$

$$with\ I_0(x_i,\lambda_j) = \frac{1}{2}|E_0|^2 \cdot [\ |R_p(x_i,\lambda_j)|^2 \cdot \cos^2(\theta_{set}) + \ |R_s(x_i,\lambda_j)|^2 \cdot \sin^2(\theta_{set})]$$

$$\varphi = tan^{-1}\left\{\sqrt{\frac{1+\alpha}{1-\alpha}} \cdot \tan(\theta_{set})\right\}, \quad \Delta = cos^{-1}\left(\frac{\beta}{\sqrt{1-\alpha^2}}\right) \quad (2)$$

In the equations (1), α and β represent normalized Fourier coefficients and $I0(xi\ ,\ \lambda j)$indicates the average intensity of the light at the pixel (xi,, λj) of the area sensor during the rotation (θ) of the polarizer or the analyzer. Also Rp and Rs are the total reflection coefficients of the P and S wave reflected by the specimen, and θset represents the initial angle of the polarizer or analyzer. And the ellipsometric parameters (φ, ∆) can be calculated by the equations (2).

The ellipsometric parameters (φ, ∆) can be estimated by applying the two-track analysis method which is analyzing the changes in the intensity of light for the spatial and the spectral axis. This means that the developed device can optimize the ellipsometric parameters (φ, Δ) by complementally analyzing the spatial (x) and spectral (λ) information axis with respect to the rotation (θ). Therefore, we can more accurately measure the ellipsometric parameters (φ, ∆) thickness and refractive index for the specimen by minimizing the error for of the rotation angle.

Funding: Ministry of Trade, Industry and Energy (MI, Korea) (10050809).

C059

Third-harmonic generation and scattering in combustion flames using a femtosecond laser filament

Hongwei Zang, Helong Li and Huailiang Xu

Jilin University, China

Abstract. Coherent radiation in the ultraviolent (UV) range has high potential applicability to the diagnosis of the formation processes of soot in combustion because of the high scattering efficiency in the UV wavelength region, even though the UV light is lost largely by the absorption within the combustion flames. We show that the third harmonic (TH) of a Ti: sapphire 800 nm femtosecond laser is generated in a laser-induced filament in a combustion flame and that the conversion efficiency of the TH varies sensitively by the ellipticity of the driver laser pulse but

does not vary so much by the choice of alkanol species introduced as fuel for the combustion flames. We also find that the TH recorded from the side direction of the filament is the Rayleigh scattering of the TH by soot nanoparticles within the flame and that the intensity of the TH varies depending on the fuel species as well as on the position of the laser filament within the flame.Our results show that a remote and in situ measurement of distributions of soot nanoparticles in a combustion flame can be achieved by Rayleigh scattering spectroscopy of the TH generated by a femtosecond-laser-induced filament in the combustion flame

C062

Self-powered infrared detection using freestanding zinc oxide quantum dots decorated multiwalled carbon nanotube paper

Sukanta Nandi and Abha Misra

Indian Institute of Science, India

Abstract. Detection of infrared radiation (IR) has an important technological aspect to the society as it spans applications from medical to astronomy. This has intrigued scientists to work in the field of IR detectors and decades of research have been devoted developing efficient and ultrasensitive IR detectors. In addition, demand for decreased power consumption in operating these devices has also been a major challenge and research outlook. Motivated by the importance and challenges in IR detection, the present study reports a self-powered multiwalled carbon nanotubes (MWCNT) based IR detector. MWCNT owing to its blackbody characteristics has proven to be one of the ideal candidates for IR detection, thus best suited material for the substrate to large bandgap materials such as zinc oxide (ZnO). MWCNT substrate has an added advantage of mechanically flexible paper with large electrical conductivity as compared to wide bandgap materials. The study demonstrates that coupling of ZnO quantum dots (ZnOQD) with the MWCNT paper leads to improved detection of IR. The inclusion of ZnOQDs in the MWCNT matrix induces higher mechanical stability of the paper (0.44 ± 0.10 mg/mm^3) as compared to the MWCNT paper (0.38 ± 0.11 mg/mm^3). Linear current-voltage response confirmed the ohmic behavior of the device. IR illumination was performed using an optical fiber laser of 1550 nm with a core diameter of ~8 μm and an enhanced photoresponsivity as compared to the MWCNT paper alone under IR illumination was observed. Notably, an offset current (i.e. non-zero at zero voltage) was observed in the *I-V* characteristic of both the devices prompting the self-powered device operation. Moreover, upon IR illumination, a further shift in the offset was observed owing to photothermoelectric effect caused by the incident IR. Self-powered photoresposne ($\Delta I / I_0$, where $\Delta I = I_{IR} - I_0$, I_0 is the current under dark condition and I_{IR} is the current under IR illumination) of the device was ~-94.9±10.13% (~2.3 times higher than that of MWCNT device) at ~200 mW IR incident power. The response and recovery times of the device was respectively ~225% and ~151% faster than the MWCNT paper alone. Thus, self-powered device not only exhibited a higher photoresponse but also exhibited faster response and recovery time. The responsivity of the self-powered device, defined as, $R_I = \Delta I / P_{inc}$, (where, P_{inc} is the power incident on the device active area) was evaluated to be ~24.8±2.8 μA/W which is ~2 times higher than MWCNT paper at zero bias.

C071

Research on Design Theory of Micro-cutting Tool of Monocrystalline Diamond

Di Li, Jian-Guo Fang, Yuan Zhao, Chang-Yu Xu, Song-Bao Luo

Beijing Precision Engineering Institute for Aircraft Industry, China

Abstract. As the development of modern manufacturing, micro-miniature products have attracted a lot of attention due to their reduction of materials and energy consuming and high utilization of space. The micro monocrystalline diamond (MCD) cutting tool, which can cut parts into three-dimensional micro-parts with super smooth surface and super precision dimension accuracy, is a key issue to ultra-precision machining of micro-parts. In the research, the design principle of micro MCD cutters and the mechanical analysis are studied based on the introduction of the application and features of micro-milling cutting tool of MCD. Then, experiments are made to show the feasibility of fabricating MCD micro-cutting tool by grinding with diamond wheel.

C077

Q-switched Noise-Like Pulse in a Tm-doped Fiber Laser

Jingmin Liu, Xingliang Li, Shumin Zhang, Chaoran Wang, Liangliang Chen, Zihao Guo, Lisha Liu, Yaxing Xin, and Zhenjun Yang

Hebei Normal University, China

Abstract. A Q-switched noise-like pulse operation was observed in a nonlinear polarization evolution based thulium-doped fiber laser. This novel phenomena formed in a noise like background. When the pump power was properly controlled and the polarization controller was carefully adjusted, a noise like mode locked pulse was modulated by a Q-switched pulse envelope, which resulted in the Q-switched noise-like pulse formation. In a single pulse envelope, there exist many mode locked pulses that have fundamental repetition rate which is corresponded to the cavity period. When the pump power was carefully increased from 760 mW to 1000 mW, the repetition rate of the adjacent pulse envelope can increase from 34 to 41.1 kHz, and then intra-cavity pulse energy of a envelope reached about 609 nJ. This phenomenon was first observed in thulium-doped fiber laser. It will add experimental basis for studying of the pulse dynamics in fiber lasers.

C078

Optimal Design of High Energy Similariton Thulium-doped Fiber Lasers

Lisha Liu, Xingliang Li, Shumin Zhang, Jingmin Liu, Liangliang Chen, Chaoran Wang, Yaxing Xin, Zihao Guo, and Zhenjun Yang

Hebei Normal University, China

Abstract. High-energy ultra-fast pulse light source has been widely used in laser medical, environmental monitoring, optical communication, photon spectroscopy and other fields. Compared with conventional soliton fiber lasers, self-similar pulsed fiber lasers can produce higher energy optical pulses without optical wave splitting. In this paper, we have optimized design on dispersion-managed high energy self-similar pulse in thulium doped fiber laser by using numerical simulation method. It is found that, when fixing the filter bandwidth, with the increase of the cavity length and the pump power, the output power will increase. At the same time, furthermore, with the shorter cavity length and lower pump power, to obtain a high energy self-similar pulse, a filter with broader bandwidth must be used. By optimizing cavity parameters, and choose the cavity length to be 362 cm, corresponding dispersion value of 0.2224 (ps2), filter bandwidth to be 32 nm, the small signal gain g0 to be 51 dB, pulses with pulse energy up to 32.75 nJ, dechirp pulse width of 142.64 fs have been obtained.

C079

Harmonic Condensed Soliton Phase in a Mode-Locked Fiber Laser

Liangliang Chen, Xingliang Li, Shumin Zhang, Jingmin Liu, Chaoran Wang, Zihao Guo, Lisha Liu, Yaxing Xin, and Zhenjun Yang

Hebei Normal University, China

Abstract. A new category of harmonic mode-locked pattern is reported in passively mode-locked fiber laser (MLFL). The laser base on gold nanorods (GNRs) as a mechanism to trigger mode locking. By adjusting polarization controllers and pumping power, including fundamental mode-locked pulse, condensed soliton phase, soliton rain, harmonic condensed soliton phase have been observed. The harmonics condensed soliton phase were experimentally verified for the first time in the MLFL. The experimental results explained the conditions for the generation of condensed soliton phase and extend the pulse type of harmonic mode-locking (HML).

C080

Near-infrared array receiver for real-time 3D imaging application

Yunxiu Yang, Changdong Guo, Shijie Deng, Qian Dai, Haihua Huang, Xianguo Kou, Xiaolong Lu, Fei Yuan, Li Jin, Jianbo Gao, and Hai-Zhi Song

Southwest Institute of Technical Physics, China

Abstract. In this paper, a near-infrared array receiver consisting of two 16-element linear-arrays InGaAs reach-through avalanche photodiodes and readout circuit assembled by system-level integrated package was developed for 3D real-time imaging. The readout circuit includes 32 transimpedance amplifiers, double-threshold comparators and time-to-digital converters (TDC). With transimpedance amplifier based on closed-loop structure of inverter-like amplifier circuit, and post-stage differential output amplifier, the readout circuit can achieve high gain, large bandwidth and low noise. The double threshold comparator was used to solve walking error. With two-step architecture combining 8-bit coarse counting and 6-bit fine counting, the dynamic range of the receiver is increased by coarse counting while its resolution is improved by combining fine counting. When the system emits a laser pulse, the receiver starts timing and converts the echo signal to a voltage signal. When a stop timing signal is generated, the system quantifies the time of flight to 14-bit digital signal. The developed receiver demonstrates the pulse responsivity of 5.4×10^5 V/W, the 3dB bandwidth of 142.9 MHz, the minimum detectable optical power of about 26.7 nW (SNR=10), and the time resolution of 200 ps. When the receiver is applied to a lidar system, where a 1550 nm semiconductor laser illuminates the target scene with pulse width shorter than 10 ns and repetition frequency more than 20 kHz, combining timing control with software algorithm, we get a clear environmental 3D image in real time.

C086

Tapered fiber based on infrared DNA molecule sensor

Jun Pan, Jijun Feng, Xiaoyu Sun and Heping Zeng

University of Shanghai for Science and Technology, China

Abstract. A single mode tapered fiber is fabricated for the measurement of DNA molecule with monitoring the surrounding refractive index changes. The waist diameter of the tapered fiber is about 8 μm. The refractive index change was measured by monitoring the variation of the transmission spectrum dip with a sensitivities of about 1342 nm/RIU. Such a sensor has the advantages of low cost and easy fabrication, which would have a wide application prospects.

CONFERENCE VENUE

Shenzhen Convention & Exhibition Center | 深圳会展中心

The Shenzhen Convention & Exhibition Center (SZCEC) was designed by German architects and provides modern exhibition facilities. Located in the downtown area of Shenzhen, it is connected to all major transportation systems and easily accessible from all parts of the city. Many four-star and five-star hotels and top restaurants are within short walking distance.

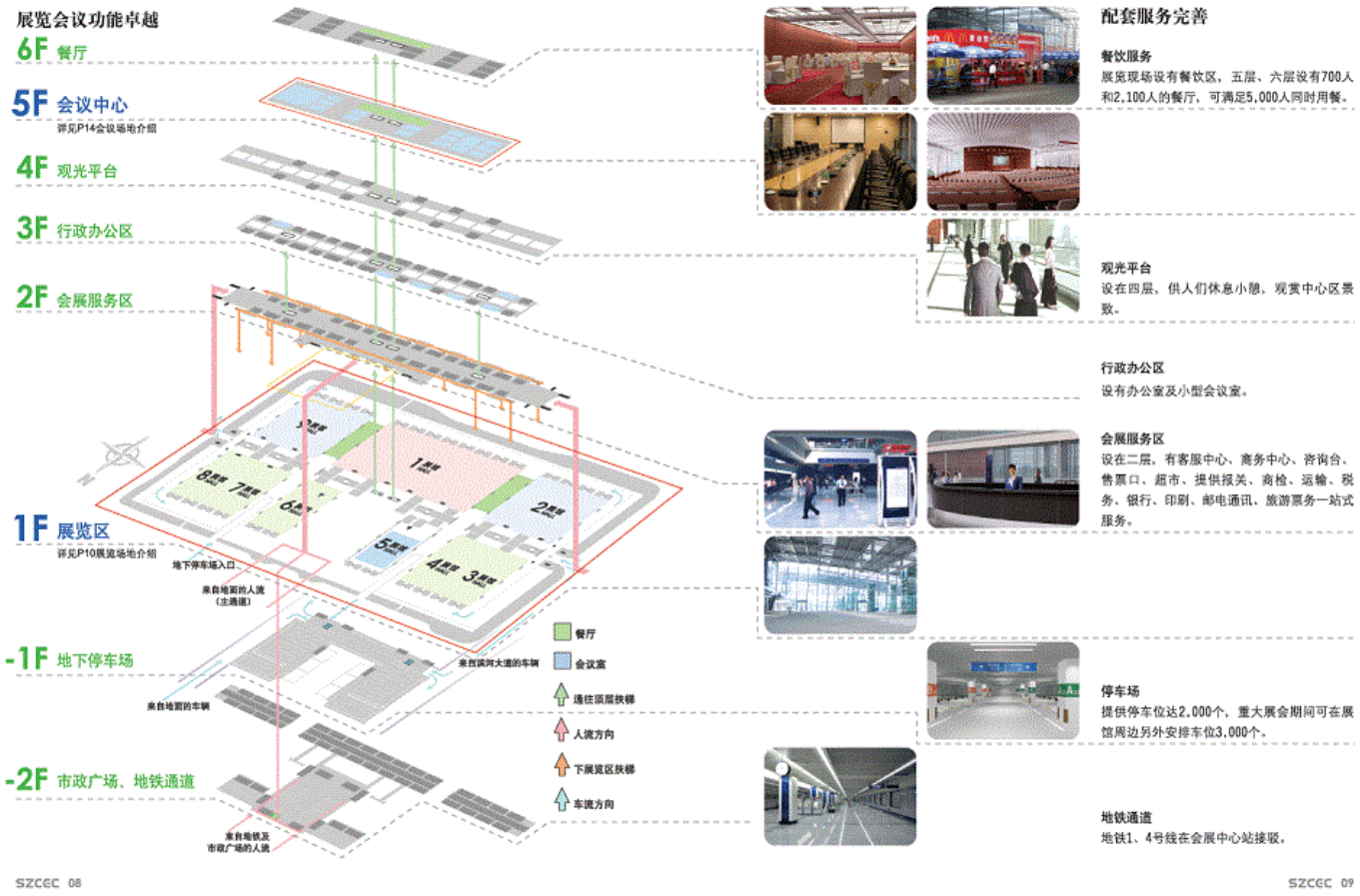
SZCEC website: www.szcec.com

Map & Address

Address: Fuhua Third Road, Futian District, Shenzhen City, Guangdong, China

地址：中国广东省深圳市福田区福华三路深圳会展中心

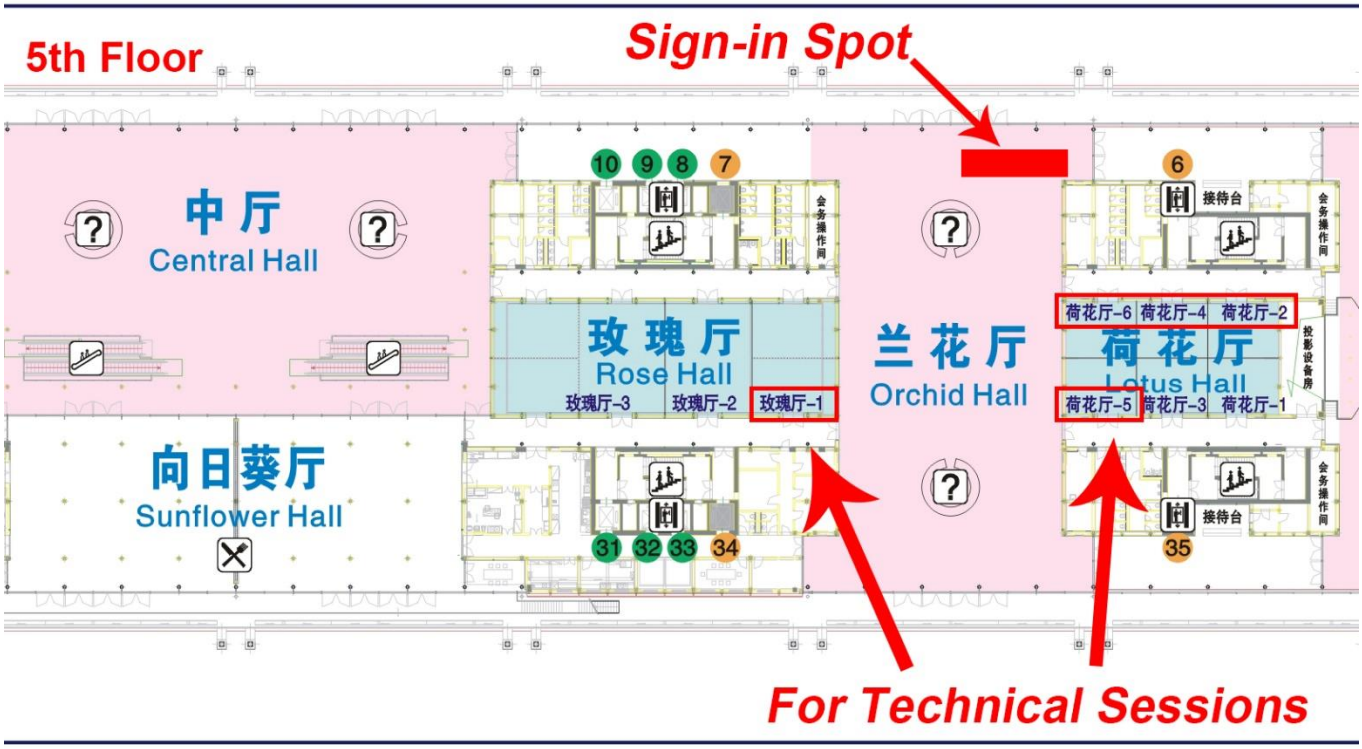
Hall Structure & Service of SZCEC

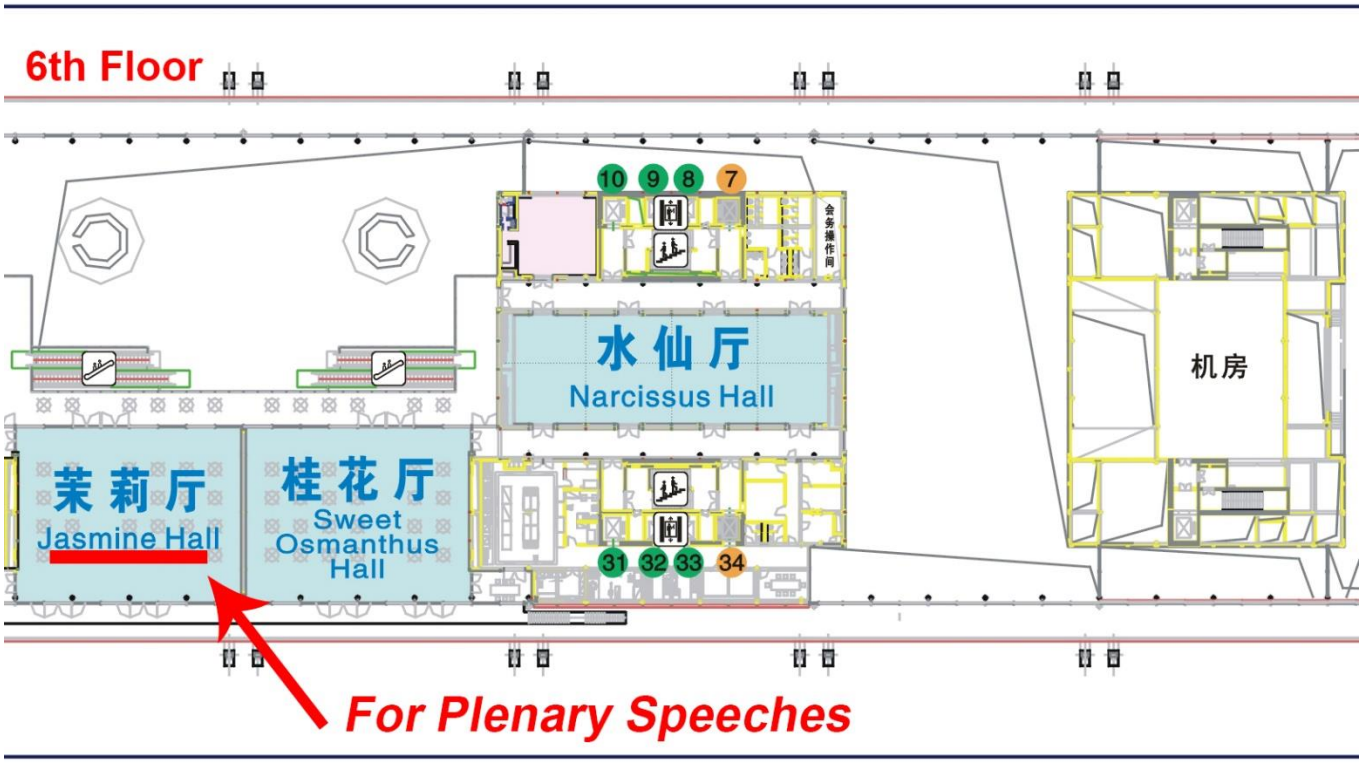


- **Chinese Restaurants:** Chinese restaurants are located in the Food and Beverage Square, 1st Floor and B1 Floor, SZCEC.
- **Western Food:** Western restaurants are located in the Food and Beverage Square, 1st Floor and B1 Floor, SZCEC.
- **Washroom:** Locate on the 2nd floor, SZCEC, and each exhibition hall has Man and Woman Washrooms. Please pay attention to the washroom logo.
- **Rest Area:** Each hall has specified rest area.
- **Wifi Service:** Wireless wifi is available in the whole Convention & Exhibition Center. Users can have two hours free Wifi service with the verified mobile phone number.
- **Business Service:** Room 212, 2nd Floor, SZCEC.
- **ATM:** ATM Counter is located at left and right sides of main entrance hall, 2nd Floor, SZCEC.
- **Storage:** Hall 1, Gate 8, 1-109.
- **Locker Service:** Both sides of Exhibition Hall North Entrance, 2nd Floor, SZCEC.
    - Big Locker: RMB 5/Time.
    - Small Locker: RMB 1/Time.
- **Medical Aid:** The temporary Medical Aid locates in room 207, 2nd Floor, SZCEC. The organizing committee office has medicine chest. If any emergency, please call 120.
- **Hotel Service:** Room 205,2nd Floor, SZCEC.

ART (Alarm Recording Telephone): 110

The 5th & 6th Floor | Conference Rooms of OGC 2019





From Shenzhen Airport

Shenzhen Bao'an International Airport is 32km from downtown.

By Metro

It's highly recommended to take metro from airport to SZCEC.

- Departure station: Airport East
- Destination Station: Shenzhen Convention and Exhibition Center

(Chinese pronunciation :Hui Zhan Zhong Xin)

- Duration: 50 mint
- Cost: RMB 7

By Airport Bus

- Bus No. : Line 9
- Departure station: Airport
- Destination Station: Shenzhen Convention and Exhibition Center (***Chinese pronunciation*** :Hui Zhan Zhong Xin)
- Duration:1 hour (depend on traffic situation)
- Cost: RMB 20

By Taxi

- Destination Station: Shenzhen Convention and Exhibition Center (***Chinese pronunciation*** :Hui Zhan Zhong Xin)
- Duration:40 mints (depend on traffic situation)
- Cost: about RMB 120

From Guangzhou international airport

You can take Airport Express at Gate7 of the Arrival Hall in the airport.

- Bus leaves every hour to Shenzhen from 09:50-20:50.
- After arriving in Shenzhen, taxi is the best way to the Convention, which costs less than RMB 30, and within 20 minutes

From Downtown Guangzhou

By Train

There are direct trains every 15 minutes from Guangzhou to Shenzhen which you can take at both Guangzhou Eastern Railway Station and Guangzhou Railway Station.

- The ticket is about RMB 70 ~ 85 per person.
- All High-speed trains begin with the letter "D".
- The trip is around 50-70 minutes.
- Service hours are 06:30-21:30.

By Bus/Coach

There are direct bus/coach services every 10 minutes from Guangzhou to Shenzhen which you can take at the below stations:

- Guangdong Provincial Bus Station

No. 145 Huangshi Road West, Guangzhou

Tel: 86-20-86661297/ 86692865-2091

- Guangyuan Passenger Transport Station

No. 283 Guangyuan Road, Guangzhou

Tel: 86-20-86376666, 86379888

- Guangzhou Jinhan Passenger Transport Station

Tianhe Building, Tiyu Xi Road, Guangzhou

Tel: 86-20-38864843 33437883

• There are several destinations in Shenzhen. Please choose Luo Hu (罗湖) as the final destination for the convenience of transportation after arrival. The journey is about 75-120 minutes, which costs RMB 60-70.

• The service hours are 06:00-22:30.

• After you arrive at Luo Hu, you can take the Shenzhen Metro to the Expo whose station name is Hui Zhan Zhong Xin (Shenzhen Convention & Exhibition Center). Of course, you can take a taxi, which costs around RMB 30

From Hong Kong Airport

By Bus/Coach

There are very frequent bus and coach services that can take you from the Hong Kong airport to Huanggang border and most hotels in Shenzhen. The duration is 45-60 minutes.

Bus/coach companies have counters inside the airport. The staff at the information booth should be able to direct you to their counters.

Cost around HKD 90~160.

By Ferry

This is an easy way to come to Shenzhen from HK Airport, if the schedule suits you.

There are signs all over the place inside the Airport showing you how to get to the Ferry Transfer Desk after you arrive at the airport.

It is located just before the immigration processing area as well as before the luggage pickup area.

- ✧ Taking the ferry to Shenzhen will by-pass entering Hong Kong altogether from the immigration point of view and the ferry will take you from the airport directly into China via the ferry port called Shekou in Shenzhen.
- ✧ After you purchase the ticket, you can give them the tags of your checked luggage and they will transfer them for you onto the ferry.
- ✧ It will cost HKD 220 for this 30-40minute journey.
- ✧ After you arrive in Shekou, pick up your checked luggage and do the immigration and custom processes.
- ✧ Then, go outside to take a taxi to your hotel. Please go to take a public taxi with taxi sign marked on the car. It costs around RMB 60-80 from Shekou port to the Expo by taxi.
- ✧

HK International Airport Departure	Shenzhen Shekou
9:00	7:45
10:15	8:45
11:00	10:00
12:30	11:15
13:30	12:15
14:30	13:30
15:30	14:30
16:30	15:30
17:30	16:30
18:30	17:30

From Downtown Hong Kong

By Train

- Getting to Shenzhen from downtown Hong Kong is simple, as it takes less than an hour on a KCR train.
- The KCR train connects East Tsim Sha Tsui to Lo Wu and Lok Ma Chau with several intermediate stops. It interchanges with the urban section of the MTR at Kowloon Tong Station and East Tsim Sha Tsui Terminal.
- The journey from East Tsim Sha Tsui to Lo Wu or Lok Ma Chau takes 40-60 minutes and costs HK$33-36.50, first class is charged double. Trains depart every few minutes but some short trips are operated in rush hour, so check the destination screen before boarding. The train can be crowed during rush hours as it serves millions of commuters along the line as well.
- After you go through the immigration at Lo Wu or Lok Ma Chau, you can take the Shenzhen Metro (Line 1 at Lo Wu costing RMB 4, and Line 4 at Lok Ma Chau costing RMB 2) to the Expo whose station name is Huizhan Zhongxin (Shenzhen Convention & Exhibition Center). Of course, you can take a taxi. It costs around RMB 30 from Lo Wu, and less than RMB 20 from Lok Ma Chau).

By Bus

There are very frequent bus services that can take you from the Hong Kong downtown to Huanggang border. You can take such buses in Mong Kok, Prince Edward, Jordon, Kwun Tong. The journey takes 40-60 minutes, costs around HKD 30-40. Services hours are 0:00-24:00.

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