2021 Optoelectronics Global Conference (OGC 2021)

Shenzhen, China

15-18 September, 2021

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CONTENTS

ABOUT OGC 2021

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

2021 IEEE the 6th Optoelectronics Global Conference (OGC 2021) will be held concurrently with the 23rd China International Optoelectronic Exposition (CIOE) in Shenzhen, China, from September 15 to September 18, 2021. OGC 2021 is sponsored by IEEE Photonics Society and Guangzhou Photonics Chapter, hosted by Department of Electrical and Electronic Engineering, Southern University of Science and Technology.

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. It's expected that 300-500 professionals will attend the conference.

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

9 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
- Near-infrared, Mid-infrared and Far-infrared Technologies and Applications
- Quantum Optics and Information
- Fiber-Based Technologies and Applications
- Optoelectronic Devices and Applications
- Biophotonics and Optical Biomedicine
- AI Photonics
- Silicon Photonics

Special Sessions

- Perovskite Materials and Optoelectronic Applications
- Liquid Crystal Photonics
- Translational Photomedicine and Biophotonics
- THz Metamaterials and Device Applications
- Emerging Technologies for Information Displays and Lighting
- Photophysics of Structured Materials for Nanophotonics

Workshops

- Optical Fiber Upgrade
- Computational Imaging

CONFERENCE COMMITTEE

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Nan Zhang, JPT, China

Symposia Chairs

S1. LASER TECHNOLOGY

Guiyao Zhou, South China Normal University, China
Tianye Huang, China University of Geosciences (Wuhan), China
Jinhui Yuan, The University of Science and Technology Beijing, China

S2. OPTICAL COMMUNICATION AND NETWORKS

Lei Deng, Huazhong University of Science and Technology, China

Xiaodan Pang, KTH Royal Institute of Technology, Sweden

Junwen Zhang, Fudan University, China

Jianping Li, Guangdong University of Technology, China

Qi Yang, Huazhong University of Science and Technology, China

S3. NEAR-INFRARED, MID-INFRARED AND FAR-INFRARED TECHNOLOGIES AND APPLICATIONS

Qijie Wang, Nanyang Technological University, Singapore

Yan Zhang, Capital Normal University, China

Xinhai Zhang, Southern University of Science and Technology, China

Li Hua, Shanghai Institute of Microsystem and Information Technology, China

Wang Cheng, ShanghaiTech University, ChinaS4. Precision Optics

S4. QUANTUM OPTICS AND INFORMATION

Ming Ding, Beihang University, China

Qiang Zhou, University of Electronic Science and Technology of China, China

Yong-Chun Liu, Tsinghua University, China

Xuejian Wu, Rutgers University-Newark, USA

S5. FIBER-BASED TECHNOLOGIES AND APPLICATIONS

Yuwen Qin, Guangdong University of Technology, China

Xia Yu, Beihang University, China

Lei Wei, Nanyang Technological University, Singapore

Youngjoo Chung, Gwangju Institute of Science and Technology, South Korea

S6. OPTOELECTRONIC DEVICES AND APPLICATIONS

Yu Yu, Huazhong University of Science and Technology, China

Xinlun Cai, Sun Yat-Sen University, China

Haoshuo Chen, Nokia Bell Labs, USA

Qiang Li, Zhejiang University, China

Lei Lei, Shenzhen University, China

S7. BIOPHOTONICS AND OPTICAL BIOMEDICINE

Changfeng Wu, Southern University of Science and Technology, China

Liwei Liu, Shenzhen University, China

Wei Zheng, Shenzhen institutes of Advanced Technology, Chinese Academy of Sciences, China

Xuantao Su, Shandong University, China

Junle Qu, Shenzhen University, China

S8. AI PHOTONICS

Qunbi Zhuge, Shanghai Jiao Tong University, China

Yongli Zhao, University of Posts and Telecommunications, China

Hongwei Chen, Tsinghua University, China

Jianqiang Li, Kuaishou Technology, China

Chaoran Huang, Chinese University of Hong Kong, China

S9. SILICON PHOTONICS

Mingbin Yu, Shanghai Institute of Microsystem and Information Technology, China

Zeng Li, Huawei Technologies CO., LTD., China

Xiao Xi, National Information Optoelectronics Innovation Center, CICT, China
Di Liang, Hewlett Packard Labs, USA
Yaocheng Shi, Zhejiang University, China
Ke Xu, Harbin Institute of Technology, Shenzhen, China

Special Sessions Chairs

T1. PEROVSKITE MATERIALS AND OPTOELECTRONIC APPLICATIONS
Kai Wang, Southern University of Science and Technology, China
Aung Ko Ko Kyaw, Southern University of Science and Technology, China
Haizheng Zhong, Beijing Institute of Technology, China
Gongqiang Li, Nanjing Tech University, China

T2. LIQUID CRYSTAL PHOTONICS
Dan Luo, Southern University of Science and Technology, China
Yanjun Liu, Southern University of Science and Technology, China
Wei Hu, Nanjing University, China
Zhigang Zheng, East China University of Science and Technology, China

T3. TRANSLATIONAL PHOTOMEDICINE AND BIOPHOTONICS
Gina Jinna Chen, Southern University of Science and Technology, China
Linbo Liu, Nanyang Technological University, Singapore
Jing Dong, Harvard University, USA
Guanghui Wang, Nan Jing University, China

T4. THZ METAMATERIALS AND DEVICE APPLICATIONS
Chunmei Ouyang, Tianjin University, China
Yuanmu Yang, Tsinghua University, China
Caihong Zhang, Nanjing University, China
Longqing Cong, Southern University of Science and Technology, China
Huifang Zhang, University of Cambridge, UK

T5. EMERGING TECHNOLOGIES FOR INFORMATION DISPLAYS AND LIGHTING
Xiaowei Sun, Southern University of Science and Technology, China
Zhaojun Liu, Southern University of Science and Technology, China

T6. PHOTOPHYSICS OF STRUCTURED MATERIALS FOR NANOPHOTONICS
Rui Chen, Southern University of Science and Technology, China
Guichuan Xing, University of Macau, China
Tingchao He, Shenzhen University, China
Yue Wang, Nanjing University of Science and Technology, China

Workshops Committee

Workshop <Optical Fiber Upgrade>
Chair: **Zhenggang Lian,** Yangtze Optical Electronics Co., China

Workshop <Computational Imaging>

Chairs: **Fucai Zhang**, Southern University of Science and Technology, China
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INSTRUCTION FOR PARTICIPATION

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For Invited Speech

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The duration of a speech slot is 30 minutes. Please target your lecture for a duration of about 27 minutes for the presentation plus about 3 minutes for questions from the audience.

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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 13 minutes for the presentation plus about 2 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.

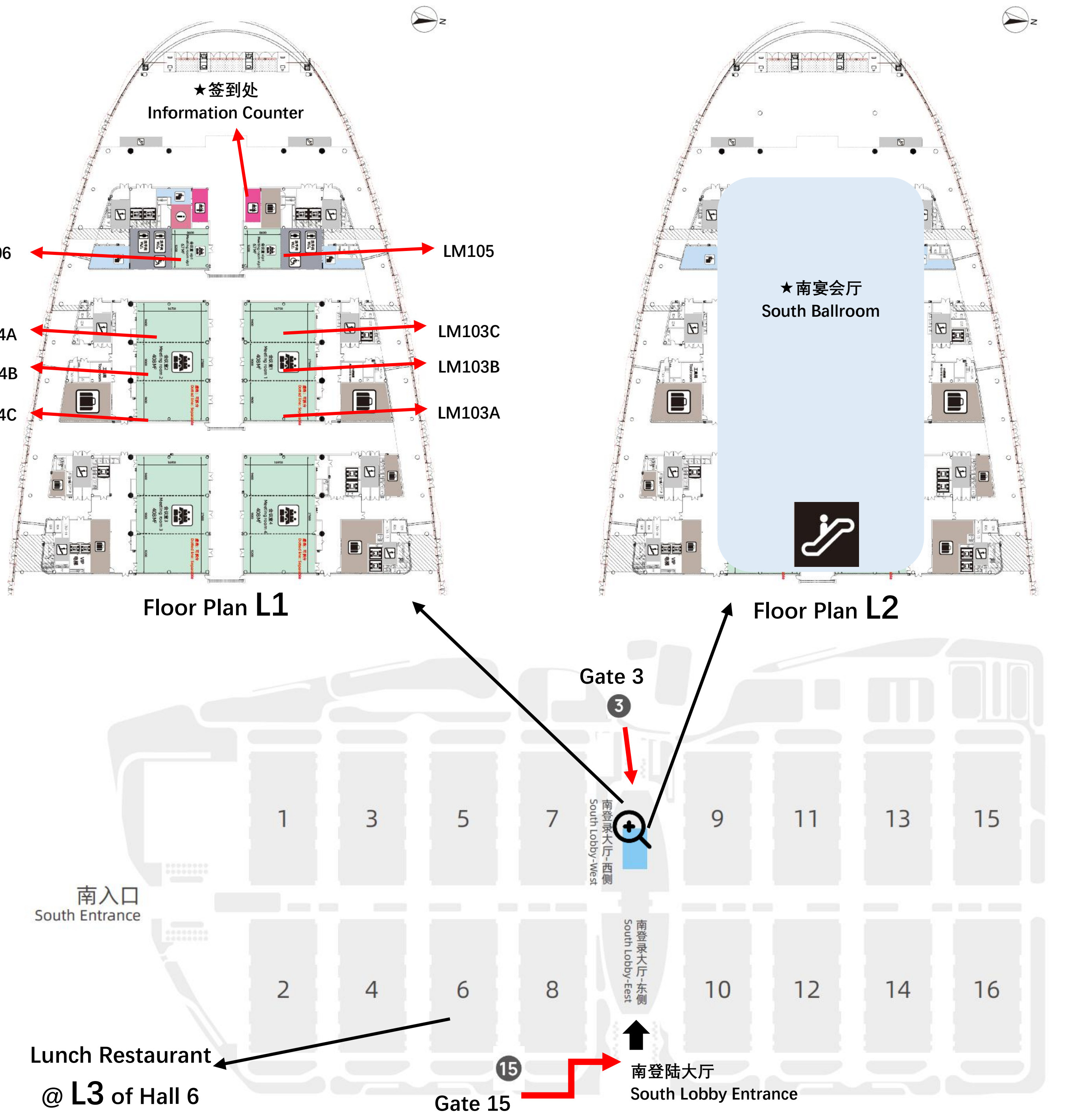
Reminders

- 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.
- 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.

Important

- You and your belongings will be subject to security screening.
  进入会场之前需接受安检。
- You are requested to present your ID and the health code before entering the conference venue.
  进入会场需出示您的身份证和粤康码。
- Please make sure you always have your ID with you.
  请确保您随身携带您的身份证。
- You are suggested to scan the QR code below to obtain the health code.
  请提前扫描以下小程序码获取您的粤康码。

CONFERENCE VENUE



Information Counter	**Outside LM105 @ 1F | 南登陆大厅一楼**
Conference Rooms	**LM103A&B&C; LM104A&B&C; LM105&LM106 @ 1F | 南登陆大厅一楼**
Opening Ceremony	**South Ballroom @ 2F | 南登陆大厅 2 楼南宴会厅**
Lunch Restaurant	**L3 of Hall 6 | 六号馆三楼**

AGENDA OVERVIEW (Onsite Part)

Sept. 15, 2021 | SIGN-IN

@ Information Counter outside Room LM105 (1F) | 一楼会议室 LM105 外签到台

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

Sept. 16, 2021 | Technical Meeting

@ South Ballroom (2F) | 二楼宴会厅 A

CIOE & OGC Opening Ceremony

09:30-10:00	**Opening Remarks**

Plenary Session

chaired by Liyang Shao, Southern University of Science and Technology, China

10:00-10:40	**Plenary Speech I** Title: Quantum dot Displays **Xiaowei Sun**, Southern University of Science and Technology, China; OSA Fellow, SPIE Fellow
10:40-11:20	**Plenary Speech II** Title: Visible light communication in 6G: Demand factors, Benefits and Opportunities **Nan Chi**, Fudan University, China; OSA Fellow
11:20-12:00	**Plenary Speech III** Title: Towards F6G: Trends and Challenges of Intergenerational Evolution of Optical Fiber Communications **Liangchuan Li,** Huawei Technologies Co., Ltd., China

12:00-13:30 | Lunch @ L3 of Hall 6 | 六号馆三楼

13:30-18:00	**CIOE Exhibitions**

Sept. 17, 2021

9:00-10:30 Technical Sessions

Venue	LM103-A	LM103-B	LM103-C	LM104-A	LM104-B	LM104-C	LM105
Session No.	S01	S02	S03	S04	S05	S06	S07

***S01: Laser Technology – A** <Chair: Kan Wu>
Invited Speeches (Qiancheng Zhao; Ai-Ping Luo; Wenjun Liu)

***S02: Fiber-Based Technologies and Applications – A** <Chair: Liang Wang>
Invited Speeches (Huanhuan Liu; Liang Wang)

***S03: Biophotonics and Optical Biomedicine - A** <Chair: Chao Tian>
Invited Speeches (Chao Tian; Jianbo Tang; Anhui Liang)

***S04: Optical Fiber Upgrade - A** <Chair: Jiajing Tu>
Invited Speeches (Jiajing Tu; Chunying Guan; Chaotan Sima)

***S05: Liquid Crystal Photonics - A** <Chair: Dan Luo>
Invited Speeches (Ling Wang; Xiangru Wang; Satoshi Aya; Qiong-Hua Wang; Lu-Jian Chen)

***S06: Perovskite Materials and Optoelectronic Applications – A** <Chair: Kai Wang>
Invited Speeches (Zhubing He; Dewei Zhao; Haizheng Zhong)

***S07: Photophysics of Structured Materials for Nanophotonics - A** <Chair: Rui Chen>
Invited Speeches (Linfeng Sun; Huakang Yu; Feng He)

10:30-10:45 Coffee Break

10:45-12:00 Technical Sessions

Venue	LM103-A	LM103-B	LM103-C	LM104-A	LM104-C	LM105
Session No.	S08	S09	S10	S11	S12	S13

***S08: Laser Technology – B** <Chair: Zhichao Luo>
Invited Speeches (Kan Wu; Zhichao Luo); Oral Presentations (G29121)

***S09: Fiber-Based Technologies and Applications - B**
Invited Speeches (Chen Yang); Oral Presentations (G29135; G2970; G29130)

***S10: Optoelectronic Devices and Applications - A** <Chair: Yu Yu>
Invited Speeches (Yaocheng Shi); Oral Presentations (G2915; G29129; G29134)

***S11: Optical Fiber Upgrade - B** <Chair: Meisong Liao>
Invited Speeches (Yu Zheng; Yang Yue); Oral Presentations (G29124)

***S12: Perovskite Materials and Optoelectronic Applications - B** <Chair: Kai Wang>
Invited Speeches (Xuyong Yang; Xiong Li); Oral Presentations (G29156)

***S13: THz Metamaterials and Device Applications - A** <Chair: Chunmei Ouyang>
Invited Speeche (Jinhui Shi); Oral Presentations (G2923; G2922; G2924)

12:20-13:30 Lunch @ L3 of Hall 6 | 六号馆三楼

13:30-15:30 Technical Sessions

Venue	LM103-A	LM103-B	LM103-C	LM104-A	LM104-B	LM104-C	LM105
Session No.	S14	S15	S16	S17	S18	S19	S20

***S14: Fiber-Based Technologies and Applications – C** <Chair: Yiyang Luo>
Invited Speeches (Wenjun Ni; George Y. Chen; Zhijun Yan; Chengyu Hong)

***S15: Fiber-Based Technologies and Applications – D** <Chair: Guiyao Zhou>
Invited Speeches (Yingying Wang; Xiaopeng Dong; Meng Pang); Oral Presentations (G297; G2927)

***S16: Optoelectronic Devices and Applications - B** <Chair: Lei Lei>
Invited Speeches (Pan Wang; Li Shen)

***S17: Silicon Photonics**<Chair: Guoqing Wang>
Invited Speeches (Zou Yi; Nan Ye; Yu He); Oral Presentations (G2993; G2992)

***S18: AI photonics – A**<Chair: Yongli Zhao >
Invited Speeches (Xiaosong Yu; Xiaomin Liu; Yongli Zhao)

***S19: Perovskite Materials and Optoelectronic Applications – C** <Chair: Kai Wang>
Invited Speeches (Dan Wu; Guohui Li; Hai Zhou)

***S20: THz Metamaterials and Device Applications – B**<Chair: Longqing Cong>
Invited Speeches (Longqing Cong; Liyuan Liu; Zhen Gao; Xiaoguang Zhao)

15:30-15:45 Coffee Break

15:30-17:30 Poster Session* *Venue: Lounge (1F) | 一楼长廊*

***Poster Session** - G29114; G29154; G29131; G2989; G2990; G29119; G29152; G2987; G29109; G29105; G2941; G29116; G2983; G2988; G2949; G2934; G2921; G299; G29100; G298; G2920; G2959; G2912; G2991; G2975; G2973; G2938; G3001; G29132;

15:45-18:15 Technical Sessions

Venue	LM103-A	LM103-B	LM103-C	LM104-A	LM104-B	LM104-C	LM105
Session No.	S21	S22	S23	S24	S25	S26	S27

***S21: Laser Technology – C** <Chair: Luming Zhao>
Invited Speeches (Luming Zhao; Zhaoyu Zhang; Xiaosheng Xiao); Oral Presentations (G29133)

***S22: Quantum Optics and Information – A** <Chair: Jiefei Chen>
Invited Speeches (Lingxiao Zhu; Xian Zhang; Jiefei Chen; Keyu Xia; Cuicui Lu)

***S23: Fiber-Based Technologies and Applications – E** <Chair: Huanhuan Liu>
Invited Speeches (Lei Zhang; Fei Xu; Changyuan Yu); Oral Presentations (G2945; G2939; G29127)

***S24: Biophotonics and Optical Biomedicine - B** <Chair: Changfeng Wu>
Invited Speeches (Yiming Li; Peng Xi; Xiaolong Liu); Oral Presentations (G2980)

***S25: AI photonics & Optoelectronics Technopreneurship** <Chair: Mingbin Yu>
Invited Speeches (Jianji Dong; Wei Ma; Ruijie Zhu; Zhenming Yu; Na NI)

***S26: Liquid Crystal Photonics - B** <Chair: Wei Hu>
Invited Speeches (Jiu-an Lv; Huai Yang; Pengcheng Lin); Oral Presentations (G2969)

***S27: Photophysics of Structured Materials for Nanophotonics - B** <Chair: Dehui Li>
Invited Speeches (Jiaji Cheng; He Huang; Jun Wang; Dehui Li; Zhaogang Nie)

09:00-17:15 Special Events

*Workshop: Computational Imaging *Venue: LM106*		
9:00-9:30	Jiamin Wu	Tsinghua University
9:30-10:00	Xiaoli Liu	Shenzhen University
10:00-10:30	Lu Rong	Beijing University of Technology
10:30-10:45 | Coffee break		
10:45-11:15	Shoucong Ning	National University of Singapore
11:15-11:30	Shanshan Zheng	Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences
11:30-12:00	Liangcai Cao	Tsinghua University
12:20-13:30 | Lunch @ L3 of Hall 6 | 六号馆三楼		
13:30-14:00	Zhen Chen	Cornell University
14:00-14:30	Huaidong Jiang	ShanghaiTech University
14:30-15:00	Jinli Suo	Tsinghua University
15:00-15:30	Zibang Zhang	Department of Optoelectronic Engineering, Jinan University
15:30-15:45 | Coffee Break		
15:45-16:15	Michal Odstrcil	Zeiss SMT
16:15-16:45	Andrew Maiden	University of Sheffield
16:45-17:15	Fucai Zhang	Southern University of Science and Technology

19:30-20:30 | BANQUET

晚宴餐厅位于：深圳宝安博客格兰云天国际酒店(新会展中心店)

地址：宝安区沙井街道民主大道与锦程中路西交汇处

The restaurant for banquet is located in

Grand Skylight International Hotel Blog Baoan Shenzhen

(New Int'l Exhibition Center)

Add: West Intersection Minzhu Avenue and Jincheng Middle Road, Shajing Street, Baoan District, 518104 Bao'an, China

*车程约 20 分钟

*About 20-minute drive from the conference venue to the banquet venue.

*我们邀请您于 2021 年 9 月 17 日晚 18:30 前于签到台集合，与会人员将乘坐会务组大巴一同前往晚宴餐厅。

*You're invited to gather at sign-in site and take the bus to the restaurant.

会议地点位于：深圳国际会展中心

地址：深圳市宝安区福海街道展城路 1 号

Shenzhen World Exhibition & Convention Center Address

No.1 Zhancheng Rd, Fuhai Street, Bao'an District, Shenzhen

Sept. 18, 2021

08:45-10:30 Technical Sessions

Venue	LM103-A	LM103-B	LM103-C	LM104-A	LM104-B	LM104-C	LM105
Session No.	S28	S29	S30	S31	S32	S33	S34

***S28: Laser Technology - D** <Chair: Zhijia Hu>
Invited Speeches (Dongmei Huang; Yiyang Luo; Zhijia Hu)

***S29: Quantum Optics and Information - B** <Chair: Yongmin Li>
Invited Speeches (Yani Zuo; Yongmin Li; Jiansheng Wu)

***S30: Biophotonics and Optical Biomedicine - C** <Chair: Wei Zheng>
Invited Speeches (Aaron H. P. Ho; Hongbao Xin; Bobo Gu, G29145)

***S31: Near-infrared, Mid-infrared and Far-infrared Technologies and Applications – A**
<Chair: Anbang Wang>
Invited Speeches (Song-Sui Li; Yi Gu; Anbang Wang)

***S32: Near-infrared, Mid-infrared and Far-infrared Technologies and Applications - B**
<Chair: Xiaolong Chen>
Invited Speeches (Xiaolong Chen; Yandong Gong); Oral Presentations (G29113; G29103)

***S33: Perovskite Materials and Optoelectronic Applications – D** <Chair: Aung Ko Ko Kyawi>
Invited Speeches (Rui Zhu; Yuelong Li)

***S34: Translational Photomedicine and Biophotonics** <Chair: Guanghui Wang>
Invited Speeches (Kai Li; Lingjie Kong; Qiongyu Guo)

10:30-10:45 Coffee Break

10:45-12:00 Technical Sessions

Venue	LM103-A	LM103-B	LM103-C	LM104-A	LM104-B	LM105
Session No.	S35	S36	S37	S38	S39	S40

***S35: Fiber-Based Technologies and Applications – F** <Chair: Hong Dang>
Invited Speeches (Qi Wu; Yuanhong Yang); Oral Presentation (G2910)

***S36: Quantum Optics and Information – C** <Chair: Feng Li>
Invited Speeches (Jin Wang; Feng Li); Oral Presentations (G2947)

***S37: Optoelectronic Devices and Applications – C** <Chair: Ruoming Li >
Invited Speeches (Ruoming Li); Oral Presentations (G29144; G29161; G2918)

***S38: Optical Fiber Upgrade - C** <Zhenggang Lian>
Invited Speeches (Meisong Liao; Shuhui Li); Oral Presentations (G29101)

***S39: Optical Communication and Networks – A** <Chair: Junwen Zhang>
Invited Speeches (Quan Pan; Guijun Hu); Oral Presentations (G29142)

***S40: Optical Communication and Networks - B** <Chair: Qi Yang >
Invited Speeches (Fan Zhang; Fan Li); Oral Presentations (G29150)

09:00-12:00 Special Events

Workshop: Computational Imaging** ***Venue: LM106		
9:00-9:30	Jinyang Liang	INRS - University of Quebec
9:30-10:00	Guoan Zheng	University of Connecticut
10:00-10:30	Chao Zuo	Nanjing University of Science and Technology
10:30-11:00 | Coffee Break		
11:00-11:30	Kedar Khare	Indian Institute of Technology Delhi
11:30-12:00	Guohai Situ	Shanghai Institute of Optics and Fine Mechanics

12:20-13:30 Lunch @ L3 of Hall 6 | 六号馆三楼

PLENARY SPEAKER / 10:00-10:40, Sept. 16, 2021

Xiaowei Sun
Southern University of Science and Technology, China
OSA Fellow, SPIE Fellow

Dr. Xiao Wei Sun is presently a Chair Professor in the Southern University of Science and Technology, Shenzhen, China. He is the founding Head of the Department of Electrical and Electronic Engineering. Before joining Southern University of Science and Technology, he had been working at Nanyang Technological University, Singapore as a Full Professor. He was the Director of Microelectronics Center at Nanyang Technological University. He was awarded the Honorary Doctor of the Belarusian State University of Informatics and Radioelectronics (BSUIR) in 2021. He was awarded the Nanyang Award for Research and Innovation in 2009, the 1000 Talent Award by the Chinese Government in 2012, and the Jacques Beaulieu Excellence Research Chair of INRS (Institut national de la recherchescientifique), Quebec, Canada in 2013. He is an Academician of the Asia-Pacific Academy of Materials. He is the fellow of several academic societies including Society for Information Display (SID), Optical Society of America (OSA), SPIE, and Institute of Physics (IoP, UK). He is a Distinguished Lecturer of IEEE Nanotechnology Council and Chair of the IEEE Nanotechnology Council Guangdong Chapter. He is the founder and President of the Society for Energy Photonics, a non-profitable organization promoting photonics technologies to solve energy crisis and combat global warming and climate change. His main research presently is on semiconductor nanocrystals for power-saving high-quality displays and lighting. Professor Sun has authored over 500 peer-reviewed journal publications, and delivered numerous invited talks. His H-index is 78. He is an Elsevier Highly Cited Scholar, and being listed as the "Global Top 2% Scientists" by Stanford University.

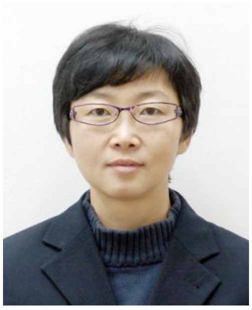
TALK ON

Quantum dot Displays

Abstract: In this talk, we will introduce the colloidal quantum dot (CQD) technology used for information displays. CQDs synthesized chemically have proven to feature tunable wavelength (quantum confinement effect), high quantum yield and narrow emission linewidth, which are perfectly suitable for wide color gamut displays. In our recent research, we focus on pixel patterning of quantum dot light-emitting diodes (QLEDs). Patterning is of paramount importance in realizing a display. Here, we present large-area, high-resolution, full-color QD patterning utilizing a selective electrophoretic deposition (SEPD) technique. We can achieve low-cost QD patterning in large-area beyond 1,000 pixels-per-inch by this technology. This technology can be used for both photoluminescence and electroluminescence applications. We demonstrate the versatility of this patterning technology to integrate various QDs into large-area arrays of full-color emitting pixels and QLEDs with good performance.

PLENARY SPEAKER / 10:40-11:20, Sept. 16, 2021

Nan Chi
Fudan University, China
OSA Fellow



Professor Nan Chi is with School of Information Science and Engineering, Fudan University, China. She received the BS degree and PhD degree in electrical engineering from Beijing University of Posts and Telecommunications, China. She is the author or co-author of more than 300 papers and has been cited more than 8900 times. She has been awarded as The National Science Fund for Distinguished Young Scholars, the New Century Excellent Talents Awards from the Education Ministry of China, Shanghai Shu Guang scholarship. Her current research interests include advanced modulation format, optical packet/label switching, optical fiber communication and visible light communication. She is a fellow of the OSA.

TALK ON

Visible light communication in 6G: Demand factors, Benefits and Opportunities

Abstract: In this paper, we present the prospects, challenges and latest progress of Visible light communication (VLC) in the 6G wireless network. It is envisioned VLC will become an indispensable part of 6G given its characteristic of high data rate, encouraging more novel concepts and applications for 6G.

PLENARY SPEAKER / 11:20-12:00, Sept. 16, 2021

Liangchuan Li
Huawei Technologies Co., Ltd., China

Liangchuan Li received his PhD in electrical engineering from the Beijing University of Posts and Telecommunications, in 2007. He is a senior research expert of Research Department of Optical Business Product Line, Huawei Technologies Company, Ltd., He is currently the chief expert on the optical communications project of the Ministry of Science and Technology's key R&D program. His research interests include PON systems and algorithms, Data Center optical networks, LH WDM transmission and digital signal processing algorithms.

TALK ON

Towards F6G: Trends and Challenges of Intergenerational Evolution of Optical Fiber Communications

Abstract: After the concept of F5G was proposed, the application scenarios of optical fiber communication are expanded. New application scenarios further drive the evolution of optical fiber communications to the sixth generation: P2MP multiple access technologies is from traditional Time division multiple access (TDMA) to new xDMA. Data center optical interconnection has shifted from Intensity detection to coherent detection. Long-haul WDM transmission evolves from 200G/400G to 800G/1.6T, and the single-mode fiber capacity approaches 100T.

In the talk, we will discuss the trends and challenges of F6G optical fiber communication technology in terms of fiber access, long-haul WDM transmission and data center optical networks.

ONSITE TECHNICAL SESSIONS / Sept. 17, 2021

Oral Sessions

S01: Laser Technology - A
Room: LM103-A | Time: 09:00-10:30

Session Chair: **Kan Wu,** Shanghai Jiao Tong University, China

09:00-09:30 | Invited Speaker: Qiancheng Zhao

Qiancheng Zhao is a postdoctoral researcher in University of California, Santa Barbara. He earned his Ph.D. degree in University of California, Irvine in 2017, and bachelor's degree in Zhejiang University in 2012. Before joined UCSB, he worked in Apple for one and a half years. His research interests include ultra-low-loss planar lightwave circuit, ultra-high-Q optical resonators, laser frequency stabilization, and silicon nitride planar photonic devices. He has authored and coauthored more than 15 journal publications including Nat. Comms., APL Photonics, IEEE JTL, OE, and edited a book. He is a guest editor of "Silicon Photonics Bloom" for Micromachines Journal.

----Invited Talk----

Integrated optical reference cavity for laser frequency stabilization

Abstract—Optical reference cavities are wide widely used for laser linewidth reduction and frequency stabilization applications such energy-efficient optical coherent communications, optical atomic clocks, and quantum photonics. For reduced cost and portability, it is desirable to miniaturize the traditional bench-top reference cavities into photonic integrated resonators. Dual-mode optical thermometry is a powerful technique to precisely probe a cavity temperature by utilizing the difference in thermal responses between optical cavity modes. This presentation shows the recent progress of all-waveguide integrated optical resonators based on dual-mode optical thermometry to actively correct laser frequency. These results present a promising step towards on-chip photonic integrated reference cavities and ultra-stable integrated lasers.

09:30-10:00 | Invited Speaker: Ai-Ping Luo

Ai-Ping Luo received the Ph.D. degree in optical engineering from the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China, in 2004. Since 2004, she has been with the School of Information and Optoelectronic Science and Engineering, South China Normal University, Guangzhou, China, where she is currently a Professor. From 2007 to 2008, she was an academic visitor at the École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. She is the author or coauthor of more than 130 international journal and conference papers. Her current research interests include fiber-based devices, fiber lasers, and nonlinear fiber optics.

----Invited Talk----

Tunable spatiotemporal mode-locked fiber laser

Abstract—Recently, the spatiotemporal mode-locked (STML) laser based on MMFs has aroused great interest owing to its potential in generating pulses with high energy and power, since the MMF has a larger core area than the SMF. In this work, we designed an all-fiber STML laser, where the single wavelength with large tuning range and dual-wavelength with tunable spacing STML pulses are achieved, respectively. Moreover, the number of the pulses can also be adjusted. Such flexible and tunable fiber laser has potential applications in fields of all optical signal processing, fiber sensing, and optical communication.

10:00-10:30 | Invited Speaker: Wenjun Liu

Wenjun Liu has been engaged in the research of femtosecond fiber laser generation and application for a long time, and has completed a series of important innovations and applications in nonlinear effect control methods, key materials, devices fabrication and mode-locked physical mechanism with an aim at the nonlinear control problem of femtosecond fiber laser. He has published more than 100 SCI retrieval papers and the H index is 44. And He won the first prize of science and technology award of the Chinese Materials Research Society and the second prize of optical science and technology award of the Chinese Optical Society.

----Invited Talk----

Nonlinear control method and application of femtosecond fiber laser

Abstract—In order to realize stable mode locked operation, the ultra short pulse fiber laser still depends on saturable absorber. However, due to the laser damage and loss caused by saturable absorber, it not only restricts the pulse width and power of the laser, but also affects the reliability of longterm operation. Therefore, the research and development of novel saturable absorber with high damage threshold and low loss and its application in fiber lasers have attracted the attention of laser experts and material experts. Based on the designability and adjustability of the saturable absorber structure, we will design and prepare the composite saturable absorber with different two-dimensional nano materials and different substrates. By designing different fiber

laser cavity types and adopting different mode-locking principles, we will realize the ultrashort mode-locked laser pulse output.

S02: Fiber-Based Technologies and Applications - A

Room: LM103-B | Time: 09:00-10:00

Session Chair: **Liang Wang**, Huazhong University of Science and Technology, China

09:00-09:30 | Invited Speaker: Huanhuan Liu

Huanhuan Liu has obtained the doctorate degree from Nanyang Technological University, Singapore in 2014. Now she is research associate professor in Southern University of Science and Technology. Her research interest focuses mainly on fiber lasers, fiber sensors, and low-dimensional nanomaterial optical devices. She has published more than 40 academic papers in Nanophotonics, Applied Physics Letters, Optics Letters, etc. She has published 15 peer-reviewed journal papers as the first author (7 papers with impact factor> 3, two cover articles). She has presided over 1 fund supported by National Natural Science Foundation of China, and mainly participated in 6 national-level scientific research projects. She has been authorized 9 national invention patents, co-edited 1 English book. She has won the best paper award of the Photonics Global Conference in 2010; the "National Outstanding Self-Financed International Student Scholarship" in 2014; the "Shanghai Young Oriental Scholar" talent honor in 2016, and the second prize of Shanghai Science and Technology Progress Award in 2020.

----Invited Talk----

Fiber-based Vortex Beam for Optical Sensing Application

Abstract—We have proposed the vortex fibers for the generation of vortex beams including orbital angular momentum modes and cylindrical vector modes, and experimentally demonstrated all-fiber vortex beams for magnetic-field, temperature, strain, and refractive-index sensing.

09:30-10:00 | Invited Speaker: Liang Wang

Liang Wang is currently a Professor at the School of Optical and Electronic Information, Huazhong University of Science and Technology. He received B.S. degree from Huazhong University of Science and Technology, Wuhan, China, in 2008, and Ph.D. degree from CUHK in 2013. He has published more than 100 research papers in major peer-reviewed journals and international conferences. His research interests include distributed fiber sensors, optical signal processing, novel fiber devices and photonic devices, etc.

----Invited Talk----

Fast locating BFS change in BOTDA sensing system based on edge detection method

Abstract—We will review our work on edge detection based ultrafast locating of the abnormal BFS change in BOTDA sensing system. The speed of event locating has been improved by two orders when compared with conventional methods. We believe this method is particularly useful in urgent situations where fast locating of abnormal temperature or strain is necessary when there is emergence.

S03: Biophotonics and Optical Biomedicine - A

Room: LM103-C | Time: 09:00-10:30

Session Chair: **Chao Tian**, University of Science and Technology of China, China

09:00-09:30 | Invited Speaker: Chao Tian

Chao Tian is a professor at the School of Engineering Science, University of Science and Technology of China (USTC). He received the B.S. degree in Electrical Engineering and the Ph.D. degree in Optical Engineering from Zhejiang University, Hangzhou, China. From 2013 to 2017, he worked as a Post-Doctoral Research Fellow in photoacoustic imaging with the Department of Biomedical Engineering at the University of Michigan, Ann Arbor. He has published over 40 peer-reviewed journal articles and is a co-inventor of six patents. Dr. Tian is a Senior Member of OSA and a member of SPIE and IEEE. His research interests focus on photoacoustic and ultrasound imaging and their biomedical applications.

----Invited Talk----

High-Performance Biomedical Photoacoustic Tomography

Abstract—Based on the energy conversion of light into sound, photoacoustic imaging is an emerging noninvasive biomedical imaging technique and has experienced explosive developments in the past two decades. As a hybrid imaging technique, photoacoustic imaging possesses distinguished optical absorption contrast as in optical imaging and superb spatial resolution as in ultrasound imaging. It can visualize biological samples at scales from organelles, cells, tissues, organs to small-animal whole body and has found unique applications in a range of biomedical fields. In this presentation, I will present our most recent progress in photoacoustic imaging, including photoacoustic tomography and photoacoustic microscopy. In photoacoustic tomography, I will present our efforts in the development of a high-performance, real-time photoacoustic scanner and its applications in the sentinel lymph node identification in vivo. Results reveal that the detector view angle, element number, center frequency, bandwidth, aperture size, focusing, orientation error, and scan step angle error all have significant impacts on the imaging performance of the scanner. The developed scanner can be used in practical scenarios and produce real-time high-performance imaging. In photoacoustic microscopy, I will report our work in single cell and single vessel imaging. Results show that optical-resolution photoacoustic microscopy can not only achieve high-resolution, high-sensitivity single cell imaging but also can visualize blood vessels architecture of the retina and choroid in living rabbits without any labeling. The work advances both the technology and applications of photoacoustic imaging in biomedicine.

09:30-10:00 | Invited Speaker: Jianbo Tang

Dr. Jianbo Tang is an Assistant Professor at the Southern University of Science and Technology. He earned his Ph.D. in Biomedical Engineering from the University of Florida. He completed his postdoctoral training at Boston University and Harvard Medical School. His research focuses on developing novel functional optical and ultrasound imaging techniques for brain function and disease studies.

----Invited Talk----

Adaptive Autocorrelation Function-based Optical Coherence Tomography Three-Dimensional Angiography

Abstract—Optical coherence tomography angiography (OCTA) for blood vessel 3-D structure imaging suffers from blood vessel tail artifacts when using a long decorrelation time or loss of small vessel signal when using a short decorrelation time. In this work, we developed a technique to suppress the tail artifacts under large vessels while enhancing the dynamic signal of small vessels, which enables the real 3-D structural imaging of blood vessel networks using OCTA. The proposed method is based on the adaptive selection of the decorrelation time of the first order field autocorrelation function (g_1) for different regions, i.e. shorter and longer decorrelation time for tail artifacts region and blood vessel region, respectively. Compared to using the same decorrelation time for every voxel, the approach of adaptively selecting decorrelation time shows good performance in suppressing the tail artifacts under large vessels and enhanced signal intensity and blood flow continuity of small vessel networks. Furthermore, our approach is able to image the blood vessels that would otherwise be buried in the tail artifacts background of large vessels.

10:00-10:30 | Invited Speaker: Anhui Liang

Professor Anhui Liang is the Director of Optical Fiber Communication and Biological Optics Interdisciplinary Research Center, Shandong University of Science & Technology. He held several important positions, e.g. Tyco Submarine Systems Ltd., which was a part of former AT&T Bell Labs, in USA; Chief Scientist, FiberHome Technologies; Chief Scientist, WTD; Deputy Director of University Academic Committee, Nanjing University of Posts and Telecommunications, Head of Optical Engineering Discipline, Guangdong University of Technology, and etc. He has published more than 100 papers and patents. He has made significant contributions in several fields including optical fiber communications, vision, optical AI, quantum mechanics, sleep and AD, and Chinese medicine etc.. He made several breakthroughs in answering 5 of 125 unresolved questions listed on Science journal. He gave two large scale internet seminars with over 247 thousands of audiences. He is China Overseas Chinese Contribution Award recipient (2014); Yearly Person of "Scientific Chinese"(2015).

----Invited Talk----

Biological Optical Fiber, Couplers, Chinese Meridian, Hairs, Covid-19 Virus Optical Waveguides and Cell Lasers

Abstract—We first discovered biological optical fiber couplers and optical AI in vertebrate's bodies. We first proposed that the Chinese Meridians are biological optical fibers including nerves, blood vessels, and tendons (fascia) etc., and it has been verified partially. In this talk, we first demonstrated visible light can pass through tendons. We first demonstrate the visible light can pass through the tendon of an acipenser sinensis fish, even after it has been boiled for several minutes. We first proposed hairs of human and animals are optical waveguides in mid-far infrared region and near infrared region 2. We first proposed human hairs have dual roles: heat block on the radial direction and heat dissipation along axial direction. In about 1.2 million years ago, long body hairs on human body became short fine hairs, we first propose the reason for this is that human avoided long body hairs to be burned by fire, which is used by human to pursue animals, to defend animals or to warm their own bodies, through evolution. In about 700-800 thousand years ago, human started cooking food by using fire, we first propose the reason for this is that human can handle fire more easily and safely than other animals because of without long body hairs. Why did human start to standup at about 2.6-4 million years ago? We propose the reason may be that human stand up to use hand to handle fire more easily and safely, pursue and frighten dangerous animals, and watch fire easily. There are only human and three kinds of birds (e.g. Milvus migrans, Haliastur sphenurus and Falco berigora) in Australia take advantage of fires intensively in nature, all of them are upright animals. We first proposed the Covid-19 virus is a spherical or ellipsoid optical waveguide. We first proposed that cell lasers exists naturally as well.

S04: Optical Fiber Upgrade - A

Room: LM104-A | Time: 09:00-10:30

Session Chair: **Jiajing Tu**, Jinan University, China

09:00-09:30 | Invited Speaker: Jiajing Tu

Jiajing Tu, Assosiate Professer, Jinan University. She received Ph.D degree from Hokkaido University, Sapporo, Japan in Sep. 2014. From Nov. 2014 to Dec. 2016, she worked as a postdoctoral research fellow in University of Science and Technology Beijing. From Jan. 2017 to Jan. 2019, she was working as the Hong Kong Scholar in The Hong Kong Polytechnic University. Now, she works in Jinan University (Guangzhou) as Associate Professor. Her research interests include specialty optical fiber design and application for communication, sensing, high-power delivery etc.

----Invited Talk----

OAM-Carrying Space Division Multiplexing Fiber

Abstract—Space division multiplexing (SDM) technology is a promising approach to overcome Shannon Limit in optical fiber communication. This talk will introduce OAM fiber design towards SDM, which includes strongly-guiding fiber and mode group supporting fiber.

09:30-10:00 | Invited Speaker: Chunying Guan

Chunying Guan received her B.Sc. in Optoelectronic Technology (2001), M.Sc. in Optical Engineering (2004), and Ph.D. in Mechanical Design and Theory (2007), from Harbin Engineering University, China. From 2001 to present, she is working in Harbin Engineering University. In 2013, she was a visiting scholar in the Optoelectronics Research Centre, University of Southampton, UK. In 2016, she was a senior visiting Fellow in the School of Physics and Astronomy, University of Birmingham, UK. She is currently a full professor at the College of Science, Harbin Engineering University, China. Her research interests focus on microstructured fibers, optical fiber sensors and nanophotonics. She has published over 110 journal articles and 50 conference papers, hold over 30 patents.

----Invited Talk----

Hole-Assisted Multi-Core Fiber and Applications

Abstract—The multicore fibers are important and offer an opportunity to realize sensing applications as well as novel fiber-based devices. In this talk, we will present integrated devices based on hole-assisted dual-core fiber (EHADCF) and applications. The air hole in the EHADCF provides a natural channel to form a microfluidic platform. The EHADCF-based sensors based on the resonant coupling and the mode interference have been realized. In addition, a high efficiency, compact mode converter based on tapered HADCF has been proposed and demonstrated. The multicore fibers can greatly improve the integration degree of fiber devices.

10:00-10:30 | Invited Speaker: Chaotan Sima

Dr. Chaotan Sima is an Associate Professor and Ph.D. supervisor in School of Optical and Electronic Information at Huazhong University of Science and Technology, Wuhan, China, and Next Generation Internet Access National Engineering Laboratory. In 2006, he graduated from Huazhong University of Science and Technology with the distinguished bachelor degree. In 2013, He obtained the PhD degree in optoelectronics, under the supervision of Prof. Peter Smith and Prof. Michalis Zervas at the Optoelectronics Research Centre in the University of Southampton, with the project of planar Bragg grating devices for advanced optical communication systems. After the industry experience as a R&D director, he joined the School of Optical and Electronic Information in Huazhong University of Science and Technology in 2014. He has been awarded the Marie-Curie Fellowship in 2019. His research interests include integrated Bragg grating devices and implementation, special fiber design, and optical gas sensing. He has authored/co-authored over 50 international publications, some of which are invited. He has been the PI for over 10 grants including projects from National Natural Science Foundation of China and National Key National Key Research and Development Project. He serves as an editorial member of Optical and Quantum Electronics, and a frequent reviewer of tens of OSA, IEEE and IET technical journals. He is also the TPC member of several international optoelectronic conferences, as well as a IEEE senior member and a member of OSA and CSOE.

----Invited Talk----

Design of novel holey fibers with multilayer refractive index membranes

Abstract—Benefiting from air-guiding mechanism, holey fiber has advantages of pure polarization, low latency, and high damage threshold, etc., allowing breakthroughs in optical telecom, optical sensing and higher-power laser applications. In this paper, two kinds of low loss holey fibers with multiple refractive index membranes are proposed and demonstrated. Based on photonic band gap (PBG) effect, the designed PBG fiber contains honeycomb capillary cladding and elliptical core with horizontal asymmetry for birefringence. By innovatively introducing three modified silica capillary membranes with different refractive indices, superior optical characteristics have been achieved simultaneously, such as <2dB/km confinement loss within 180nm wideband, significantly reduced bending loss and high birefringence of 10-3 level. Based on the anti-resonant fiber (ARF) structure, the glass-based capillary membranes with varied refractive indices layers are introduced and formatted in the cladding air tubes and results show that, at the laser wavelengths of 980 nm and 1064 nm, the confinement loss is favorably reduced by about 6 dB/km and the bending loss around 15 cm bending radius is also reduced by 2 dB/km. The universal design of holey fibers with multilayer refractive index membranes has great potential in small footprint fiber optical gyroscope, optical fiber transmission as well as high energy delivery.

S05: Liquid Crystal Photonics - A

Room: LM104-B | Time: 09:00-11:30

Session Chair: **Dan Luo**, Southern University of Science and Technology, China

09:00-09:30 | Invited Speaker: Ling Wang

Ling WANG is a full professor at School of Materials Science and Engineering of Tianjin University. He was an awardee of National Outstanding Young Talents and distinguished professor of PEIYANG Young Scholars of Tianjin University. He received his PhD degree of Materials Science from University of Science and Technology Beijing in 2013. He worked as a Postdoctoral Fellow at the Advanced Materials and Liquid Crystal Institute (USA), and Senior Research Fellow at the Artie McFerrin Department of Chemical Engineering of Texas A&M University (USA). His research interests focus on design, synthesis and properties of smart soft materials, bioinspired materials and functional nanomaterials, as well as their emerging applications in diverse fields ranging from soft robotics, adaptive camouflage to energy and safety issues.

----Invited Talk----

Liquid Metal and Liquid Crystal Smart Actuators for Programmable Soft Robotics

Abstract—Bio-inspired soft-bodied robots engineered from responsive soft materials have recently attracted increasing attention from the perspective of both fundamental discoveries and promising technological applications. Compared to conventional rigid robots, soft robotics possess many attractive features such as structural deformability, human-friendly interaction, a high degree of freedom for actuation as well as environmental compliance and adaptability. Liquid crystal networks (LCNs) with anisotropic, reversible and programmable shape-morphing properties have been considered particularly promising for stimulus-driven soft actuators with diverse robotic motions, such as gripping, walking, swimming and oscillation, and intelligent functions including reconfigurability, self-regulation and associative learning. However, LCN-based soft robotic systems are often limited by their inadequate intrinsic thermal or electrical conductivity and mechanical incompatibility with functional nanomaterials. In this talk, I will demonstrate a general strategy to integrate electrically conductive liquid metals (LMs) and shape-morphing LCNs towards multifunctional and programmable soft robotics. As proof-of-concept demonstrations, I will present a light-fueled soft oscillator, an inchworm-inspired soft crawler and programmable robotic Shadow Play exhibiting multifunctional controllability. The strategy could open up a new technological arena for developing advanced multifunctional

soft materials towards bioinspired soft machines, integrated soft electronics and beyond.

09:30-10:00 | Invited Speaker: Xiangru Wang

Xiangru Wang graduated from the University of Electronic Science and Technology of China (UESTC) in 2006. and obtained a PhD in optics in 2012, From 2009 to 2011, he worked at the US Top3 optical center CREOL University of Central Florida as Visiting Research Scientist. During the scientific research work in the United States, he participated as the main researcher in the US Department of Defense's DARPA and JTO projects "High Power Laser Beam Combining Technology", "Large Mode Field High Power Fiber Laser Technology" and other major US defense projects, achieving 400 for the first time in the world. After joining in the UESTC in 2012, he has been principle investigator of the PHI group and a number of national, provincial and ministerial projects such as 863, and the National Natural Science Foundation of China, and took the lead in breaking through the key technology of optical phased array rapid response in microseconds. In recent years, he has published more than 40 papers indexed by SCI and EI and nearly 20 academic speaks, and obtained more than 20 patents. Research interests include: "Liquid crystal Microwave Phased Array Technology", "Satellite Interconnection Network Technology", "Wireless Energy Transmission Technology", "Satellite-to-ground Energy Transmission Technology", "Broad Spectrum Dielectric Control Technology" and other microwave/laser cutting-edge technologies . He is currently a member of IEEE and OSA, as well as a special reviewer for Optics Letters, J. Soc. Am. B, Applied Physics: B, J. Quan. Elect. and other internationally well known journals.

----Invited Talk----

Reconfigurable Microwave Phase Array antenna Based on Nematic Liquid Crystal: Design and Experimental Validation

Abstract—Liquid crystals (LCs) are widely used in reconfigurable microwave devices for their voltage tunable dielectric constant and loss. For the design of materials and devices, accurate measurements of the complex permittivity of LCs are required. This paper presents our recent initiatory works on microwave application including: material synthesis, dielectric tensor measurement method, device design particularly on reflective array and phase shifter. Our new synthesised nematic liquid crystal compounds are generally based on high dielectric rules, such as triphenyldiacetyl LCs with pendant fluorine atom or a pendant methyl group or an ethyl group . the anisotropic dielectric tensor is measured on the reported method of performing microwave characterizations of LCs using a double ridged waveguide cavity and the perturbation method. To realize the broadband test and make operating frequency points distribute uniformly, the multi-mode technique is introduced and 11 modes (TE1,0,2n-1,n= 1, 2, ⋯, 11) are chosen as operating modes. Then adopting several non-radiating slots to suppress the undesired-modes effectively, which makes it possible that using one cavity to measure the complex permittivity in a wide frequency range 5-40 GHz. Based our home made liquid crystal compound, and technical measured dielectric tensor, several liquid crystal devices are designed and manufactured and tested including reflective arrays and phase shifters.

10:00-10:30 | Invited Speaker: Satoshi Aya

Prof. Satoshi Aya received my Ph.D. degree in materials engineering from Tokyo Institute of Technology in 2014. Later, he had worked as an engineer in Hitachi High-Technologies (2014-2015) and postdoctoral researcher in RIKEN Center for Emergent Matter Science (2015-2019) in Japan. Since 2019, he joined to South China University of Technology as aprincipal investigator. His principal interests are the physicochemical properties of soft matters, particularly in liquid crystal physics, surface science, colloids and electro-optical aspects of materials in liquid crystal states, etc.

----Invited Talk----

Ferroelectric nematic liquid crystals: topology and nonlinear optical properties

Abstract—Magnetic and electric states are closely related. However, many fundamental magnetic states cannot find their electric counterparts especially in liquid matter systems. Typically, many complex electromagnetic states require low symmetries of matters. Thereby, their appearance is limited mostly in solid-state materials, hindering the material processibility and tunability for a wide range of applications.

Recently, there emerged a new class of materials, dubbed splay nematic or ferroelectric nematic, where the head-to-tail symmetry of the traditional nematic state is broken. Here, we report on several novel electric analogues to the magnetic states, including the ferroelectric and new helielectric nematic states. All the matter states exhibit polar ordering in addition to the traditional local nematic orientational ordering. The systematic studies are composed of (1) machine-learning-guided massive synthesis from the fluidic monomer to moldable polymer materials, (2) structure and topological characterizations, and (3) determination of both the dielectric and nonlinear optic coefficients. On the conference, we will discuss the detailed topology and nonlinear optical properties of the matter states.

10:30-11:00 | Invited Speaker: Qiong-Hua Wang

Qiong-Hua Wang is a professor of optics at the School of Instrumentation and Optoelectronic Engineering, Beihang University, China. She was a professor at Sichuan University from 2004 to 2018. She was a post-doctoral research fellow at the School of Optics/CREOL at the University of Central Florida from 2001 to 2004. She worked at the University of Electronic Science and Technology of China (UESTC) from 1995 to 2001. She received M. S. and Ph. D. degrees from UESTC in 1995 and 2001, respectively. She published approximately 200 papers cited by Science Citation Index and authored 2 books. She holds 5 U. S. patents and 100 Chinese patents. She is a Fellow of the Society for Information Display and an associate editor of Optics Express and the Journal of the Society for Information Display. Her research interests include optics and optoelectronics, especially display technologies.

----Invited Talk----

Fast reponse liquid crystal lens for 2D/3D switchable display

Abstract—Adaptive liquid crystal (LC) lens offers a tunable focal length, which has widely used in auto-focusing, 2D/3D switchable displays, tunable photonic devices and so on. Many approaches using nematic LC have been demonstrated, and the basic operation principle of the LC lens is to generate electric-field-induced gradient refractive index profile across the LC layer. In this paper, we propose a multi-view 2D/3D switchable display by using adaptive LC lens array with a low operating voltage and fast response time. The LC lens array is composed of three parts: the LC layer, top plane iridium tin oxide (ITO) electrode and bottom periodic strip ITO electrodes. In the voltage-off state, the LC lens is equivalent to a transparent glass substrate and the viewers can see a clear 2D image. In the 3D mode, the LC lens array can be used as a cylindrical lens array under a suitable operating voltage. As a result, the 2D and 3D images can be switched according to the state of the LC lens. The experimental result shows that the 2D/3D switchable display with LC lens has a wide viewing angle, no moiré pattern, and much thinner compared to other 2D/3D switchable display devices.

11:00-11:30 | Invited Speaker: Lu-Jian Chen

Prof. Lu-Jian Chen received his Ph.D. in Materials Science and Engineering at Zhejiang University. He served as assistant professor (2007-2010), associate professor (2010-2017), and full professor (2017) in Department of Electronic Engineering, Xiamen University. He held visiting appointments in State Key Laboratory of Silicon Materials, Zhejiang University (2010-2012, 2015-2017) and School of Engineering and Applied Physics, Harvard University (2012-2013). His research interests include liquid crystal photonics, microfluidic technology and organic-inorganic hybrid optical materials.

----Invited Talk----

Reconfigurable optofluidic liquid crystal gratings fabricated via visible light interference

Abstract—Holographic liquid crystal (LC) gratings via visible light interference were fabricated by using a mixture of LCs, reactive mesogens and photoinitiator. The dynamic reconfigurability and anti-counterfeiting property of LC gratings were realized by infilling different organic solvents. Also, without the need of applying an external electric field, the optofluidic tunabilities of LC distributed Bragg reflector (DBR) film integrated in a microfluidic device in response to the refractive index of fluid were discussed

S06: Perovskite Materials and Optoelectronic Applications - A

Room: LM104-C | Time: 09:00-10:30

Session Chair: **Kai Wang**, Southern University of Science and Technology, China

09:00-09:30 | Invited Speaker: Zhubing He

Zhu-Bing He obtained his Ph.D. degree in Physics and Materials Science from City University of Hong Kong in 2009. He joined as an associate professor in the Department of Materials Science and Engineering of Southern University of Science and Technology in 2012, after working as research scientist to develop HJT photovoltaics in industry. Currently, he focuses on interface science and engineering in solar conversion fields, especially high efficient hybrid and heterojunction solar cells, spectrum splitting and accumulation of solar photons via nanophotonics, and heat transfer in fluid and phase change materials.

----Invited Talk----

Interface engineering for high-performance semitransparent perovskite solar cells

Abstract—Semitransparent solar cells act as a crucial role in such typical photovoltaic applications as smart windows, transparent chargeable devices, tandem and bifacial devices and so on. Relying on the commercial conductive transparent oxides as the front electrodes, the development of rear transparent electrode (RTE) and interfacial managements are especially essential. In this talk, I shall summarize our recent progress on the interface engineering to realize high-performance semitransparent perovskite solar cells by means of novel material-combinations and interfacial modulations. We push our semitransparent device conversion efficiency from 13% to over 18%, along with a high transmittance of 39.46% in the wavelength span from 300 nm to 1200 nm. Their based 4-Terminal tandem solar cells achieved a champion device conversion efficiency of 27.59%. Our works provide a reliable and promising strategy to realize high-performance semitransparent perovskite solar cells.

09:30-10:00 | Invited Speaker: Dewei Zhao

Dewei Zhao is currently a professor at Sichuan University. He received his Ph.D. from Nanyang Technological University, Singapore in 2011. Since 2012, he worked as a postdoc at the University of Michigan and the University of Florida and as a research assistant professor in Prof. Yanfa Yan's group at The University of Toledo. His research focuses on organic/inorganic hybrid optoelectronic devices, such as thin-film solar cells, light-emitting diodes, and photodetectors.

----Invited Talk----

Efficient Low-Bandgap Mixed Tin-Lead Perovskite Solar Cells

Abstract—Tandem solar cells using all metal-halide perovskite thin films show great promise for next-generation solar cells in terms of reduced cost, flexibility, and high efficiency, an effective way to break the Shockley-Queisser limit of single-junction cells. Low-bandgap mixed tin (Sn)-lead (Pb) perovskite solar cells, as a key to make highly efficient all-perovskite tandem solar cells, have been gaining extensive interest due to their appropriate bandgaps and promising application to build efficient all-perovskite tandem cells. Tin fluoride (SnF2) as a basis along with various strategies has been widely used. However, fully understanding the roles of SnF2 in both films and devices is still lacking. Here, we will present the progress and strategies on low-bandgap Sn-Pb cells devoted by our group in the past years. More importantly, we systematically investigate the effect of single SnF2 additive on both optoelectronic properties of low-bandgap mixed Sn-Pb perovskite films and solar cells performance. We find that a decent amount of SnF2 not only suppresses the oxidation of Sn2+ and reduces the hole concentration related to Sn vacancies, but also promotes the perovskite growth, which reduces the disorder of crystal arrangement and improves the crystallinity. We also probe and evidence the location of excessive the F- ions. Our work suggests that such a fundamental understanding of SnF2 additives would definitely help unveil the in-depth mechanisms of additional additives and approaches proposed in efficient low-Eg mixed Sn-Pb perovskite solar cells towards making highly efficient all-perovskite tandem solar cells.

10:00-10:30 | Invited Speaker: Yangyang Ju

Yangyang Ju received the B.S.degree from JiLin University, China and Ph.D degree from Tomsk polytechnic University, Russia. She is currently working as a postdoc at Beijing Institute of Technology University. Her research field mainly focuses on Leadfree halide perovskites and their applications in gas sensing.

----Invited Talk----

The Interactions between perovskites and oxygen: what we learn? what we expect?

Abstract—Although perovskite-based optoelectronic devices are under rapid development, the toxicity and poor ambient stability of organic-inorganic lead halide perovskites present a major obstacle for their commercialization. Among the various factors, the interaction between perovskite and oxygen have been a major topic. Tin (Sn) based perovskites have been emerging as promising low toxic substitutes for lead (Pb) based perovskites as their analogous optoelectronic properties. However, the prone oxidation of Sn (II) to Sn (IV) induced degradation prevents them from moving forward toward high performance devices. Herein, we report on the time evolution of the photoluminescence properties in phenylethylammonium tin halide perovskite (PEA2SnI4) film as a function of oxygen concentration. By correlating the material characterizations and theoretical analysis, we illustrated that the interactions between PEA2SnI4 and oxygen contain physisorption and chemical reactions. Depending on the oxygen concentration, the chemical reactions between PEA2SnI4 and oxygen can be reversible and/or irreversible. Based on the above understanding, we demonstrate the first perovskite-based oxygen sensor by combining optical fiber with PEA2SnI4 as sensitive materials.

S07: Photophysics of Structured Materials for Nanophotonics - A

Room: LM105 | Time: 09:00-10:30

Session Chair: **Rui Chen**, Southern University of Science and Technology, China

09:00-09:30 | Invited Speaker: Linfeng Sun

Linfeng Sun is currently a full professor in the School of Physics, Beijing Institute of Technology, China. He received his doctoral degree from Department of Physics and Applied Physics in Nanyang Technological University, Singapore. Before joined BIT, he worked as a research professor in Sungkyunkwan University, South Korea, and was selected as "Korean research fellow" in 2017. He was awarded the "Chinese government award for outstanding self-financed students abroad" in 2014, and the "Young Leader Award" in ICDT 2020. Currently, he served as the Youth Editorial Member of the journal "SmartMat" and the assistant editor of the journal "Nano-Micro Letters", as well as the Guest Editor of the Journals of "Frontier in Neuroscience", "Frontier in Physics", "Micromachines", etc. His research interests focus on the device physics design, characterization, and applications, including 2D layered materials-based transistors, photodetectors, and volatile and nonvolatile memory and neuromorphic computing. His work published in Nature Communications was highlighted in 2021 Roadmap of Neuromorphic Computing and Engineering and another work published in Science Advances was highlighted by mainstream new media outlets including Tencent News, Netease News, the homepage of BIT, etc.

----Invited Talk----

Memristive two-dimensional materials for information storage and neuromorphic Computing

Abstract—To overcome the traditional von Neumann bottleneck in modern computer system, neuromorphic computation is essential for constructing artificial neural networks, which could offer a platform for processing complicated issues, like image classification, pattern recognition, decision-making, etc., in a straightforward way. Great efforts have been paid to mimic neuromorphic computing using various materials and devices structures. However, neuromorphic computation has remained technically challenging to be demonstrated without using numerous transistors and capacitors. Recently two-dimensional materials have attracted the attentions of research communities due to their unique physical properties. This talk will introduce some of our recent works on the memristive behaviors of novel two-dimensional materials for information storage and neuromorphic computing devices, overcoming the limitation of scalability and power consumption in conventional CMOS-based neuromorphic devices.

09:30-10:00 | Invited Speaker: Huakang Yu

Huakang Yu is a professor of the College of Physics and Optoelectronics at Souoth China University of Technology, China. He received his B.E. in Information Engineering and PhD in Optical Engineering from Zhejiang University in 2008 and 2013, respectively. His main research interest is low-dimensional nanophotonics.

----Invited Talk----

Single gold nanoparticles for manipulating cavity mode of bottle microresonators

Abstract—Microlasers with reduced dimension, favorable tunability and high-Q factor, are promising for applications such as on-chip optical communication, sensing and information processing. Cavity mode manipulation is dispensable so as to achieve either single mode operation or wavelength switch. In this talk we will introduce the successful cavity mode manipulation of a bottle microresonator simply by depositing single gold nanoparticles. Such micrometer-scale bottle microresonators usually exhibited multi-mode lasing behavior. By precise deposition of gold nanoparticles onto microresonator surface, we could efficiently manipulate cavity modes in a reconfigurable and tunable manner. To demonstrate this simple method, we achieved single mode lasing with a high side-mode suppression factor of approximately 13 dB.

10:00-10:30 | Invited Speaker: Feng He

Feng He, Assistant Professor of Harbin Institute of Technology (Shenzhen), graduated from Lanzhou University in 2011, received her master's degree in materials engineering from the State University of New York at Stony Brook in 2013, and PhD degree from the University of Texas at Austin in 2018. She then continued post-doctoral research at the University of Texas at Austin. During her Ph.D. study, her research direction was ultrafast phonon spectroscopy. She pioneered the use of femtosecond lasers to study the correlation between microscopic coherent phonon motion and macroscopic coherent heat conduction. She was awarded the Brookhaven National Laboratory Scholarship in the United States and was selected as the Rising Star of Mechanical Engineering held by MIT in 2018. The main research interests and fields are light-matter interaction in quantum materials, ultrafast spectroscopy, coherent phonon dynamics, nano-scale energy transport, etc. Overall, she published 18 papers in internationally renowned journals including ACS Nano, Physical Review Letters, Optics Letters, Applied Physics Letters, etc.

----Invited Talk----

Ultrafast phonon spectroscopy: a great tool to explore more!

Abstract—To understand and ultimately control the properties of most functional materials, from molecular soft-matter to quantum materials, requires access to the structure, coupling, and dynamics on the elementary time and length scales that define the microscopic interactions in these materials. Ultrafast spectroscopy is a great tool to gain access to these goals. I will introduce our pump-probe technique, combined with the surface plasmon resonance (SPR) method, to investigate the phonon-phonon quantum coherent coupling (QCC) in III-V semiconductor superlattice structures, as well as quantum confinement effects in semi-metals. The resulting enhanced and qualitatively new forms of light-matter interaction enable measurements of quantum dynamics in an interacting environment. Other applications include the inter-molecular coupling and dynamics in soft-matter hetero-structures, surface plasmon/phonon interferometry as a probe of electronic structure and dynamics, and quantum phase transitions in correlated electron materials. These examples highlight the general applicability of the ultrafast spectroscopy, complementing emergent X-ray and electron imaging tools, aiming towards the ultimate goal of probing matter on its most elementary spatio-temporal level.

S08: Laser Technology - B

Room: LM103-A | Time: 10:45-12:00

Session Chair: **Zhichao Luo**, South China Normal University, China

10:45-11:15 | Invited Speaker: Kan Wu

Dr. Kan Wu is currently a professor in the State Key Laboratory of Advanced Optical Communication Systems and Networks, Department of Electronic Engineering, School of Electronic Information and Electrical Engineering, Shanghai Jiao Tong University. He received B.S degree and M.S degree from Shanghai Jiao Tong University in 2006 and 2009, and Ph.D. degree from Nanyang Technological University in Singapore in 2013. His research interests include high-repetition-rate mode-locked lasers and photonic integration. Four of his papers have been the ESI hot papers and highly cited papers. He has invited papers published on Photonic Research, Optics Communications and Nanoscale Advances. Six of his papers have been cited more than 100 times each. His publications include Light Science and Applications, Nature Communications, Physical Review X and Optical Letters, etc. Dr. Kan Wu was awarded Excellent Young Scholars of NSFC in 2019.

----Invited Talk----

Optical amplifier based on integrated erbium-doped lithium niobate on insulator with 24 dB small-signal gain and 0 dBm saturation power

Abstract—Novel integrated erbium-doped lithium niobate on insulator introduces high confinement on the optical mode and can provide high gain. Together with the electro-optic and nonlinear effects in lithium niobate, it is very promising to achieve a fully integrated photonic signal processing system on thin-film lithium niobate. In this talk, we will introduce our recent progress on the optical amplifier based on erbium-doped lithium niobate on insulator.

11:15-11:45 | Invited Speaker: Zhichao Luo

Zhi-Chao Luo received Ph.D. degree in Optics in 2012 from the South China Normal University, Guangdong, China. Since 2012, he has been with the School of Information and Optoelectronic Science and Engineering, South China Normal University, where he is currently a Professor. His research revolves around soliton dynamics in ultrafast fiber lasers, high-performance fiber laser technologies as well as their applications.

----Invited Talk----

Real-time visualization of pulsating soliton dynamics in fiber lasers

Abstract—In this talk, we review our recent results on the real-time spectral dynamics of soliton pulsating behavior in the ultrafast fiber lasers based on the dispersive Fourier transform. Our findings may be useful for better understanding the soliton dynamics, and will prove to be fruitful to the various communities interested in solitons and fiber lasers.

11:45-12:00 | G29121

Research advances of radiation-hardened active fibers in SIOM

Chongyun Shao, Yan Jiao, Fan Wang, Chunlei Yu and Lili Hu

Shanghai Institute of Optics and Fine Mechanics, China

Abstract—Owing to their reduced weight, size and high conversion efficiency, rare earth (RE) doped active fibers are crucial in space-based applications, such as space laser communication, laser radar and space waste disposal. However, the radiation induced attenuation of the RE-doped active fibers is approximately 1000 times larger than that of RE-free passive fibers under the same radiation condition, which poses a severe challenge to the long-term stability of active fiber lasers or amplifiers in space. In this report, three aspects will be covered. First, the space radiation environment, the application requirements, and challenges of active fibers used in space will be briefly introduces. Second, the latest research progress of radiation-resistant active fibers in SIOM will be systematically introduced. Finally, the potential issues that require further investigation will be suggested.

S09: Fiber-Based Technologies and Applications - B

Room: LM103-B | Time: 10:45-12:00

Session Chair: Dan Lu,

10:45-11:15 | Invited Speaker: Chen Yang

Yang Chen joined Yangtze Optical Fiber and Cable Joint Stock Limited Company in 2006, engaged in the research and development and market promotion of new communication optical fiber and specialty optical fiber. There are more than 20 authorized Chinese invention patents and 4 authorized American invention patents. He has won the second prize of national science and Technology Progress Award and the first prize of provincial and ministerial science and Technology Progress Award three times.

----Invited Talk----

From communication to sensing: diversified development of fibre technology and Application

Abstract—As an important carrier of light, fibre has given birth to fibre communication, fibre laser and fibre sensing. The application of fibre has also stepped into the technological road of diversified development.
Taking advantages of PCVD process, YOFC has developed a variety of new fibres. Starting from fibre communication, fibre laser and fibre sensing, this report introduces the characteristics and applications in different fields of these fibres.

11:15-11:30 | G29135

Transfer Learning for Optical Sensing with Orbital Angular Momentum Beams

Yuntian Wang, Zhitai Zhou, Huanhuan Liu, Hong Dang, Luoyuan Liao, Jinna Chen, Xiaoying Tang, Jianbo Tang and Perry Ping Shum
Southern University of Science and Technology, China

Abstract—We trained a neural network based on Resnet to improve the sensing accuracy in measuring the magnetic field applied on a Magneto-optic effect crystal, $Bi_4Ge_3O_{12}$(BGO). The sensing system implements the superposition of vortex beams carrying orbital angular momentum (OAM) with topological charge of 1. Such composited OAM beams passing through a linear polarizer will produce petal-like pattern, and the pattern captured on charge-coupled device (CCD) sensor will rotate when magnetic field applies on BGO crystals. Detecting the pattern rotation can extract the information of external magnetic field. Considering the noise added on the CCD is rather arbitrary, using transfer learning based on Resnet can significantly improve the precision and accuracy to recognize the angle rotation of different SNR images. This is a potential application in fiber sensing.

11:30-11:45 | G2970

Investigation of Rayleigh-assisted coherent optical spectrum analyzer

Hong Dang, Linqi Cheng, Huanhuan Liu, Jinna Chen, Luoyuan Liao, Changzheng Du, Tianqin Lin, Jiwen Cui, Perry Ping Shum
Southern University of Science and Technology, China

Abstract—Optical spectrum analyzers (OSAs) with high spectral resolution are of significant interest in the fields of sensing, spectroscopy, and communication. However, as recent researches have been no longer satisfied with the spectral resolution of the current available OSAs, new methods are needed urgently. In this paper, we experimentally demonstrate an OSA combining the Rayleigh backward scattering (RBS) and the heterodyne interferometry. As the interferometry configuration downshifts the backward scatterings from the optical frequency band to an electronically tractable frequency range, the responses raised by the concomitant stimulated Brillouin scattering (SBS) could be filtered out by an electrical low-pass filter. Benefiting from this combination, the proposed Rayleigh-assisted coherent optical spectrum analyzer (RCOSA) could achieve a spectral resolution of 10 kHz (0.08fm).

11:45-12:00 | G29130

Nano-Strain Optical Fiber Sensing System Based on Coherent Phase Detection Technology

Zhengxuan Shi, Zhengxuan Shi, Baoqiang Yan, Cunzheng Fan, Hao Li, Yuezhen Sun, Zhilin Xu, Zhijun Yan, Qizhen Sun
School of Optical and Electronic Information Huazhong University of Science and Technology, China

Abstract—We proposed a nano-strain optical fiber sensing system based on coherent phase detection technology assisted with backscattering enhanced optical fiber, in which the system have achieved highly sensitive strain detection with up to 0.049rad/nε and minimum resolution of 561pε @ 0.01Hz.

S10: Optoelectronic Devices and Applications - A

Room: LM103-C | Time: 10:45-12:00

Session Chair: **Yu Yu**, Huazhong University of Science and Technology, China

10:45-11:15 | Invited Speaker: Yaocheng Shi

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. He has authored more than 100 refereed international journal papers. He is the recipient of the national science fund for excellent young scholars. His research activities are in the photonic integrated devices.

----Invited Talk----

Optical phased array based on silicon waveguide for wide-angle beam steering

Abstract—With the growing demand for automotive LiDAR, optical phased array (OPA) is considered to be one of the leading technologies since it provides an all-solid-state beam steering without mechanical scanners. In this talk, wide-scan-angle optical phased arrays based on silicon-on-insulator (SOI) platform will be introduced.

11:15-11:30 | G2915

A Compressive Sensing single pixel Imaging system using cascaded MZM structure

Guoqing Wang, Liyang Shao, Dongrui Xiao, Fang Zhao, Ping Shum, Chao Wang
Southern University of Science and Technology, China

Abstract—A low-cost compressive sensing single pixel imaging (SPI) system employing cascaded Mach-Zehnder interference (MZI) structure is presented. The cascaded MZI structure is employed to provide the random patterns that required by the compressive sensing approach. A proof-of- principle experiment is performed. A fiber-based low-cost cascaded MZIs as the key devices enable proposed imaging system. Data compression ratios from 6% to 25% are obtained in the proposed system. The proposed design has great potential in solving big data issue and has extensive applications where easy-access and low-cost demanded.

11:30-11:45 | G29129

Monolithic-integrated GaN optical sensor to detect the adulterated honey

Jian Chen, Tingxuan Chen, Yuelin Xie, Ling Zhu*
Shenzhen University, China

Abstract—This paper reports a monolithic-integrated GaN optical sensor to act as a suger sensor to determine the concentration of fructose in adulterated honey. In this optical sensor chip, it contains two key function devices, one is the light-emitting diode(LED) and the other is a photo detector(PD), which are monolithic integrated in one chip. It can be achieved by fabricating on a same GaN epilayer on sapphire wafer with the same InGaN/GaN multi-quantum wells. The light emitted from the LED can directly detect the liquid substance on the surface through the transparent sapphire substrate, while the PD receives the refracted light. Finally, the changes of refractive index of fructose solution and adulterated honey samples can quantitatively reflected by the measured photocurrent signal. This novel single-chip integrated solution completely eliminates the complex assembly of external optical elements and reduces the impact of external environment on PD sensitivity. The results show that the linear relationship between the adulteration concentration and the change of photocurrent signal is -0.206 μA/% in the range of 5-25% gradient concentration. The developed microsensor has the advantages of small size, low cost, high repeatability, easy to integration and operation.

11:45-12:00 | G29134

Modeling and Analysis of Zinc Diffusion Effect in High-Speed Modified Uni-Travelling-Carrier Photodiodes

Ruoyun Yao, Qianwen Guo, Wanshu Xiong, Chen Ji
Zhejiang University, China

Abstract—We investigate the influence of Zinc diffusion on the electron transport and high-speed characteristics of InP based Uni-Travelling-Carrier Photodiodes (UTC-PD). By analyzing the electric field distribution and energy band structure of three types of Zinc diffusion profiles, the fundamental electron transport mechanisms inside UTC-PDs are systematically studied. We show that high speed UTC-PD performance is limited by electrical field assisted electron transport inside the absorber region, and small energy barrier from Zn diffusion during MOCVD growth can strongly impact InP UTC-PD high frequency response.

S11: Optical Fiber Upgrade - B
Room: LM104-A | Time: 10:45-12:00

Session Chair: **Meisong Liao**, Shanghai Institute of Optics and Fine Mechanics

10:45-11:15 | Invited Speaker: Yu Zheng

Yu Zheng is the chief engineer of the iFiber Optoelectronics Technology Co. He received his PhD from National Engineering Laboratory for Fiber Optic Sensing Technology, Wuhan University of technology in 2017. The main research direction is special optical fiber and sensor. He has more than ten years of experience in the preparation of special optical fibers. He has published more than 20 journal papers and applied for more than 10 patents.

----Invited Talk----

Hollow-core anti-resonant fiber for laser delivery with robust single-mode operation and polarization maintaining property

Abstract—Hollow-core anti-resonant fibers (HC-ARFs), as one of the microstructured optical fibers (MOFs), have great potentials in various fields such as fiber telecommunications, high-power laser delivery, optical fiber sensing, and ultrafast pulse compression and shaping due to their remarkable features of enhanced light-matter interaction, large-mode-area, high power damage threshold, low waveguide dispersion, and small nonlinear coefficient, etc. The fabrication of HC-ARFs with broad transmission windows, robust single-mode operation, low transmission attenuation, reduced bending effects, and good polarization-maintaining properties have become highly demanding during the last few years. To develop the demanded features, we have optimized the fabrication techniques to precisely control structural parameters during fiber drawing. The fabricated HC-ARFs have a typical attenuation of ~ 15 dB/km at 1060 nm and ~18 dB/km at 1550 nm. Furthermore, by carefully designing the fiber structure, single-mode operation over a broadband region (900-1700 nm) with flat attenuation is realized. Even using a fiber as short as 10 cm, higher-order modes (HOMs) can be strongly suppressed to ensure robust single-mode delivery. Another noteworthy feature is in a novel elliptical-core HC-ARF, which possesses ultra-low polarization-mode inter-coupling, meaning the modal polarization can be well maintained during propagation. Such a feature has potentials for various applications for fiber optic gyroscopes, driverless vehicles, etc. To the best of our knowledge, this is the first experimental demonstration of an elliptical structure in MOFs, representing a significant step forward of advanced MOF fabrication techniques and extended application scopes. In this invited talk, I will first go through the fabrication and then introduce these new findings related to HC-ARFs.

11:15-11:45 | Invited Speaker: Yang Yue

Yang Yue received the B.S. and M.S. degrees in electrical engineering and optics from Nankai University, China, in 2004 and 2007, respectively. He received the Ph.D. degree in electrical engineering from the University of Southern California, USA, in 2012. He is a Professor with the Institute of Modern Optics, Nankai University, Tianjin, China. Dr. Yue's current research interests include integrated photonics, fiber optics, optical communications and networking, optical interconnect, detection, imaging and display technology. He has published over 200 peer-reviewed journal papers (including Science) and conference proceedings with >8,000 citations, four edited books, >50 issued or pending patents, >100 invited presentations. He is an Associate Editor for IEEE Access, and an Editor Board Member for three other scientific journals. He also served as Guest Editor for eight journal special issues, Committee Member and Session Chair for >50 international conferences, Reviewer for >60 prestigious journals.

----Invited Talk----

Specialty Optical Ring Fibers with Radially Fundamental OAM Modes for Dense Space-Division Multiplexing

Abstract—An OAM-carrying beam has a doughnut shaped intensity profile due to its twisted helical phase front. Besides, the amount of 2π phase shift that occurs in the azimuthal direction represents different states or modes, which are orthogonal to each other while propagating coaxially. These properties enabled researchers to push the frontiers of OAM in the optical communications. The complex multiplexing formats of combining mode division multiplexing (MDM) technology based on OAM modes with dense space-division multiplexing (DSDM) along multicore/multimode fibers can be utilized to further improve the transmission rate and spectral efficiency.

Here, we introduce some specialty optical fibers for supporting numerous OAM modes. Firstly, we design an air-core fiber with a single As2S3 high-index thin ring, which can support 1322 OAM modes at 1550 nm while maintaining single radial mode condition. Based on this fiber material, we further introduce the concept of multi-ring fiber and propose a multi-ring air-core chalcogenide fiber, which has 19 high-index rings with each ring supporting 120 radially fundamental OAM modes at 1550 nm, i.e. 2280 OAM modes in total. The chalcogenide material is promising but challenging because of its complex fabrication procedure. From practical fabrication point, we also propose a 7-ring-core Ge-doped fiber and it can provide 434 OAM modes across C and L bands. Furthermore, the trench is designed for the 7-ring-core fiber, which could significantly reduce the inter-ring crosstalk and facilitate a compact fiber structure for dense space-division multiplexing (DSDM). These ring fiber designs have great potential to increase the spectral efficiency and the overall capacity in fiber-based communication systems.

11:45-12:00 | G29124

Progress of Yb-doped Large-mode-area photonic crystal fiber in SIOM

Fan Wang, Suya Feng, Meng Wang, Chongyun Shao, Shikai Wang, Chunlei Yu and Lili Hu
Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, China

Abstract—The threshold of nonlinear process in high peak power pulsed fiber laser can be enhanced by increasing the fundamental mode area and decreasing the fiber length. Large-mode-area photonic crystal fiber has been proved to be an effective solution due to the good laser beam quality with large core diameter. Sol-gel derived Yb-doped silica glass has unique capability of combining low refractive index, high dopants concentration and good doping homogeneity. Fiber core with low refractive index is beneficial for maintaining fundamental mode operation with increasing core diameter. High doping concentration of Yb ions in fiber core increases the absorption coefficient and thus decreases the fiber length. In this report, the progress of large-mode-area photonic crystal fiber based on sol-gel derived core glass in SIOM is presented.

S12: Perovskite Materials and Optoelectronic Applications - B

Room: LM104-C | Time: 10:45-12:00

Session Chair: **Kai Wang**, Southern University of Science and Technology, China

10:45-11:15 | Invited Speaker: Xuyong Yang

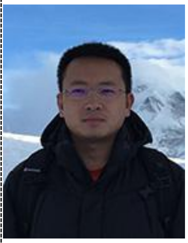
Xuyong Yang received his Ph.D. degree from Nanyang Technological University (Singapore) in 2014. He was subsequently worked as a Postdoctoral Research Fellow at Luminous Center of Excellence for Semiconductor Lighting and Displays in Nanyang Technological University. He joined Shanghai University in 2015 and is currently a Full Professor of the Key Laboratory of Advanced Display and System Applications of Ministry of Education. His research interests are focused on the preparation of highly efficient luminescent nanomaterials and the design and development of quantum dots/perovskite based light-emitting devices. He has authored or co-authored more than 80 peer-reviewed research articles in major scientific journals including Nature Communications, Joule, Advanced Materials, Advanced Functional Materials, Nano Letters, ACS Nano, Materials Horizons, Small, Chemistry of Materials, etc.

----Invited Talk----

Stable and Large-Area Perovskite Light-Emitting Devices

Abstract—Perovskites based light-emitting diodes (QLEDs/PeLEDs) have attracted extensive attention for lighting and display applications because of their excellent advantages, such as narrow emission bandwidth, color tunability, high brightness and low-cost fabrication techniques. The external quantum efficiencies (EQEs) for PeLEDs have reached those for commercial organic light-emitting diodes (OLEDs). Despite the rapid advance in device performance has been achieved, the operational lifetime of these devices still cannot meet the requirements for practical applications. In this report, we will present our latest advances in improving performance and stability of PeLEDs, and the scaling up strategies for PeLEDs will also be discussed.

11:15-11:45 | Invited Speaker: Xiong Li



Prof. Li received his PhD in 2008 from the Department of Chemistry, Wuhan University. Afterwards, he joined the laboratory of Prof. Michael Graetzel at the EPFL in Switzerland as a postdoctoral scientist. Since returning to China from Jul. 2017, Dr. Li has been engaged as Full Professor of Molecules and Nanomaterials for Renewable Energies in WNLO, Huazhong UST.

During the last 10 years, Dr. Li has gained national and international recognition for his work in the field of molecular photovoltaics and perovskite solar cells (PSCs). His significant research work has been translated into 50 peer reviewed journal articles (7000 citations in the SCI database) and 12 patents pending. Most notable is his outstanding contributions to realize stable and efficient perovskite solar cells that are suited for large-scale practical deployment as first/co-first author of four papers published recently in Science and Nature family journals (Science 2014, 345, 295; Nature Chem. 2015, 7, 703; Science 2016, 353, 58; Nature Commu. 2018, 9, 4482). Dr Li's contribution has been further recognised via a number of awards including the "Hundred talents program" and the “Thousand Talent Program” in China.

----Invited Talk----

Grain boundary reinforcement and charge transport modulation for efficient and stable perovskite solar cells and modules

Abstract—For fabricating high-performance perovskite solar cells (PSCs) and modules, it is essential to prepare high-quality perovskite absorbing layer together with suitable charge transport layers. Here, we introduce a multifunctional triphenylamine or fullerene derivative in mixed-ion perovskites to reinforce the grain boundaries and prompt directional charge transport. Meanwhile, we employ a radical polymer of poly(4-glycidyloxy-2,2,6,6-tetramethylpiperidine-1-oxyl) (PTEO) to stabilize the bulk morphology and electrical properties of highly doped organic hole transporting layers by preventing the aggregation of lithium salts. Integrating with the vacuum-flash solution processing method, we fabricate efficient planar PSCs that deliver a champion

efficiency of 22.1% and 23.12% on an aperture area of 1.0 cm2 for p-i-n and n-i-p PSCs, respectively. For perovskite solar modules, a certified efficiency of 19.0% and 19.6% on 6×6 cm2 substrate for respective p-i-n and n-i-p device architectures are demonstrated. The as-fabricated cells also exhibit high operational and thermal stability, retaining above 90 % of their initial efficiencies after 1000-hours maximum power point tracking under continuous illumination at 85 °C.

11:45-12:00 | G29156

Unraveling In Situ Growth Kinetics for High-Quality Hybrid Perovskite Single-Crystal Thin Films on Hole-Transport Layers

Zhaojin Wang, Xiaobing Tang, Dan Wu, Pai Liu, Jiayun Sun, Fankai Zheng, Xiao Wei Sun, and Kai Wang
Southern University of Science and Technology, China

Abstract—Bearing the advantages of compact size and promising optoelectrical property of perovskite, it is critically important to develop in-situ growth method of high-quality perovskite single-crystal thin films (SCTFs) directly on hole-transport layers (HTLs), to boost the performance of optoelectronic devices. In this work, a full study of growth kinetics for MAPbBr3 SCTFs on HTLs are investigated by altering key factors including interface energies, the precursor solution concentration and heating rate. The high-quality SCTFs with a record ratio of area to thickness of 1.94 x 104 mm were obtained. Moreover, the SCTFs exhibit excellent crystallinity with record full width at half maximum of 0.017° for XRD rocking curve analysis and ultra-long fluorescent lifetime of 1552 ns. As a result, SCTFs performed the long-term thermal and structural stabilities over 360 days and 470 K, respectively. This work discloses the growth kinetics for high-quality MAPbBr3 SCTFs on HTLs and provides a constructive and promising preparation method for ultra-stable optoelectronic devices based on perovskite SCTFs.

S13: THz Metamaterials and Device Applications - A

Room: LM105 | Time: 10:45-12:00

Session Chair: **Chunmei Ouyang,** Tianjin University, China

10:45-11:15 | Invited Speaker: Jinhui Shi

Prof. Jinhui Shi has received his Ph.D. (Material Science, 2007), M. Eng. (Optical Engineering, 2005) and B.S. (Optoelectronic Technology, 2001) in Harbin Engineering University. From 2001 to present, he has been working in College of Science, Harbin Engineering University. In 2009 and 2013, he was a visiting research fellow in Optoelectronics Research Center, University of Southampton, and worked with Prof. N. I. Zheludev. From 2011 to 2014, he was a posdoctoral researcher in State Key Lab of Millimeter Waves, Southeast University in China, and worked with Prof. Tiejun Cui. From 2016 to 2018, he was a visiting researcher in metamaterial group, School of Physics and Astronomy, University of Birmingham, and worked with Prof. Shuang Zhang.

Now his current research interests include metamaterials, plasmonics and in-fiber devices. He is principle investigator of more than 10 projects, has authored and co-authored over 90 published journal papers including Physical Review B, Applied Physics Letters, Optics Letters, Optics Express, Science Advances and Laser & Photonics Review.

----Invited Talk----

Asymmetric transmission and polarization manipulation in terahetz metamaterials

Abstract—In this talk, we first review asymmetric transmission and polarization manipulation. In addition, we numerically, theoretically and experimentally study high-performance dichroic asymmetric transmission of linearly polarized waves in terahertz chiral metamaterial. The orthogonal arrangement between the two layers gives rise to a strong coupling between orthogonal linearly polarized states in two separated frequency bands. It is worth mentioning that the so-called dichroic AT effects are robust within a wide angle of incidence up to 60° and suitable for manipulating different linearly polarized waves. In comparison with previously reported metamaterials, S-shaped chiral metamaterial offers an opportunity to realize high-efficiency dichroic nanophotonic devices with a wide range of potential applications in optical polarization manipulation, chiral biosensing and polarization information processing. In addition, tunable polarization response in bilayered metamaterials will be also discussed.

11:15-11:30 | G2923

Active polarization converter based on VO2-metal hybrid metasurfaces at terahertz frequencies

Jing Zhao, Chunmei Ouyang, Yi Liu, Jiajun Ma and Weili Zhang
Tianjin University, China

Abstract—Recently, the active control of metasurfaces has been increasingly favored by researchers. Here we propose a multi-layer terahertz metasurface integrated with phase change material of vanadium dioxide. In the simulation, it is found that upon heating, the insulator-to-metal phase transition of vanadium dioxide effectively broaden the polarization conversion bandwidth of the metasurface, and the polarization conversion ratio can reach more than 95 %. The bandwidth-controllable polarization converters with high polarization conversion ratio are expected to be applied to terahertz communications, therefore enriching terahertz functional devices.

11:30-11:45 | G2922

Bidirectional Hyperbolic Surface Modes in Terahertz Topological Transition Metasurfaces

Yi Liu, Liu Yi, Chunmei Ouyang, Yanfeng Li and Weili Zhang
College of Precision Instrument and Optoelectronics Engineering. Tianjin University, China

Abstract—Hyperbolic metasurfaces (HMSs), composed of subwavelength and regularly-arranged metallic blocks, show great potential for manipulating surface plasmon polaritons (SPPs) and designing advanced surface wave devices. Additionally, topological transition that describes the special dispersion properties in HMSs has attracted immense interest. Here, we propose a novel terahertz HMS that enables bidirectional hyperbolic surface modes in orthogonal directions by placing terahertz electric dipoles at different edges of the model. Moreover, while previous literature mostly focused on the study of eigenmodes, our research on multi-energy bands will expand the application range of planar photonic devices in self-collimating transport, negative refraction and anomalous wave propagation.

11:45-12:00 | G2924

Broadband topological edge-states in two-dimensional terahertz photonic crystals with metallic elliptical cylinders

Jiajun Ma, Chunmei Ouyang, Quan Xu, Yi Liu, Jiaguang Han and Weili Zhang
TianJin University, China

Abstract—Originating from the discovery of the quantum spin Hall effect (QSHE), the topological edge states (TES) have been a novel way to control the electromagnetic propagation. According to the time-spatial reversal symmetry and topological defect theory, we propose a topological photonic crystal (TPC) made of elliptical cylinders in the terahertz regime, which possesses a large operation bandwidth. Multiple topological transitions between the trivial and topological structures can be realized by breaking the spatial reversal symmetry instead of breaking the time reversal symmetry. The interfaces between the trivial and nontrivial areas can produce one-way propagating edge states that propagate around sharp corners without backscattering. Our finding provides a platform for the development of TPC-based devices and open up unprecedented venues for topological signal processing and sensing.

S14: Fiber-Based Technologies and Applications - C

Room: LM103-A | Time: 13:30-15:30

Session Chair: **Yiyang Luo,** Chongqing University, China

13:30-14:00 | Invited Speaker: Wenjun Ni

Dr. Wenjun Ni, is currently an associate preofessor in South-Central University for Nationalities. He works in the field of special optical fiber device, fiber acoustic sensing and photoacoustic gas detection. He has published more than 40 papers in international journals, such as Photonics Research, Optics Letters, Optics Express, Journal of Lightwave Technology. Earlier, he is a research fellow in Centre of Optical Fiber Technology, Nanyang Technological University from Jan. 2019 to Dec. 2020, and supervised by professor Perry Ping Shum. In 2014 and 2019, he obtained his Bachelor and Ph. D degree from South-Central University for Nationalities, Wuhan, China and Huazhong University of Science and Technology, Wuhan, China, respectively.

----Invited Talk----

Optical and Acoustic Characteristics in Anti-Resonant Bragg Hollow Core Fiber

Abstract—HCF (hollow core fiber) paves a promising solution for special scenarios sensing applications, such as in the fields of inline optofluidic, photothermal spectroscopy and photoacoustic imaging. Particularly, anti-resonant hollow core fiber (AR-HCF) as a hot topic has attracted intensive attentions attributed to its unique AR effect in recent years. In this paper, we propose an AR-HCF with Bragg cladding structure, which can be referred to Bragg hollow core fiber (BHCF). We conduct the simulation on the spectral characteristics and optical field distribution of AR-HCF and BHCF using the beam propagation and Finite Element Analysis method, respectively. Moerover, we explore the propagation of acoustic waves in BHCF, and the simulation results illustrate that BHCF has a great potential in short-haul distributed optical fiber sensing when it is combined with gas filling photoacoustic spectroscopy techniques. All these findings will facilitate the applications of the HCF based sensors.

14:00-14:30 | Invited Speaker: George Y. Chen

Dr. Chen graduated with a 4-year MEng (Bachelor's and Master's joint degree) from Imperial College London in 2009, in the field of electronics and electrical engineering with computer science. He completed his PhD from the Optoelectronics Research Centre at the University of Southampton in 2013. He worked in an industrial research lab as a postdoctoral research fellow for SPI Lasers Ltd. from 2013 to 2015. He joined the University of South Australia as a research fellow in 2015, and played a critical role in establishing the Laser Physics and Photonic Devices Laboratories. He was a part of the MinEx CRC (world's largest co-op research centre on minerals exploration). He joined Shenzhen University in 2021 as a Professor. His research focuses on new sensing techniques and new applications, driven by specialty fibers and functional materials.

----Invited Talk----

Resolving elusive defects in optical fiber coatings

Abstract—Material defects in optical fibers and their coatings can lead to significant scattering centers. Under intense irradiation, such as those of high-power lasers, such scattering can cause local areas to heat up. These defects must be reported early to avoid component and system damage. The main challenge to date has been developing a reliable technique that can measure defects along long stretches of fiber, behind opaque packaging, and provide position information. We review the progress to date on an elegant skew-ray technique for detecting and radially resolving microscopic defects in low-index-coated optical fibers, and discuss the prospects and challenges of developing a fully distributed sensing system.

14:30-15:00 | Invited Speaker: Zhijun Yan

Yan Zhijun, associate professor and doctoral guide. He has got the bachelor and master in Condensed physics, School of Physical Science and Technology, Lanzhou University, PhD in Aston Institute of Photonic Technology, Aston University, postdoctoral research, Awarded Excellent Overseas Self-funded doctoral Student Scholarship in 2012 and Hundred Distinguished Professor Program of Shaanxi Province in 2014, and joined School of Optics and Electronic Information, Huazhong University of Science and Technology, 2016, main research area: Design, Fabrication and Application of new type, silicon dioxide based waveguide grating devices.

----Invited Talk----

All fiber light duplex emitter and receiver based on radiation tilted fiber grating

Abstract—45° tilted fiber grating (45°-TFG) can couple S-polarization light out of the fiber core into radiation mode. The unique coupling property has promoted the 45°-TFG to be an ideal in-fiber polarizer. In our previous works, we have reported many papers related to the polarizing property of the 45°-TFGs. Recently, we have focused on the radiation property of 45°-TFGs, and achieved the light duplex radiating and receiving, and promote such grating applied in fiber spectrometer, OCT, optical wireless communication, optical wireless sensing and wavelength selective switch.

15:00-15:30 | Invited Speaker: Chengyu Hong

Dr Hong is Associate Professor at the College of Civil and Transportation Engineering, Shenzhen University. He is Director of Laboratory of Geotechncial and Underground Engineering, Deputy Director of Smart Infrastructure Research Center (Underground Polis of Academy), Deputy Director of Shenzhen Key Laboratory of Green, Efficient and Intelligent Construction of Underground Metro Station. His current research activities include additive manufacturing, optical fiber sensors, infrastructure sensing, disaster prevention and mitigation of underground infrastructures. He has published more than 100 journal and conference papers. He is also the member of Technical Committee TCC220 "Field Monitoring in Geomechanics" of the International Society for Soil Mechanics and Geotechncial Engineering.

----Invited Talk----

Application of Optical Fiber Sensor Technologies for Geotechnical Monitoring

Abstract—Optical fiber sensors are effective measures for infrastructure monitoring. Encapsulation methods of optical fiber sensors are critical for successful monitoring of infrastructures. In this study, a number of encapsulation methods of optical fiber sensors using additive manufacturing technology for strain/stress/displacement monitoring were proposed and discussed. Polylactic Acid (PLA) and carbon fiber were selected as encapsulation materials of optical fiber sensors. Mechanical behavior (such as internal strain and temperature distribution) of encapsulated prototypes of optical fiber sensors including fiber Bragg grating sensors and Optical Fiber Distributed Reflectometry (OFDR) based sensors during additive manufacturing process were discussed. Measurement performance of optical fiber sensors such as measurement accuracy, minimum resolution, and maximum measurement range were summarized. Field monitoring studies of optical fiber sensors were also conducted for piles, retaining walls, soil nails, etc.

S15: Fiber-Based Technologies and Applications - D
Room: LM103-B | Time: 13:30-15:30

Session Chair: **Guiyao Zhou**, South China Normal University, China

13:30-14:00 | Invited Speaker: Yingying Wang

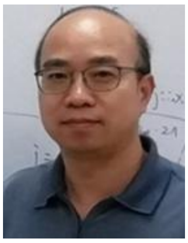
Ying-YingWang received her bachelor's degree from Beijing Jiaotong University, China, in 2005 and Ph.D degree from University of Bath, U.K, in 2011. From 2012 to 2019, she was as an Associate Professor in Beijing University of Technology, China. In November 2019, she joined the Institute of Photonics Technology, Jinan University, Guangzhou as a Professor. Her research field mainly focuses on hollow-core optical fiber and its applications. She has authored or co-authored more than 50 papers with h-index of 19. She currently serves as TPC member for CLEO and OFC.

----Invited Talk----

Recent Progress in Hollow Core Optical Fiber Technology

Abstract—Hollow-core fiber (HCF) has found plenty of applications in areas ranging from low latency optical communication, ultra-intense pulse delivery, single-cycle pulse generation to biochemical sensing and quantum optics. These applications call for better performance HCF especially in loss, bandwidth and modal control. Here we review our recent efforts in developing low loss HCF, high birefringence HCF and broadband HCF, as well as some related technology like HCF splicing and connecting. These techniques herald a new opportunity to fully unleash the potential of hollow-core fiber in laser and telecommunication related applications.

14:00-14:30 | Invited Speaker: Xiaopeng Dong



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.

----Invited Talk----

All Fiber Interferometric Sensors for Ocean Temperature, Salinity, And Depth Detection

Abstract—In this talk, several kinds of all fiber sensors for ocean temperature, salinity, and depth detection, developed in our lab. based on the mode interference effect will be presented. The specially designed fiber and sensor configuration, including specific signal processing method, are employed to increase the detection sensitivity, range, and robustness for deep sea measurement requirement.

14:30-15:00 | Invited Speaker: Meng Pang

Meng Pang graduated from Tianjin University (with bachelor degree), Tsinghua University (with Master degree) in 2004 and 2007 and HongKong PolyU (With PhD degree) in 2011. Then, he joined Prof. Xiaoyi Bao's group as a postdoc fellow at University of Ottawa, Canada, where he studied random fibre lasers and nonlinear fibre optics. From 2013, he worked as a postdoc fellow in Russell's division, Max-Planck Institute for Science of Light (MPL), Germany, where he was promoted as a team leader in 2015. He joined Shanghai Insitute of Optics and Fine Mechanics (SIOM, CAS) as senior researcher and professor in 2019. His research topics include optomechanical effects in photonic crystal fibres, mode-locked fibre lasers and pulse propagation in optical fibres. Until now, he published more than 30 journal papers, including Nature Photonics, Nature Communications, Light S&A, and Optica.

----Invited Talk----

Controlling multiple pulses through strong optoemchanical interacations in mode-locked fiber lasers

Abstract—The tightly-trapped optomechanical interactions in solid-core photonic crystal fiber (PCF) can be used to force fiber lasers to mode-lock at a high harmonic of their cavity round-trip frequency. In such optomechanical mode-locking lasers, the solid-core of a PCF with a high air-filling fraction acts like a quartz oscillator that can be driven by a sequence of optical pulses whose repetition rate lies close to the resonant frequency of the oscillator. The ensuring optically-driven mechanical oscillation then acts back on the pulses, dividing the laser cavity into many equally-spaced time-slots within each of which optical pulses can be separately trapped. The repetition rate of the time-slots corresponds to the mechanical resonance frequency of the PCF, which can be a few GHz, and the passive locking between the mechanical wave and the pulse sequence turns out to be extremely stable, resulting in GHz-rate pulsed light sources that can work for weeks without interruption. We have been perfecting this technique over the last several years, and now can produce sub-100 fs pulses with ~2 GHz repetition rate at 1550 nm. This optomechanical mode-locking mechanism works at any wavelength where the core is transparent, and can be used to store supramolecular pulse sequence over many hours and to study and control complex soliton dynamics.

15:00-15:15 | G297

A sensitized plastic optical fiber multi-point bending sensor based on deep learning

Shun Lu, Zhongwei Tan, Guangde Li
Beijing Jiaotong University, China

Abstract—Since the variations of mode interference induced by curvature in multi-mode fiber (MMF) can be well represented by the fiber specklegram. The paper proposes a fiber multi-point bending sensor based on deep learning to detect the bending of short-distance fiber and reduce the cost of detection. In the experiment, plastic fiber with sensitization processing was used as the transmission medium and CCD(Charge-coupled Device) is used to collect specklegram of different bending angles and different bending area at the end of the fiber output. A fiber of 60cm was bent at 15cm, 30cm and 45cm from the input, respectively. The convolutional neural network was used to classify the output speckle under different bending conditions. It was found after testing that the neural network can classify speckles with a bending interval of 15° with an accuracy rate of 94.3%. This method indicates the capability to distinguish the specklegram even when the fiber is under complicated bending due to the specklegram can represent the status of the whole section of fiber. The method proposed in this paper can be used in fields of short-range sensing or optical fiber multi-point bending measurement, it can also find applications in distinguishing the status of certain structures, such as robotic arms, mechanical fingers and some disabled auxiliary equipment.

15:15-15:30 | G2927

A multi-layer-film based fiber probe for ultrasound generation

Geng Chen, Liuyang Yang, Dongchen Xu, Chenhao Dai, Zhijun Yan, Qizhen Sun
Huazhong University of Science and Technology, China

Abstract—A multi-layer film structure is demonstrated on the cleaved end face of double-cladding fiber for ultrasound generation. The acoustic pressure generated from the probe is 146kPa with a bandwidth of 38MHz. Meanwhile, this probe has the potential to integrate ultrasound generation and detection.

S16: Optoelectronic Devices and Applications - B

Room: LM103-C | Time: 13:30-14:30

Session Chair: **Lei Lei,** Shenzhen University, China

13:30-14:00 | Invited Speaker: Pan Wang

Dr. Pan Wang is a Professor in the College of Optical Science and Engineering at Zhejiang University. He received his Ph. D degree in Optics Engineering from Department of Optical Engineering, Zhejiang University, China in 2013. After that, he joined Anatoly Zayats' group as a research associate at the Department of Physics, King's College London, United Kingdom. Since May 2019, he started his faculty career as a tenure-track Professor at Zhejiang University. His research interests include nanophotonics, plasmonics and metamaterials.

----Invited Talk----

Plasmonic nanocavity-based optoelectronic devices

Abstract—Metal-insulator-metal plasmonic nanocavities with nanometer-scale insulator thickness can provide extreme confinement and enhancement of optical fields, and have attracted great research interests recently. In this talk, I will first introduce high-quality nanoparticle-on-mirror plasmonic nanocavities based on ultrasmooth single-crystalline gold microflakes and their integration with optical fibers. Then, by constructing tunnel junctions on the top of high-density Au nanorod array, we demonstrated large-scale and efficient electrical launching of surface plasmons in the metamaterial based on inelastic electron tunneling, which as well results in an eye-visible light emission due to the radiative decay of the plasmonic modes. By engineering the geometrical parameters of the metamaterials, we can tune the tunneling-induced emission throughout the visible and near-infrared spectral range. Moreover, by harvesting the simultaneously generated hot electrons from the elastic tunneling process, we show that the light emission can be dynamically modulated due to the hot-electron-activated chemical reactions in the highly confined junctions. Therefore, plasmonic nanocavities with the capability of extreme electric and optical confinement can significantly enhance light-matter interactions, and will find promising applications in fundamental researches as well as in developing optoelectronic devices with small size and high performance.

14:00-14:30 | Invited Speaker: Li Shen

Li Shen received the B.Sc. and M.Phil. degrees from the Huazhong University of Science and Technology (HUST), Wuhan, China, in 2009 and 2012, respectively, and the Ph.D. degree from the Optoelectronics Research Centre (ORC), University of Southampton, Southampton, U.K., in 2015. He is currently an Associate Professor with HUST and a Visiting Scholar with the ORC. He has authored or coauthored more than 30 peer-review journal papers. His research interests include novel semiconductor photonic devices, silicon photonics, mid-infrared photonics.

----Invited Talk----

Group IV waveguides for wavelengths beyond the telecom band

Abstract—This talk reviews recent progress in characterizing Group IV waveguides for the mid-infrared wavelengths. Integrated silicon devices working in the emerging 2 µm wavelength band and Ge-on-Si waveguide platform are demonstrated for longer wavelength regime. Our results indicate the suitability of these two platform for both linear and nonlinear applications in this long wavelength regime.

S17: Silicon Photonics

Room: LM104-A | Time: 13:30-15:30

Session Chair: **Guoqing Wang,** Southern University of Science and Technology, China

13:30-14:00 | Invited Speaker: Zou Yi

Dr. Yi Zou is an Assistant Professor in the School of Information Science and Technology at ShanghaiTech University.

He received his Ph.D. in Electrical and Computer Engineering from the University of Texas at Austin in 2014. From 2015 to 2017 he worked in the College of Engineering and Applied Sciences at Nanjing University as a research associate professor. He joined the faculty of ShanghaiTech University in the fall of 2017. Dr. Zou has published more than 30 peer-reviewed papers in major optics journals, including Photonics Research, IEEE Journal of Selected Topics in Quantum Electronics, Applied Physics Letters, Optics Letters, Optics express, etc., and received more than 1100 citations.

His current research interests include integrated photonic open sensor platform, programmable photonic processor, and novel properties of artificial nanostructures and their applications.

----Invited Talk----

Half-Wavelength Pitch Wavelength Array with Low-Crosstalk

Abstract—Waveguide arrays are among the fundamental building blocks for integrated photonics. A dense waveguide array could enable high-density integration of waveguide elements, significantly reducing on-chip estate and cost, and improve the devices' performance such as a wider field of view for an on-chip optical phased array. Here we report our approach for improving the waveguide integration density. An ultra-dense waveguide array with half-wavelength pitch is designed, fabricated, and measured, featuring 30 dB crosstalk suppression.

14:00-14:30 | Invited Speaker: Nan Ye

Dr. Nan Ye obtained his Ph.D degree from the Tyndall National Institute, University College Cork. He worked as a researcher at the IMEC-Ugent in Belgium and a research associate in the University of Virginia at USA. Now, he is in Shanghai University as an associate professor. He has been working on the hybrid-integration of Ge/III-V detectors on the SOI/SiNx platform and sub-system technologies. Dr. Ye has published more than 30 journal papers/conference proceedings involving invited paper in Journal of Lightwave Technology, and Post-Deadline-Paper at the European Conference on Fiber Communications (ECOC).

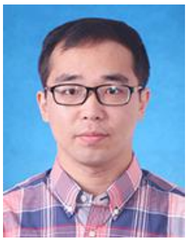
----Invited Talk----

Hybrid photodiode integrated on the silicon photonics platform

Abstract—Due to that the fabrication process is partially compatible with the CMOS process, it could provide massive production for the photonics chips based on the SOI or SiNx platform. The SiNx platform can also offer low loss, wide transparent window and high power handling property, which makes it an ideal platform for the fabrication of integrated optical comb generation devices. While, achieving high-speed, large-responsivity photodetectors for optical fiber communications based on these two platforms also require Ge or III-V materials demonstrating high absorption and high carrier migration rate. This is challenged by the difficulties of heterogeneous integration involving low active material utilization rate and long device manufacturing cycles. Adhesive bonding technology can improve the interface roughness and cleanness tolerance for increasing the integration yield. Applying micro-transfering method can improve the utilization rate of heterogeneous materials and shorten the manufacturing cycle. This report describes the implementation of 1550/1064 nm III-V on SiNx photodetectors by using Su-8-addhessive bonding technology; 1550 nm Ge photodetectors integrated on SOI platforms by using BCB-adhesive bonding and micro-

transfer printing method. Both hybrid-integrated devices can work at the rate up to 40 Gbit/s.

14:30-15:00 | Invited Speaker: Yu He



Yu He received the B.S. degree from Nankai University, China and Ph.D degree from Shanghai Jiao Tong University, China. He is currently working as a postdoc at Shanghai Jiao Tong University. His research interests include silicon photonics devices and circuit, polarization handling devices and wavelength/mode multiplexing devices.

----Invited Talk----

Photonic interconnect employing on-chip mode-division multiplexing

Abstract—In this invited talk, we review recent advances in mode-division multiplexing devices based on silicon-on-insulator (SOI) platform. Subwavelength grating structures and metamaterials are introduced to assist the mode coupling process. High-order mode multiplexing and modal crosstalk mitigation methods are explored.

15:00-15:15 | G2993

Refractive Index Sensing Based on Mode Splitting in Subwavelength Grating Metamaterial Microring Resonators

Wanxin Li, Jiaxin Chen, Jinzhao Wang, Jiewen Li, Yunxu Sun and Xiaochuan Xu
Harbin Institute of Technology (Shenzhen), China

Abstract—Microscale cavities have been extensively studied for ultrasensitive sensing in recent years. However, highly sensitive sensors are generally accompanied by high noise level. In this paper, we propose to use mode splitting in subwavelength grating metamaterial ring resonators (SGMRRs) for self-referenced refractive index sensing. Due to the reflection in the subwavelength grating, the clockwise and counter clockwise propagating modes mutually couple to each other, leading to the lift of degeneracy. The wavelength difference between the split modes, which is sensitive to refractive index perturbation, forms an ultra-sensitive self referenced architecture. We theoretically demonstrated that a self-referenced surface sensitivity of 21 pm/nm can be achieved with an effective suppression of thermal noise.

15:15-15:30 | G2992

Fabrication-Friendly Ultra-Long Waveguide Grating Antenna for Silicon-on-Insulator Platform

Jiaxin Chen, Wanxin Li, Jinzhao Wang, Jiewen Li, Weiming Yao, Zhengquan Huang, Yong Yao, Xiaochuan Xu
Harbin institute of technology (Shenzhen), China

Abstract—Light detection and ranging (LiDAR) based on the optical phased array (OPA) on silicon photonics platform has been attracting intensive attention. Beamwidth and field-of-view are two critical design parameters for OPAs, which are determined by the length waveguide grating antenna (WGA) and the high packing density of the WGA array. However, the high index contrast on silicon-on-insulator (SOI) brings a great challenge to implementing long WGA and high packing density simultaneously. In this paper, we propose a fabrication-friendly WGA with weak perturbation strength achieved by placing subwavelength silicon segments around the strip waveguide. Bound state in the continuum (BIC) is leveraged to suppress the sidewall emission. We theoretically and experimentally demonstrated a millimeter-long WGA with a feature size over 100 nm on SOI. The beam width of 0.13o is experimentally observed.

S18: AI Photonics - A

Room: LM104-B | Time: 13:30-15:00

Session Chair: **Yongli Zhao,** University of Posts and Telecommunications, China

13:30-14:00 | Invited Speaker: Xiaosong Yu

Xiaosong Yu received his Ph.D. degree from Beijing University of Posts and Telecommunications (BUPT), Beijing, China, and was a visiting scholar in University of California, Davis. Now he is with institute of information photonics and optical Communications (IPOC) in BUPT. His interested research focuses on Elastic Optical Networks (EONs), Spatial Division Multiplexing (SDM) optical networks, software defined optical networking (SDON), datacenter networks, quantum-key-distribution enabled optical networks, and so on.

----Invited Talk----

Applications of Machine Learning in Quantum Key Distribution Networks

Abstract—Quantum key distribution (QKD) technology can achieve information theoretical security with one-time pad encryption. Machine learning (ML) provides systems with the ability to automatically learn and improve from experience without being explicitly programmed. There are some applications of ML in telecommunication networks, such as traffic prediction and fault prediction. There is increasing interest in the field in applying ML to improve the performance of quantum communication networks. In this paper, the applications of ML in quantum key distribution networks (QKDNs) will be introduced, including the applications at the quantum layer, key management layer, and control and management layers.

14:00-14:30 | Invited Speaker: Xiaomin Liu

Xiaomin Liu received the B.I. Degree in information engineering from Shanghai Jiao Tong University in 2020. She is currently pursuing Ph.D. degree in the State Key Laboratory of Advanced Optical Communication Systems and Networks in Shanghai Jiao Tong University, China. Her current research interests include modeling, monitoring and optimization in optical networks.

----Invited Talk----

Design and deployment of the data-driven fiber nonlinearity estimation for dynamics optical networks

Abstract—Machine-learning-based (ML-based) techniques for fiber nonlinearity estimation in optical networks may achieve higher accuracy while the low reliability of black-box methods also hinders the practical deployment. We design a ML-based modeling method for fiber nonlinearity and further investigate the training framework to alleviate the parameter uncertainty during online learning.

14:30-15:00 | Invited Speaker: Yongli Zhao

He received B.E. and Ph.D. degrees from Beijing University of Posts and Telecommunications (BUPT), Beijing, China, in 2005 and 2010, respectively. Since 2018, he is a full professor at BUPT. During Jan. 2016 to Jan. 2017, he was a visiting associate professor at UC Davis. Now, he is a Fellow member of IET, senior member of IEEE, and OSA. Up to now, he has published more than 400 international journal and conference papers. He has published 8 books and 3 independent chapters in different English books. His current research focuses on software defined optical networks, elastic optical networks, datacenter networking, machine learning in optical networks, optical network security, and quantum key distribution networking.

----Invited Talk----

Applications of Machine Learning in Quantum Key Distribution Networks

Abstract—Quantum key distribution (QKD) technology can achieve information theoretical secure with one-time pad encryption. Machine learning (ML) provides systems the ability to automatically learn and improve from experience without being explicitly programmed. There are some applications of ML in telecommunication networks, such as traffic prediction and fault prediction. There is increasing interest in the field in applying ML to improve the performance of quantum communication networks. In this talk, I will introduce the applications of machine learning (ML) in quantum key distribution networks (QKDNs), including the applications in quantum layer, key management layer, and control and management layers.

S19: Perovskite Materials and Optoelectronic Applications - C

Room: LM104-C | Time: 13:30-15:00

Session Chair: **Kai Wang**, Southern University of Science and Technology, China

13:30-14:00 | Invited Speaker: Dan Wu

Prof. WU Dan received her B.E. degree in electronics science and engineering from Harbin Institute and Technology (HIT), Harbin, China, in 2009, M.E. degree in optical engineering from Huazhong University of Science and Technology (HUST), Wuhan, China, in 2011, and the Ph.D. degree in electronic engineering from Nanyang Technological University (NTU), Singapore, 2018, respectively. From 2018 to 2020, she worked as a research assistant professor in academy for advanced interdisciplinary studies in Southern University of Science and Technology (SUSTech).

Prof. WU joined Shenzhen Technology University (SZTU) in 2020. Now, she is an Assistant Professor in college of new materials and new energies. Her research interests include optical field manipulation by micro/nano-photonic structures, inverse nanophotonic optimization, perovskite/quantum dots light-emitting diodes, narrow bandwidth photodetectors etc.. She has authored/co-authored over 49 peer-reviewed journal publications in Advanced Science, Journal of Materials Chemistry A, Optics Express etc. and over 10 peer-reviewed conference papers in her research fields.

Prof. WU was the recipient of Talent of Peacock Program C, Shenzhen, China. She was also the recipient of High-level Talents, Nanshan District of Shenzhen. She received Asia innovation Forum Young Entrepreneur Award in 2012. She was the PI of 4 projects from National Natural Science Fund of China, National Key R&D Program of China Key Special Program, Guangdong Educational Committee Special Innovation Program, and Shenzhen Science and Technology Innovation Council Basic Research General Program of Shenzhen.

----Invited Talk----

Strategies for Improving the Performance of Perovskite Photodiodes: Interfacial Built-in Electric Field Manipulation and In situ Growth of Perovskite Single Crystal Thin Film on Transport Layer

Abstract—The key problem in designing the highly efficient perovskite photodiodes is necessity of "multiple-parameters-optimization" to obtain different optimized conditions for different structures, which is usually complicated and time-consuming. It is highly desirable to develop a general design guideline, which is applicable to all types of devices to further enhance the performance of the perovskite photodiodes. To achieve this goal, it is desirable to trace back to the intrinsic nature of perovskites. In this talk, the unintentional doping of the perovskite and their influence on the built-in electric field at the active and transport layer interfaces is discussed, based on which a universal strategy is proposed for efficient design of perovskite photodiode. Moreover, along with the superior optoelectronic property of polycrystalline perovskites, hybrid perovskite single crystal thin films (SCTFs) have drawn considerable attentions due to additional merits in the past few years. To meet the requirement of moisture, oxygen, and especially the high thermal stability for wide photodetection fields, FAPbBr3 with high decomposition temperature is expected to be a promising candidate. In this talk, in-situ growth of high-quality FAPbBr3 SCTFs on the hole transport layer is systematically discussed, which is based on gradient heating nucleation and room temperature growth for ultra-stable photodiodes with remarkable performance.

14:00-14:30 | Invited Speaker: Guohui Li

Guohui Li is the Associate Professor of Optical Engineering at the University of Taiyuan University of Technology, Sanjin Talent of Shanxi Province. He received his Ph. D in 2011 in optics from the East China Normal University. His research interests are in fundamental studies of solid state and photonic structures and optoelectronic devices, especially photonic crystals, plasmonics, and meta-materials, and applications of these structures in information technology applications such as lasers and photodetectors. He has published over 30 refereed journal articles, has given over 10 invited talks, and was granted 10 US patents.

----Invited Talk----

High quality perovskite nanoplatelet lasers with high operational stability

Abstract—MAPbI3 perovskite has attracted widespread interests for developing low-cost near infrared semiconductor gain media. However, it faces the instability issue under operation conditions, which remains a critical challenge. It is found that the instability of the MAPbI3 nanoplatelet laser comes from the thermal-induced-degradation progressing from the surface defects towards neighboring regions. By using PbI2 passivation, the defect-initiated degradation is significantly suppressed and the nanoplatelet degrades in a layer-by-layer way, enabling the MAPbI3 laser sustain for 4500 s (2.7×107 pulses), which is almost 3 times longer than that of the nanoplatelet laser without passivation. Meanwhile, the PbI2 passivated MAPbI3 nanoplatelet laser displays a quality factor up to ~7800, the highest reported for all MAPbI3 nanolasers. Furthermore, a high stability MAPbI3 nanoplatelet laser that can last for 8500 s (5.1×107 pulses) is demonstrated based on a dual passivation strategy, by retarding the defect-initiated degradation and surface-initiated degradation, simultaneously. This work provides in-depth insights for understanding the operating degradation of perovskite lasers and the dual passivation strategy paves the way for developing high stability near infrared semiconductor laser media.

14:30-15:00 | Invited Speaker: Hai Zhou

Hai Zhou received the Ph.D. degree in Microelectronics and Solid State Electronics from Wuhan University, Wuhan, China. After that, he joined Hubei University until 2021. In 2017, Hai joined Prof. Yanfa Yan's group as a visiting scholar in the University of Toledo. Now, he is a Distinguished Professor of the Dongguan University of Technology. His main research areas include self-power photodetectors, ultraviolet LEDs devices, and photoelectric devices based on perovskite micro/nano materials.

----Invited Talk----

Perovskite Micro/Nano Structure Photodetectors with Application in Optical Communication

Abstract—In recent years, due to the ultra-fast charge generation rate, high absorption coefficient, good defect tolerance and big carrier mobility of organic-inorganic metal halide perovskites, they have been successfully applied in fields such as solar cells, light-emitting diodes, photodetectors and lasers. However, the instability of organic-inorganic metal halide perovskite cations in oxygen and moisture hinders its commercialization. As an alternative, the all-inorganic CsPbX3 (X = Cl, Br and I) perovskite materials have attracted great interest due to its high thermal stability. Unfortunately, the fabrication of highly stable CsPbX3 PC films via solution processes is challenging. For CsPbBr3, the low solubility of CsBr in dimethylformamide (DMF) and dimethyl sulfoxide (DMSO) solvents causes insufficient and unbalanced reaction of the precursors, which leads to discontinuous and porous morphology and off-stoichiometric compositions in solution-processed perovskite films. Additionally, due to the much lower solubility of CsBr than that of PbBr2 in the solvents, CsBr behaves as the growth seeds during the nucleation of perovskite crystallites, which aggravates the formation of voids and impurity phases, hindering the achievement of the high-performance PDs.

To address these issues, we introduce a facile sequential spin-coating method to prepare high-quality CsPbBr3 perovskite films, wherein a CsPb2Br5 precursor film is prepared by the conventional one-step solution route and followed by spin-coating of a CsBr precursor solution. Then we constructed normal SnO2/perovskite/Carbon and special single-layer ZnO hollow hemispheres based perovskite structure PDs, respectively, and their applications in optical communication have been studied.

S20: THz Metamaterials and Device Applications - B

Room: LM105 | Time: 13:30-15:30

Session Chair: **Longqing Cong,** Southern University of Science and Technology, China

13:30-14:00 | Invited Speaker: Longqing Cong

Longqing Cong, Associate Professor at SUSTech. He received bachelor and master degree from Tianjin University and PhD degree from Nanyang Technological University. He worked as a research fellow and postdoc researcher at Nanyang Technological University and University of Pennsylvania, respectively. He joined SUSTech in March 2021 as an associate professor in the department of electrical and electronic engineering. He has published over 40 peer-reviewed journal papers with more than 3600 citations, h-index of 31, among which 36 are in the first rank of JCR, and 4 are the highly cited papers of ESI. He serves as a long-term reviewer for over 30 journals, associate guest editor of journal Frontiers in Physics, and topical editor of journal Electronics. He was awarded the gold medal of "MRS Singapore best PhD thesis" in 2018; world's Top 2% Scientists by Elsevier; and the National Distinguished Youth Expert.

----Invited Talk----

Dielectric Metasurfaces Modulated by Temporal Loss Boundary

Abstract—We introduce a temporal loss boundary into a terahertz dielectric metasurface cavity that can act as a brake to modulate the dynamics of photons oscillating in the cavity. The loss boundary has two freedoms: boundary height (intensity) and boundary timing. Coupled modes can be distinguished by the loss boundary, and a transition from coupled to uncoupled state is experimentally observed at a critical intensity and timing. In the modulation process, the uniform dielectric metasurface reveals an ultrafast switch between transparency and opaque within 14 ps. This ultrafast metasurface scheme would be useful for terahertz applications such as high-speed and secure wireless communications and data processing.

14:00-14:30 | Invited Speaker: Liyuan Liu

Liyuan Liu, obtained her PhD degree from FOM institute AMOLF in the Netherlands in 2015 and joined the Terahertz wave center in Tianjin University in 2016. She focuses on the investigation the dielectric properties and vibrational dynamics of aqueous system, and their application in Terahertz absorber.

----Invited Talk----

Tetramethylurea Inclusion based Ultra-broadband Microwave Metamaterial Absorber

Abstract—Ultra-broadband microwave absorbers (UBMAs) with water inclusion recently attract significantly increasing attentions because of its flexibility, low cost and easy processing. Although these UBMAs can get ultra-broadband absorption, it is difficult to attain the absorption range with the central frequency far away from 20 GHz, where the dielectric relaxation peak of water locates. An efficient way to expand the absorption region of UBMAs with inclusion is to modulate the central frequency and bandwidth of the inclusion dielectric response. In present work, we theoretically studied the concentration dependence of dielectric properties of tetramethylurea (TMU) and water mixture using Debye model. Based on the obtained dielectric spectra of TMU/water mixture, we designed an UMBA absorber achieving 90% of perfect absorption (PA), which covers a very broad frequency range from 4 to 40 GHz.

14:30-15:00 | Invited Speaker: Zhen Gao

Zhen GAO is a tenure-tracked Associate Professor in the Department of Electrical and Electronic Engineering, South University of Science and Technology. He received his PhD degree in Physics & Applied Physics from Nanyang Technological University (NTU), Singapore in 2018. Prior to NTU, he received his B.S. degree in 2009 and M. S. degree in 2012 in Electrical Engineering from Zhejiang University, China. His current research interests include topological photonics, spoof plasmonics, photonic crystals, metamaterials. As the first or corresponding author, he has published more than 30 academic papers on high-impact journals such as Nature, Nature communication, Physical Review Letters, Advanced Materials, Advanced Functional Materials, Advanced Optical Materials, Physical Review Applied, Physical Review B (Rapid Communication), Applied Physics Letters, and Optics Letters. He received the National Distinguished Youth Expert (2020), Chinese Government Award for Outstanding Self-financed Student Award (2016), National-level Professional Talent in Shenzhen, Ten Major Progress of Optics in China (2019) and 2019 Top Ten News of Optics in China (Light 10).

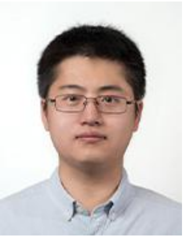
----Invited Talk----

Broadband wave manipulation in a surface-wave photonic crystal

Abstract—Surface electromagnetic waves on a structured metal/dielectric interface, or spoof surface plasmons at microwave and terahertz frequencies, have shown promising potentials for many advanced applications owning to their sub-diffractive field confinement and giant local-field enhancement, but they fundamentally suffer from serious scattering and reflection losses when encountering sharp corners and T-shaped Junctions. Here we solve the bottleneck by combining the photonic bandgap of photonic crystal and the subwavelength nature of spoof surface plasmons, proposing a new concept of surface-wave photonic crystal which can support broadband and high-efficient routing of surface waves around sharp corners on a single structured metal surface. Functional devices such as a T-shaped splitter and a square open resonator are also demonstrated, both of which

cannot be fulfilled with merely traditional surface-wave waveguides. We demonstrate that surface-wave photonic crystal can indeed be utilized for broadband and high-efficient sharp-bending and splitting of surface electromagnetic waves, thereby enabling the realization of ultra-compact plasmonic components and paving the way for a new class of integrated photonic circuits.

15:00-15:30 | Invited Speaker: Xiaoguang Zhao



Xiaoguang Zhao (Ph.D.) is an Associate Professor in the Department of Precision Instruments at Tsinghua University. Dr. Zhao received his Ph.D. in Mechanical Engineering from Boston University and his M.E. and B.S degree from Tsinghua University. Dr. Zhao's research interests include metamaterials, terahertz science and technology, microelectromechanical systems (MEMS), magnetic resonance imaging (MRI), and RF circuits and system design. Dr. Zhao has more than 40 peer-reviewed journal publications and 7 of them are selected as the cover image of the journal, including Advanced Materials, Optica, ACS Photonics, Advanced Functional Materials, Microsystems & Nanoengineering, Small, and Applied Physics Letters. He holds 3 patents on metamaterials for MRI and wireless communication.

----Invited Talk----

Tunable metamaterials enabled by MEMS for terahertz applications

Abstract—Metamaterials are a class of artificially engineered materials, exhibiting unprecedented properties enabled by their constituent subwavelength unit cells. The effective properties of metamaterials may be dynamically controlled by driving unit cells via different approaches, including photo-doping, electrical gating, or mechanical actuation. With such dynamic tuning mechanisms, the propagation modality of electromagnetic waves may be modulated to achieve functional devices for modulation, beam steering, focusing, and polarization control, among others. In addition, the perfect absorption and near field effect enabled by metamaterials may be used in electromagnetic detectors across the frequency spectrum. Microsystem technology provides a platform to achieve functional metamaterial devices by covering all requisite processes, including fabrication, packaging, and system integration. We report our progresses in constructing functional devices by integrating metamaterials with microsystems technology and discuss remaining challenges and the future direction of metamaterial devices for terahertz applications.

S21: Laser Technology - C

Room: LM103-A | Time: 15:45-17:30

Session Chair: **Luming Zhao**, Huazhong University of Science and Technology, China

15:45-16:15 | Invited Speaker: Luming Zhao

Luming Zhao received the B.Eng. and M.Eng. degrees from Tsinghua University, Beijing, China, and the Ph.D. degree from Nanyang Technological University, Singapore. He is currently a professor with School of Optical and Electronic Information, Huazhong University of Science and Technology, Wuhan, China. His research interests include ultrafast optics, fiber oscillators, fiber amplifiers, and soliton dynamics.

----Invited Talk----

Pulse separation reduction for soliton communication based on Nonlinear Fourier Transform

Abstract—Soliton communication is an old topic of soliton applications. One of the key issue in soliton communication is to achieve multiple solitons with narrower separation. We found that solitons from a fiber laser can be purified by separating from the coexisting CW background. Consequently, much narrower soliton separation can be achieved, which paves a way to manipulate the soliton separation and revives soliton communication.

16:15-16:45 | Invited Speaker: Zhaoyu Zhang

Prof. Zhaoyu Zhang is an Associate Professor in School of Science and Engineering, the Chinese University of Hong Kong, Shenzhen. He is also the Director of Shenzhen Key Lab for Semiconductor Lasers. He received his Ph.D. degree in Electrical Engineering from California Institute of technology in 2007. He worked as a postdoc associate in Chemistry at UC Berkeley and Molecular Foundry at Lawrence Berkeley National Lab from 2008 to 2011. After that, he worked as an Associate Professor at Peking University from 2011 to 2015. He moved to the Chinese University of Hong Kong, Shenzhen in June 2015. Currently, his research interests include compact semiconductor lasers monolithic integration with silicon photonics for telecommunication, organic light emitting diodes and lasers for display and illumination applications. He is a member of OSA, IEEE photonics, and SPIE.

----Invited Talk----

Monolithic Integration of Microcavity Lasers on Silicon Substrate

Abstract—Silicon photonics technology has monolithically integrated optical components such as waveguides, modulators,

beam splitters, detectors, but currently silicon photonics technology cannot monolithically integrate the light source of the core component, that is, semiconductor laser [1-4]. Semiconductor III-V photonic crystal and microdisk laser is regard as a promising ultra-compact light source with unique advantages of small footprint, low threshold and high speed modulation. Here, we demonstrate several kinds of microcavity lasers fabricated from two types of epitaxial wafer. The first one is InAs/GaAs quantum dots (QD) gain material monolithically grown on planar on-axis Si (001) substrates Fig.1. With its robust tolerance to defects and ultrahigh gain at ~1300nm telecom wavelength, we are able to make several microcavity including 2D photonic crystal (PhC) membrane lasers and microdisk lasers [5,6]. The second one is InP/InGaAs quantum well (QW) material lateral growth on SOI substrates-based Si (111) Fig.2(b), which can effectively solve the problem of lattice mismatch and large buffer layer thickness [7]. Based on the success of previous silicon-based lasers, our ultimate goal is to make single-mode continuous-wave nanobeam microcavity laser on a lateral growth III-V quantum well epitaxial wafer, which is electrical pumped at room-temperature and operating at the optical telecommunication wavelength of approximately 1550 nm. Then, this light signal will couple out through Si waveguide Fig.2(a). This design is expected to solve the key problems of next-generation optical communication chips or quantum communication chips, making it possible to monolithically integrate semiconductor lasers with silicon photonics chips, and has important research value and broad application prospects.

16:45-17:15 | Invited Speaker: Xiaosheng Xiao

Xiaosheng Xiao received the B. E. and Ph.D. degrees from Tsinghua University, Beijing, China, in 2002 and 2007, respectively. From 2007 to 2008, he was with the Network Technology Research Centre, Nanyang Technological University, Singapore, as a Research Fellow. From 2009 to 2019, he has been a faculty in the Department of Precision Instruments, Tsinghua University, Beijing, China. Since 2019, he has been an associate professor with the State Key Laboratory of Information Photonics and Optical Communications, School of Electronic Engineering, Beijing University of Posts and Telecommunications, Beijing, China. His research interests include mode-locked fiber lasers, optical fiber communications, and fiber optics.

----Invited Talk----

Spatiotemporal mode-locking in multimode fiber lasers with large modal dispersion

Abstract—Mode-locked lasers with single transverse-mode have been investigated extensively in the last decades. Recently, locking of multiple longitudinal and transverse modes simultaneously, spatiotemporal mode-locking (STML), was proposed in multimode fiber lasers with small modal dispersion, which has been considered to be critical for achieving STML. Here, we report that STML can also be achieved in multimode lasers with much larger modal dispersion. In addition, high-dimensional nonlinear dynamics observed in the lasers will be reported.

17:15-17:30 | G29133

Intracavity frequency doubling deep-ultraviolet Ho3+: ZBLAN fiber laser with wavelength tuning from 269.5 to 275.4 nm

Tianran Li, Jinhai Zou, Qiujun Ruan, Zhipeng Dong and Zhengqian Luo
Xiamen university, China

Abstract—Laser sources emitting in the deep ultraviolet (DUV) spectral region are required by numerous industrial and scientific applications owing to their characteristics of higher photon energy, more strongly scattering than other wavelengths and better absorption in most materials. DUV lasers can be produced by several techniques to date, mainly including free-electron lasers, excimer lasers, and high-order harmonic conversion such as frequency-converted fiber lasers and frequency-converted solid-state lasers, which suffer from a bulky structure and a high cost. For the first time, we successfully demonstrate a compact tunable green-light intracavity frequency-doubled DUV laser. Pumped by the 450 nm laser diode, with the 10 cm length Ho3+: ZBLAN fiber as gain medium, the maximum power at 272.6 nm is 1.36 mW under the green power of 293 mW. A visible reflective diffraction grating is used to realize the laser tuning output, which acts as a resonator along with a coated plane mirror, and a 7-mm BBO crystal is used for frequency conversion. Stable DUV lasers are obtained at 269.5 ~ 275.4 nm and the minimum linewidth is <0.025 nm with a maximum visible - DUV efficiency of 5.3‰. To our knowledge, it is the first demonstration of tunable DUV laser below 280 nm by visible light fiber laser direct frequency doubling technology.

S22: Quantum Optics and Information - A

Room: LM103-B | Time: 15:45-18:15

Session Chair: **Jiefei Chen**, Southern University of Science and Technology, China

15:45-16:15 | Invited Speaker: Xian Zhang

2004.9–2008.6, Zhejiang University, Physics, bachelor degree,
2008.8–2013.9, Zhejiang University, Optics, PhD
2013.12-2016.10, ICTP/ LENS - University of Florence, Italy, Postdoc research fellow
2016.10-now, Zhejiang University, Institute of Advanced Technology, assistant researcher
My past work includes: (1) Optical lattice of Strontium atoms (88Sr and 87Sr) and its application on gravity measurement and Einstein Equivalence Principle test. (2). Large-momentum-transfer atom interferometer

using optical Bragg diffraction with 88Sr atoms. (3). A lattice-trapped atom interferometer of 88Sr. (4) Optical interferometers for non-destructive and noise immune detection of atoms.

Currently my research interests include: (1). Optical/atom interferometers for precision measurements (2). Quantum simulation with ultra-cold atoms in optical lattices 3. Angular momentum of laser beams and its interaction with atomic systems

----Invited Talk----

Optical interferometers for low-noise non-destructive precision measurements of cold atoms

Abstract—Two novel noise-suppressing and lock-free optical interferometers based on far-off resonant dispersive probing are proposed and experimentally demonstrated in the study of the quantum non-destructive (QND) interaction of cold atoms. A QND measurement is usually carried out by a Mach-Zehnder type interferometer. It is an experimental challenge in its own right to reduce the classical noise, including suppression of acoustic noise, laser phase noise, laser amplitude noise, and locking the interferometer at the white-light position that corresponds to a nearly zero path-length difference.

To this end, here we report two interferometers. The first one is based on a Mach-Zehnder type, differential interferometer composed of two beams with different frequencies. A long-term stability in phase monitor has been obtained by use of the vibration immune mechanism via subtraction of the interferograms of the two outputs of the differential interferometer. The second one is a ring-type interferometer with an inserted acousto-optic modulator (AOM). It is acoustic noise immune and lock-free in principle. The experiments show that the interferometer is able to reduce the vibration-induced optical phase noise by about 30 dB.

Our results can benefit measurements involving light-atom interaction such as atom interferometers and optical lattices. For instance, it is possible to non-destructively measure Bloch oscillations in optical lattices in real-time with these interferometers, which could help people overcome the low sampling problem in the area of precision measurements or inertial sensing with cold atoms.

16:15-16:45 | Invited Speaker: Jiefei Chen

Associate Professor. Resesarch area include quantum optics and atomic, molecular and optical physics. Winner of 2011 Young Scientist Award in Physical/Mathematical Science, awarded by Hong Kong Institution of Science; 2016 Critical Progress of Optics in China "Temporal Purity and Quantum Interference of Single Photons from Two independent Cold Atomic Ensembles". Representative works include observation of single photon precursor, generation and manipulation of narrowband time-frequency entangled photon pairs. Now serving as a topical editor of Journal of Optical Socienty of America B, in the topic of quantum optics.

----Invited Talk----

Non-Hermitian Quantum Interface Between Photons and Magnons

Abstract—We realize a tunable non-Hermitian beam-splitter for the interference between traveling photonic and localized magnonic modes. The localized magnonic modes are collective atomic coherence, widely used in quantum storage, probabilistic entanglement between atomic sources, atomic sensor, etc. The non-Hermitian magnon-photon beam splitter (MPBS) is achieved by the coherent and incoherent interaction mediated by the excited levels of atoms, which is reconfigurable by adjusting the detuning of excitation. An unconventional correlated interference pattern is observed at the photon and magnon output ports of a hybrid interferometer, which implies the quantum statistics of photons and magnons is altered in such a system.

Our work is based on a three-level atomic system prepared in a magneto-optical trap, applicable to realize interference between a single photon and magnon. Our recent results demonstrate that Hong-Ou-Mandel interference between photons and the stored single quanta of magnons, and the coalescence of the photons and magnons is altered through the beam-splitter-type quantum interface. These results implie a new type of non-Hermitian quantum physics based on atom-light interface, and a potential mechanism to manipulate the quantum information.

16:45-17:15 | Invited Speaker: Keyu Xia

Dr. Keyu Xia was awarded his doctoral degree of ``Optics'' by Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences in 2007. He became a full professor at Nanjing University in China in 2017. He has published more than 40 peer-reviewed papers in journals including Science, Nature Photonics, Science Advances, PRL and PRX etc. His research activities recently concentrate on chiral and nonreciprocal optics. He has proposed the first experimentally feasible approach for optical isolation at the single-photon level, based on chiral cavity and waveguide QED systems. He and co-workers experimentally demonstrated the susceptibility-momentum locking as a new mechanism for building up a chiral quantum optical system and further achieving magnetic-free optical isolation at room temperature. Dr. Xia's works have been reported or reviewed by media and magazines such as Phys.org, Science, Nature, and Nature Photonics.

----Invited Talk----

Non-magnetic optical non-reciprocity via chiral atomic susceptibility

Abstract—Optical non-reciprocal devices allow light to propagate along one direction but isolate the back scattering. The conventional magneto-optical-effect-based non-reciprocal devices are difficult to be integrated on a chip. Achieving non-magnetic optical non-reciprocity is highly desirable for integration photonics. Here, we present non-magnetic optical non-reciprocity by creating chiral susceptiblity in atoms. First, we present a new mechanism of the susceptibility-momentum locking in atoms for realizing non-magnetic optical non-reciprocity. Using this mechanism, we show isolation of a genuine single-

photon pulse. We also propose a method to create chiral cross-Kerr nonlinearity in atoms and use it to bypass dynamic reciprocity in nonlinear optical systems and achieve optical circulators.

17:15-17:45 | Invited Speaker: Cuicui Lu

Cuicui Lu is an associate professor in Beijing Institute of Technology. Her research interests include nanophotonics and topological photonics. She has published 40 papers, including Physical Review Letters, Light: Science & Applications, Advances in Optics and Photonics, Optica, Advanced Optical Materials, etc. She serves as a topical editor of Optics Letters, and a review editor of Frontiers in Physics.

----Invited Talk----

Topological hybrid nanocavity for strong coupling applications

Abstract—Topological photonic nanocavity provides a new platform for realizing nano-photonic devices and studying interaction between light and matter. Here, we propose a topological photonic-plasmonic hybrid nanocavity by assembling a topological two-dimensional photonic crystal corner-state nanocavity and a plasmonic nano-antenna. The hybrid nanocavity has an ultra-high figure of merit Q/V of 1.5×10^6 (λ / n)^(-3), which is two orders more than that of bare topological photonic cavities. The hybrid topological nanocavity design enables to transform a weak-coupling system into a strong-coupling system in topological photonic realm for the first time. Meanwhile, strong coupling and weak coupling can be easily switched in the topological hybrid system by tuning the structure dimension of plamonic nano-antenna. This work provides a method to realize coupling phase transition protected by topology, opens a research direction by combing dielectric topological photonic crystal and metal plasmonics, and has great potential in topological lasers, quantum optics, and integrated photonics.

17:45-18:15 | Invited Speaker: Lingxiao Zhu

Lingxiao Zhu is an associate professor of the College of Intelligence Science and the Quantum Information Interdisciplinary Center at National University of Defense Technology. His current research interests are centered on the quantum sensing based on cold atoms and chip-scale quantum sensor. He was awarded the 2018 Yong Elite Scientists Sponsorship Program by CAST, China.

----Invited Talk----

A dielectric metasurface optical chip for the generation of cold atoms

Abstract—Compact and robust cold atom sources are increasingly important for quantum research, especially for transferring cutting-edge quantum science into practical applications. The Nobel Prize-winning technology, magnetic-optical trap (MOT), is the popular tool to cool and trap atoms. However, the hardware used in conventional MOTs, such as optical and vacuum components, etc., are often bulky and the assembly process is very labour intensive. In this talk, I will present the application of the metasurface optical chip to replace the conventional bulky optical elements used to produce a cold atomic ensemble with a single incident laser beam.

S23: Fiber-Based Technologies and Applications - E

Room: LM103-C | Time: 15:45-18:00

Session Chair: **Huanhuan Liu**, Southern University of Science and Technology, China

15:45-16:15 | Invited Speaker: Lei Zhang

Dr. Lei Zhang is a Professor in College of Optical Science and Engineering, Zhejiang University. He obtained his PhD in analytical chemistry from Zhejiang University in 2006. After 2 years post-doctoral employments in Zhejiang University, he jointed College of Optical Science and Engineering, Zhejiang University in 2008. His research focuses on optical micro/nanofiber sensors, wearable devices, optofluidics, and microfluidics. Prof. Zhang has more than 40 scientific publications in peer-reviewed journals and international conferences.

----Invited Talk----

Micro/Nanofibre Optical Sensors：From light confinement, biosensing to wearable sensing

Abstract—Micro-/nanofibers (MNFs) are optical fibers with diameters close to or below the wavelength of the guided light. These tiny fibers can offer engineerable waveguiding properties including optical confinement, fractional evanescent fields, and surface intensity, which is very attractive to optical sensing on the micro-/nano scale. In this talk, I first introduce the basics of MNF optics and MNF optical sensors from physical and chemical to biological applications. Then, I review and discuss hybrid MNF structures for advanced optical sensing by merging MNFs with functional structures. Thirdly, I introduce the emerging trends in developing MNF-based advanced sensing technology for ultrasensitive and wearable sensors and discuss the future prospects and challenges in this exciting research field.

16:15-16:45 | Invited Speaker: Fei Xu

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. His current research interests include developing novel fiber devices for ultra-small sensor, laser and imaging systems.

----Invited Talk----

Flexible Microfiber Sensors for Health Monitoring

Abstract—These attachable and flexible smart devices connected to human skin for the continuous and close monitoring of an individual's activities are commonly considered as essential components in the next generation of human-portable devices for remote diagnosis and treatment. Silica-fiber-based sensors have the advantage of being small, electrically isolated, immune to electromagnetic fields, and easily incorporated into networks. However, only few of them were used for monitoring physiological signals directly, due to their limited sensitivity, size, comfort, and safety. In this work, we will report our research on flexible microfiber devices with ultra-high sensitivity and miniature size, and their applications on real-time health monitoring of not only the human body but also living cell.

16:45-17:15 | Invited Speaker: Changyuan Yu

Changyuan YU received his Ph.D. in Electrical Engineering from the University of Southern California, USA in 2005. He was a visiting researcher at NEC Labs America in Princeton, USA in 2005. He then 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, where he is now a full professor in Department of Electronic and Information Engineering, while 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, 500+ journal and conference papers (90 keynote/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.

----Invited Talk----

Optical Sensor Based on Ring Core Fiber

Abstract—We report our recent research of optical sensor based on ring core fiber for temperature and refractive index (RI) sensing.

17:15-17:30 | G2945

Intra-cavity HOM in dissipative soliton resonance with 3 W average power

Longtao Wang, Linping Teng, Jiangtao Xu, Xianglong Zeng

Shanghai University, China

Abstract—We proposed a scheme of high power intra-cavity high order modes (HOMs) in a compact Er:Yb co-doped double-clad fiber laser based on a long period fiber grating (LPFG) and achieved mode-locked pulses in dissipative soliton resonance (DSR) regime with 3 W average output power.

17:30-17:45 | G2939

Theoretical Analysis for TFG in FMF Based on VCM

Yuze Dai, Zhijun Yan, Qingguo Song, Xiangpeng Xiao

Huazhong University of Science and Technology, China

Abstract—We have promoted the conclusion of single mode tilted fiber grating into the multi-mode condition theoretically. The change of the vector potential in volume current method has been given. Moreover, using the 3-D phase matching condition, we have analyzed and simulated the longitudinal outgoing angle of the radiant mode on condition that the incident light is high-order mode

17:45-18:00 | G29127

An In-fiber Optical Antenna Based on 45° Tiled Fiber Grating

Qingguo Song, Xiangpeng Xiao,Yuze dai, Qizhen Sun, Chen Liu, Zhijun Yan.

Huazhong University of Science and Technology Wuhan, China

Abstract—we have proposed an in-fiber optical antenna, which is based on a structure of 45° titled fiber grating (TFG). The receiving characteristics is numerically and experimentally analyzed. Using such optical antenna, a spatial wavelength filtering system is built.

S24: Biophotonics and Optical Biomedicine - B

Room: LM104-A | Time: 15:45-17:45

Session Chair: **Changfeng Wu,** Southern University of Science and Technology, China

15:45-16:15 | Invited Speaker: Yiming Li

Yiming Li is an associate professor in the department of Biomedical Engineering at Southern University of Science and Technology. He received his B. Eng. in Biomedical Engineering at Shanghai Jiao Tong university in 2009, his master in Medical Physics at Heidelberg University in 2010, and his PhD in Biophysics at Karlsruhe Institute of Technology in 2015, under the supervision of Prof. Uli Nienhaus. Afterwards, he was an EMBL-EIPOD postdoctoral fellow at European Molecular Biology Laboratory (EMBL, Heidelberg) and a visiting scholar at Yale University (2016-2019). He has published many papers in high-impact international scientific journals, including Nature Methods, ACS Nano. The software he developed earned the first place in the SMLM challenge 2016, the most prestigious software contest in the field. Yiming's research interests include development of cutting-edge 3D super-resolution imaging techniques and their biological applications.

----Invited Talk----

Maximum Information extraction for super-resolution imaging using experimental PSF models

Abstract—Single-molecule localization microscopy (SMLM) such as PALM or STORM achieves nanometer superresolution and has become an important method for structural cell biology. Various extensions of SMLM using two or more detection channels were instrumental for this success, as they greatly increased the information content that can be extracted from the sample. Here we develop a GPU based global fitting algorithm with flexible PSF modeling and parameter sharing to extract maximum information from multi-channel single molecule data. We showed both in simulation and experiment that global fitting can substantially improve the 3D localization precision for biplane, 4Pi-SMLM and color assignment for ratiometric multicolor imaging.

16:15-16:45 | Invited Speaker: Peng Xi

Dr. Peng Xi is a full professor in College of Future Technology, Peking University, China. His research interest is on the development of optical super-resolution microscopy techniques. He has been awarded the National Outstanding Young Scholar. He has published over 80 scientific journal papers on peer-reviewed journals including Nature, Nature Methods, etc., and delivered over 30 keynote/invited talks on international conferences hosted by SPIE and OSA. He is a Senior member of OSA. He is on the editorial board of 5 SCI-indexed journals such as Light: Science and Applications, and Advanced Photonics.

----Invited Talk----

Super-resolution: an adventure on a new dimension

Abstract—Structured illumination microscopy (SIM) brings two-fold resolution improvement over the conventional wide-field microscopy. Here we report polarized SIM (pSIM), which decouples the dipole information and spatial super-resolution in SIM through spatial-angular hyperspace analysis [1]. With a careful inspection of the polarization behavior of the SIM system, pSIM maintains measurement accuracy and sensitivity of the dipole orientation on SIM. We applied pSIM on 2D-SIM, 3D-SIM, or total internal reflection fluorescence (TIRF)-SIM imaging modalities, on a series of biological systems, such as cytoskeleton networks and λ-DNA. Further, we imaged the dynamics of short actin sliding across a myosin-coated surface. More importantly, pSIM reveals the "side-by-side" organization of the actin ring structures in the membrane-associated periodic skeleton of hippocampal neurons. It also images the dipole dynamics of green fluorescent protein-labeled microtubules in live U2OS cells. We further employed the spectral (chemical) information jointly with the polarization information, toward the study of subcellular multi-organelle interactome

16:45-17:15 | Invited Speaker: Xiaolong Liu

Liu Xiaolong, currently is a Professor in biomedical engineering, and the Director of Liver Disease Research Institute at Mengchao Hepatobiliary Hospital of Fujian Medical University. He received the Ph.D. degree in biophysics from Xi'an Jiaotong University, Xi'an, China, in 2008. His current research is focusing on biophotonics and nanomedicine for cancer diagnosis and therapy. He has published more than 100 scientific papers in the world recognized academic journals, including Nature Communications, ACS Nano, Advanced Science, iScience, Small and other journals. He currently is also the adjunct Professor of Xi'an Jiaotong University, Fuzhou University and Chinese Academy of Sciences. He has received the "Alexander von Humboldt fellowship" in 2008, the "Youth top creative talent of Fujian Province" in 2014, and the "Young Scientist Award" of Japanese Cancer Association in 2015.

----Invited Talk----

Fluorescence surgery navigation probes and systems

Abstract—Fluorescent surgery navigation has very important impact in clinical practice , especially for precision surgery , such as clearly indicating surgical margin, showing important blood vessels, finding micro-metastases, planning surgical paths, which are all very crucial for improving the accuracy, safty and thoroughness, especially for tumor resection. Recently, the ICG has been

widely applied in different field of fluorescent surgery navigation, such as hepatic surgery and breast surgery. However, it still suffers from several drawbacks, including: (1) relatively strong background fluorescent signal in NIR-I region; (2) the specificity is not enough, still showing relatively high false positive rate in distinguishing precancerous lesions and tumor lesions, such as it is very difficult to distinguish cirrhosis nodules and micro-metastases; (3) the mechanisms of uptaking and excretion of ICG under pathologic conditions are still not very clear, which significantly limits its clinical applications. Here, we have summarized the clinical avaliable fluorescent probes and systems, their clinical applications and current challenges, as well as possible solutions.

17:15-17:30 | G2980

Circuit-free, optoelectronic sensing of biophysical and biochemical signals based on photon recycling of a micro-LED

He Ding, Guoqing Lv, Zhao Shi, Jian Yang, Yongtian Wang, Xing Sheng
Beijing Institute of Technology, China

Abstract—Conventional bioelectrical sensors and systems integrate multiple power harvesting, signal amplification and data transmission components for wireless biological signal detection. This paper reports that real-time biophysical and biochemical activities can be optically captured using a microscale light-emitting diode (micro-LED), eliminating the need for complicated sensing circuits. Such a thin-film diode-based device simultaneously absorbs and emits photons, enabling wireless power harvesting and signal transmission. Additionally, owing to its strong photon-recycling effects, the photoluminescence (PL) emission of the micro-LED exhibits a superlinear dependence on the external conductance. Taking advantage of these unique mechanisms, instantaneous biophysical signals including galvanic skin response, pressure and temperature, and biochemical signals like ascorbic acid concentration, can be optically monitored, and it demonstrates that such an optoelectronic sensing technique outperforms a traditional tethered, electrically-based sensing circuit, in terms of its footprint, accuracy and sensitivity. We believe that this presented optoelectronic sensing approach could establish promising routes to advanced biological sensors.

S25: AI Photonics & Optoelectronics Technopreneurship

Room: LM104-B | Time: 15:45-18:15

Session Chair: **Mingbin Yu**, Shanghai Institute of Microsystem and Information Technology, China

15:45-16:15 | Invited Speaker: Jianji Dong

Jianji Dong is Professor of Wuhan National Laboratory for Optoelectronics (WNLO), Huazhong University of Science and Technology (HUST), China. He received his PhD degree of Optical Engineering at HUST in 2008. After that, he worked as postdoc at Cambridge University, UK till 2010. From March 2010, he returned to HUST and was promoted as a full professor in 2013. His research interests include integrated microwave photonics, silicon photonics, and photonic computing. He has published more than 100 Journal papers. He was honored the Fund of Excellent Youth Scholar by NSFC, China. He is the editorial member of scientific reports, associate editor of IET Optoelectronics, and executive editor-in-chief of Frontier of Optoelectronics.

----Invited Talk----

Photonic Matrix Computing for Photonic Accelerating and Beyond

Abstract—Matrix computing, as an indispensable operator of information processing in science and engineering, undertakes most of the computation overheads for various signal processing, especially for artificial intelligence algorithms. Accelerating the matrix computing is quite significant with the dramatical increase of information capacity. Photonic matrix computing is an excellent candidate benefited from its superior performance. In recent years, photonic matrix computing has rapidly developed and reveals huge potential for photonic accelerating. Here, we review the methods of photonic matrix computations, and the advances in optical signal processing and artificial neural networks in recent years. We also comment on the perspectives of photonic matrix computing.

16:15-16:45 | Invited Speaker: Wei Ma

Prof. Ma currently is an assistant professor in the College of Information Science and Electronic Engineering, Zhejiang University. He received his Ph.D. degree in Microelectronics from Peking University in 2016, and B.S. degree in Electronics Engineering from Zhejiang University in 2011. He was a post-doctoral researcher in Northeastern University (Boston, USA) from 2016 to 2018. Prof. Ma is dedicated to interdisciplinary research that bridges engineering, optics, applied physics and information science. His research interests include nano-photonics, integrated photonics, machine learning and their application in photonic design. He was one of the first researchers that propose to apply data-driven algorithms in the inverse design of nanophotonic structures, and invented the first opto-mechanical infrared focal plane array with integrated metamaterial absorber. Prof. Ma has authored over 30 research papers in top journals including Nature Photonics, Advanced Materials, ACS Nano, Optics letters and Optics Express, with one ESI highly cited paper and one ESI hot paper.

----Invited Talk----

Complex multi-functional metasurface inverse design based on deep learning

Abstract—Innovative approaches and tools play an important role in shaping the design, characterization and optimization for the field of photonics. As a subset of machine learning that learns multilevel abstraction of data using hierarchically structured layers, deep learning provides an efficient means to design photonic structures, spawning data-driven approaches complementary to conventional physics- and rule-based methods. In this talk, we summarize our recent progress in deep-learning-based photonic design, with a focus on large scale, complex, and multi-functional metasurfaces. Both deterministic model and generative models are presented, with emphasis on either improving the prediction accuracy of optical responses or enhancing the diversity of meta-atom generation. We also provide remarks on the challenges and perspectives of this emerging research direction.

16:45-17:15 | Invited Speaker: Ruijie Zhu

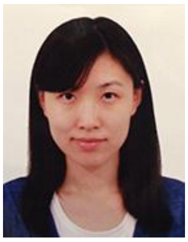
Ruijie Zhu is currently an associate professor in the School of Information Engineering, Zhengzhou University. He received the Ph.D. degree in the State Key Lab of Information Photonics and Optical Communication at Beijing University of Posts and Telecommunications (BUPT), China. He was a visiting scholar at the University of Texas at Dallas under the supervision of Prof. Jason P. Jue. He has authored or coauthored more than 50 technical papers. His research interests include F5G networks, satellite communication networks, network virtualization, and machine learning.

----Invited Talk----

Deep Reinforced Virtual Network Embedding for 6G Satellite Networks

Abstract—By enabling global Internet access and providing stable communication quality, satellite networks have been the essential part of 6G mobile communication networks. However, limited by onboard processing ability and scarcity of resources, it is challenging for satellite networks to deal with increasing services. As the core technology of network virtualization, virtual network embedding (VNE) is a promising technology to achieve efficient resource assignment and flexible network management. However, the majority of existing embedding approaches are based on terrestrial networks, which fail to adapt to high dynamics and specific constraints of satellite networks. In this paper, we first design a regional satellite network to provide better coverage for those regions with more data traffic services. Based on the regional satellite network, a load-balanced virtual network embedding algorithm based on deep reinforcement learning (DRL-LBVNE) is proposed. The DRL-LBVNE algorithm comprehensively considers the load parameters and resource constraints of satellite nodes and links to reduce the probability of mapping failure. Simulation results prove that DRL-LBVNE performs better than three state-of-art algorithms and shows excellent adaptability to satellite networks.

17:15-17:45 | Invited Speaker: Na Ni



Na Ni is an Associate Research Professor of Center of Adaptive System Engineering in ShanghaiTech University, China. She obtained Ph.D. degree from Network Technology Research Center, Nanyang Technology University (NTU) in Singapore. From 2009-2010, she worked as a research associate in A*Star Institute of Infocomm Research. From 2010 to 2019, she was an architect in GE Global Research Center Shanghai. Her research directions include computer vision, artificial intelligence, optical inspection and data management. She has published more than 30 SCI publications and has two authorized international patents.

----Invited Talk----

Blade 3D Profile Scanning Equipment

Abstract—The geometric accuracy and consistency of airfoil and gas turbine blades are critical to the engine performance and fuel efficiency. At present, Coordinate Measuring Machine (CMM) is usually used to inspect blades, which has low measurement efficiency, high cost, and cannot realize on-site inspection.

For the actual needs in blade production, high-accurate blade 3D profile scanning equipment is developed, which can realize the simultaneous measurement of the inlet and outlet edges of compressor and turbine blades as well as the blade body profile. Compared with the CMM, this equipment is insensitive to the vibration environment. This small-size equipment can be directly applied to the workshop, and can be applied to the on-site inspection and quality final inspection of blade manufacturing.

17:45-18:15 | Invited Speaker: Zhenming Yu

Zhenming Yu received the B.Eng. degree and in electronic science and technology, M. Eng. degree in optical engineering from the University of Electronic Science and Technology of China (UESTC), Chengdu, China, in 2011 and 2014 and the Ph.D. degree in electronic science and technology from Tsinghua University, Beijing, China, in 2018, respectively. He is currently working as an associate researcher fellow invited specially in the State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Posts and Telecommunications. His current research interests are fiber optic imaging system, optical and digital signal processing for coherent and direct-detection optical communication.

He has published over 30 journal and international conference papers. He was a recipient of SPIE Optics and Photonics Education Scholarship, IEEE Photonics Society Graduate Student Fellowship, National Scholarship for PhD Candidates of Tsinghua University and First prize of ZTE pengyue Algorithm Elite Challenge. He is the reviewer of IEEE/OSA Journal of Lightwave Technology, IEEE Photonics Journal, Chinese Optics Letters.

----Invited Talk----

Multimode fiber imaging and spectral imaging based on deep learning

Abstract—Multimode fiber (MMF) based endoscopy could reach high resolution and is fine enough for vivo imaging. However, the received images are speckles due to the mode crosstalk and sensitivity to environment of MMF, which makes image reconstruction the main challenge. In this report, a conditional generative adversarial network (GAN) composed of a generator and a discriminator is utilized to reconstruct the received speckles. This conditional GAN could reconstruct images with fewer training datasets to achieve the same performance and shows higher feature extraction capability. In addition, Hyperspectral imaging technology is an imaging technology that simultaneously measures two-dimensional space images and one-dimensional spectral information, which has been widely used in remote sensing, food inspection, medical diagnosis, aerospace and other fields. Traditional spectral imaging systems use scanning technology to obtain three-dimensional information of images and spectra, which have slow acquisition speed, low resolution, high system complexity and high cost. This report studies a single-exposure hyperspectral imaging system that uses compression imaging technology to compress and collect spectral images to obtain two-dimensional observations, and finally reconstruct spatial and spectral three-dimensional images based on deep learning.

S26: Liquid Crystal Photonics - B

Room: LM104-C | Time: 15:45-17:30

Session Chair: **Wei Hu,** Nanjing University, China

15:45-16:15 | Invited Speaker: Jiu-an Lv

Dr. Jiu-an Lv received his B. Sc. and M.S. degrees in the department of chemistry from northwest university, China, in 2005 and 2008, respectively. After that, he served as a process engineer at the China aerospace science and technology corporation for three years. In 2011, he began to study liquid crystal polymer materials at Fudan university and obtained Ph. D degree in 2016. Then he worked in the department of Materials in Fudan University as a postdoctoral researcher between 2016 and 2018. He jointed Westlake University as an Assistant Professor in March, 2018.

----Invited Talk----

Phototunable Self-Oscillating Systems

Abstract—Self-oscillating systems that enable autonomous, continuous motions driven by an unchanging, constant stimulus have great potential to make transformative impacts on intelligent machines, advanced robotics, and biomedical devices. Despite efforts to gain self-oscillations have been made through artificial systems using responsive soft materials of gels or liquid crystal polymers, these systems are plagued with problems that restrict their practical applicability: few available oscillation modes due to limited degrees of freedom, inability to control the evolution between different modes, and failure under loading. Here we present a phototunable self-oscillating system that possesses a broad range of oscillation modes, controllable evolution between diverse modes, and loading capability. This self-oscillating system is driven by a photoactive self-winding fiber actuator designed and prepared through a twistless strategy inspired by the helix formation of plant-tendrils, which endows the system with high degrees of freedom. It enables not only controllable generation of three basic self-oscillations but also production of diverse complex oscillatory motions. Moreover, it can work continuously over 1270000 cycles without obvious fatigue, exhibiting high robustness. We envision that this system with controllable self-oscillations, loading capability, and mechanical robustness will be useful in sophisticate autonomous devices and systems, autonomous extraction of energy from solar irradiation, compact wireless scanners, and beyond.

16:15-16:45 | Invited Speaker: Huai Yang

Huai Yang is currently a tenured Professor of College of Engineering, Peking University, where he is also Professor of Cheung Kong Scholars of Ministry of Education of China, Winner of China National Funds for Distinguished Young Scientists, Fellow of the Royal Society of Chemistry (FRSC), and Chief scientist of the National Key R&D Program of China "Key Technology and Support Platform of Material Genetic Engineering". He received his Ph.D. in Engineering from Kyushu University in Japan, where he successively served as a Visiting Research Fellow in Faculty of Engineering, Kyushu University, Japan. He was a Research fellow in Fukuoka Industry, Science and Technology Foundation, as well as Science and Technology Corporation in Japan (1996-2003). He successively served as Professor, Doctoral Supervisor, Jianlong Chair Professor, Tenured Professor, and vice-dean of School of Materials Science and Engineering, University of Science and Technology Beijing (2003-2010). At present, Prof. Huai Yang have published more than 290 papers in international academic journals such as Nat. Mater., Adv. Mater., Angew. Chem. Int. Ed, Adv. Energy Mater., Adv. Funct. Mater.; He have applied more than 130 patents, and over 60 patents of have been issued. He also served as Associate Editor of Journal of Information Display, and Editorial Member of Materials Chemistry Frontiers, Liquid Crystals, and Liquid crystal and display, etc; Managing director of the first session of the council of Polymer materials and engineering branch of China materials research institute, Vice President of China Innovation Alliance of New Materials Industry, Member of China Optics and Optoelectronics Manufactures Association (COEMA) Liquid

Crystal Branch (LCB).

----Invited Talk----

Responsive photonic crystal with tunable bandgap based on self-organized cholesteric liquid crystals

Abstract—Dynamic self-organized cholesteric liquid crystals (CLCs)have selective reflection at specific wavelength. The reflected light was circularly polarized due to the helical superstructures and the handedness of the reflection was dependent on the CLC matrix. These fascinating properties enables the CLC promising in fabricating reconfigurable and multifunctional photonics for diverse applications.

By incoporating light-responsive chiral molecules with the liquid crystal matrix, responsive photonic crystals with light-modulated photonic bandgap was achieved due to the alteration of the helical superstructure. Based on the functional liquid crystal photonic crystals, optical devices like circularly polarized light reflectors and dynamic diffraction grating were realized. Furthermore, we proceeded the research by polymerizing liquid crystal monomers into coating or freestanding polymer film. The CLC film was sensitive to the environmental humidity. The film shows vivid color changes under different humidity. It was found that the functionalities like fluorescence could be integrated with the self-organized superstructure, providing new opportunities to explore novel liquid crystal-based photonic devices.

16:45-17:15 | Invited Speaker: Pengcheng Lin

Dr Pengcheng Lin is an associate professor in Guangdong Provincial Key Laboratory on Functional Soft Condensed Matter (Guangdong University of Technology). He received his PhD degree in Polymer Chemistry and Physics from Northeastern University in 2016. He worked as a visiting scholar in City University of Hong Kong from 2018 to 2019. His research interests include molecular liquid crystals and colloidal liquid crystals.

----Invited Talk----

Multiple Stimuli-Responsive Behaviors of Molecular Liquid Crystals and Colloidal Liquid Crystals

Abstract—In recent years, the research on the stimulus response behaviors of liquid crystals has been in the forefront of science. Light, heat, electricity, magnetism and shearing can be used to control the microstructure and macroscopic properties of liquid crystals. We prepared a series of novel molecular liquid crystals and colloidal liquid crystals by chemical synthesis, analyzed their self-assembly conditions and phase diagrams, and studied their response behaviors and mechanisms in thermal, electrical and magnetic fields.

17:15-17:30 | G2969

Theoretical analysis on high power threshold of LCOPA with micro-channel heat sinks

Xiaoxian He, Mingfeng Li, Zhiqing Liang, Xiangru Wang

University Of Electronic Science and Technology Of China, China

Abstract—The liquid crystal optical phased array (LCOPA), with low SWaP (size, weight and power consumption), has been widely researched in laser communication, laser radar, laser guidance, laser weapons and many other application scenarios. As the number of laser paths increases, the laser power density also increases, such as multi-beam control ("one-to-many") and laser beam combining ("many-to-one"), it is imperative to study the high power threshold of LCOPA.

To solve the heat problem induced by high power laser of LCOPA, in this paper, we proposed a transparent high power threshold of LCOPA with micro-channel heat sinks. A high thermal conductivity and transparent (to 1064nm light) Boron compounds material was used to compose the micro-channel heat sinks. Heat on LCOPA was carried away through the circulation of the index matching fluid in micro-channel. Several typical factors (micro-channel structure parameter, cooling index matching fluid rate and substrate material parameter) are analyzed to evaluate the influence of phase distortion when a relative high power laser is pumped into the LCOPA. Typically, the optical turbulence caused by micro-channel heat sinks with cooling fluid was considered in simulation. When the incident laser power is 500W, and the total absorption is 5%, the flow rate is 1.5 m/s, the laser induced beam quality deterioration on the LC layer is less than 15% under the condition of the width and depth of micro channels are 250 m.

S27: Photophysics of Structured Materials for Nanophotonics - B
Room: LM105 | Time: 15:45-18:15

Session Chair: **Dehui Li**, Huazhong University of Science and Technology, China

15:45-16:15 | Invited Speaker: Jiaji Cheng

Dr. Jiaji Cheng's background spans physical, inorganic, analytical, and computational chemistry, quantum materials, and chiroptics. He received his Ph.D. with distinction at Université de Bordeaux in 2015 focusing on chiral inorganic assemblies and nanophotonics. Afterwards, he went to Institut de Chimie de la Matière Condensée de Bordeaux as a postdoc researcher studying on hierarchical nanomaterials with chiroptical properties. Then he jointed Hubei University as an associate professor in 2019 and selected as "Chutian Young Talents" and "Hundred Talents" program in Hubei province. He has broad, multi-disciplinary interests of nanophotonics, chiral plasmonics, non-linear and ultrafast optics in hierarchical chiral nanomaterials.

----Invited Talk----

Multiscale Chiral Inorganic Nanomaterials

Abstract—"Chirality" is not a privilege only for organic chemistry. Anything in nature that is chiral if it is distinguishable from its mirror image and it has great impact in area of biochemistry, organic chemistry, stereo-catalysis, and pharmaceutics. In recent year, chiral inorganic nanomaterials such as chiral noble metals, semiconductors and carbon-based materials has been developed rapidly with broad applications in optical polarization, negative refractive index and biomedicals. Typically, chirality in inorganic nanomaterials can be originated from: 1) intrinsic chiral crystals such as dislocations and defects; 2) chiral assemblies of achiral nanoparticles or chiral morphologies at subwavelength scale; 3) chiral interactions between achiral nanoparticles and chiral organic molecules. Herein, this report will discuss recent investigations on above mentioned multiscale chirality discovered by Cheng's group as so to unveil the structure-activity relationship of chiral maters and provide a fundamental frontier for multiscale chiral inorganic materials design.

16:15-16:45 | Invited Speaker: He Huang

He Huang, male, professor, graduated from the Department of Physics and Materials Science, City University of Hong Kong in 2017, under the supervision of Prof Andrey Rogach. After graduating from his Ph.D., he worked as a postdoc in Prof. Jochen Feldmann's group in University of Munich, Germany for 3 years. Joined Soochow University in March 2021. During the post-doctoral period, he got the EU Marie Curie Fellowship. He published more than 30 articles in the field of nanomaterials (14 first or corresponding author articles, including Nat Commun, 3 Angew Chem, Mater Today, Adv Sci, Chem Mater, etc.), with a total of more than 3500 citations with H-index 22. Research fields: synthesis and control of nanomaterials, in-situ and ex-situ monitoring, mechanism exploration, and new nanomaterial devices and applications based on perovskite.

----Invited Talk----

Perovskite Nanocrystals: From Synthesis to Applications

Abstract—Metal halide perovskites have attracted substantial interest due to their promising properties for optoelectronic applications.

At the end of 2014 when I started my PhD, I convinced Prof. Andrey Rogach to look into chemical ways to produce light-emitting perovskite nanocrystals – before that such kind of perovskites has been mostly used as thin films for solar cell applications. This initiated a new topic in the group. My journey started as we tuned the size of perovskite nanocrystals in 2015 in Adv. Sci. After that, we further reported water-resistant coating with polyhedral oligomeric silsesquioxane which was the very first time. I am always fascinated by the formation of such material. They are really forming so fast which made me especially want to explore the process. At first, we tried to change the reaction conditions and summarize the final product's properties to get some clues on the formation mechanisms of perovskite nanocrystals. Indeed, I am not satisfied with such guesses. I got the idea that maybe we can separate the precursors at two ends of a container and employ an indirect heating source to slow down the reaction and get intermediate particles for better understandings. During my postdoc as Marie Curie Fellow, I go one step more. Instead of slow down the reaction, I designed a homemade real-time in situ PL detection setup, which allows me to get full PL spectra every 100 ms. This will enable me to track the PL evaluation during the synthesis. I also use the knowledge obtained by understanding the formation mechanism to design a new synthetic method – top-down synthesis of perovskite nanocrystals.[7] On the applications, I have tried mainly light-emitting devices.

My journal continues as I joined school of optoelectronic science and engineering, Soochow university earlier this year. I am excited to extend perovskite nanocrystals to applications with enhanced stability.

16:45-17:15 | Invited Speaker: Jun Wang

Jun Wang is a professor with Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences (CAS). He obtained the PhD degree from the Chinese University of Hong Kong in 2006. Then he was granted an IRCSET postdoctoral fellowship and worked at Trinity College Dublin, Ireland. In 2011, he relocated his research activities to SIOM under the financial support from the 100-Talent Program of CAS. In 2018 and 2015, he was awarded by the National 10000-Talent Program and National Natural Science Foundation-Outstanding Youth Foundation, respectively. His research interests are focused on nonlinear optics in low-dimensional materials. So far, he has published more than 180 peer-reviewed SCI journal papers in Nature Nanotech., Prog. Mater. Sci., Adv. Mater., Nature Commun., ACS Nano, Laser Photon. Rev., etc., including 9 ESI papers and having over 7000 citations.

----Invited Talk----

Nonlinear optical effects and applications of two-dimensional semiconductors

Abstract—Nonlinear optical materials are the core materials in laser optical systems (such as ultra-short laser systems, lidar, etc.) and integrated optoelectronic devices (such as optical switches, optical modulators, etc.). With excellent nonlinear optical characteristics, low dimensional semiconductor materials have unique advantages in physical properties, integration and compatibility, which is one key to build a high-performance optoelectronic information system. We have systematically studied the third-order nonlinear optical properties of transition metal dichalcogenides, graphene, black phosphorus and other important two-dimensional semiconductors. We verified the broadband nonlinear absorption and the bandgap controlled nonlinear refractive index dispersion effect of transition metal dichalcogenides, realized the modulation of nonlinear optical characteristics, observed the dark exciton resonance induced giant two-photon absorption effect in monolayer MoS2. Self-phase modulation effect, nonlinear refractive index dispersion, optical characteristic matrix, optically induced transparency, fast/slow saturation absorption effect, all-optical switch modulation and optical limiting effect, two-photon absorption saturation effect, defect modulated nonlinear response, stimulated brillouin scattering, etc. have been observed in two-dimensional semiconductors. And their important applications in high intensity laser protection optical limiter and ultrashort mode-locked pulse laser have been verified. These results construct a good experimental and theoretical foundation for understanding the nonlinear optical mechanism of two-dimensional semiconductors and developing high-performance nonlinear optical devices.

17:15-17:45 | Invited Speaker: Dehui Li

Professor Li, received his B. S. degree in 2006 from Xi'an Jiaotong University (Xi'an, China), and his M. S. degree in 2009 from Institute of Modern Physics, Chinese Academy of Sciences (Lanzhou, China), and his Ph. D. degree in 2013 from Nanyang Technological University (Singapore). He worked in University of California, Los Angeles as postdoctoral fellow for three years and then joined Huazhong university of Science and Technology as a professor in 2016. He has published more than 50 peer-reviewed papers (including Nature, Nature Communications and Science Advances et al.). His current research focuses on rational design and synthesis of functional semiconducting nanomaterials and heterostructures, systematic investigations on their physical properties and exploring their potential applications in nanoelectronics and nanophotonic such as field-effect transistor, photodetectors and light-emitting devices.

----Invited Talk----

2D Perovskite/Transition Metal Dichalcogenides Heterostructures for Optoelectronic Applications

Abstract—Two-dimensional organic-inorganic hybrid perovskite exhibits excellent performances in the fields of light-emitting and excitonic devices due to the tunable band gap, large exciton binding energy and layered characteristics. Benefiting from its layered characteristics, stacking with other layered materials such as transition metal chalcogenide to form heterostructures can greatly expand its functionalities. I will first introduce interlayer excitons in the two-dimensional perovskite/monolayer layer transition metal chalcogenide heterostructures. Compared with interlayer excitons in the transition metal chalcogenide heterobilayers, the one in two-dimensional perovskite/monolayer layer transition metal chalcogenide heterojunctions can observe stronger photoluminescence without considering the stacking angle and post-annealing treatment. More importantly, if replacing the two-dimensional perovskite with a chiral two-dimensional perovskite possessing spin polarization, the valley degree of freedom of the interlayer excitons can be effectively manipulated. Next, I will talk stacking chiral two-dimensional perovskites and monolayer transition metal chalcogenides to form heterostructures to achieve efficient spin injection without an external magnetic field, thereby achieving valley freedom control. Our study will give impetus into the development of excitonic devices and valleytronic devices based on two-dimensional perovskites and transition metal chalcogenides.

17:45-18:15 | Invited Speaker: Zhaogang Nie

Dr. Nie Zhaogang obtained his Ph.D. in condensed matter physics at Changchun Institute of Optics, Chinese Academy of Sciences in 2007. Between 2010 and 2016, he joined the University of Electro-Communications in Japan and Nanyang Technology University in Singapore in succession for postdoctoral research. In 2016, He joined the Guangdong University of Technology as a special engaged professor. His current research interest is nonlinear optical properties and ultrafast carrier dynamics in novel optoelectronic materials and devices.

----Invited Talk----

Ultrafast Carrier Relaxation Dynamics in Two-dimensional Transition Metal Dichalcogenides and their

Heterostructures

Abstract—Two-dimensional transition metal dichalcogenides (TMDs) and their vdW heterostructures have recently emerged as promising candidates for atomically thin semiconducting electronic and optoelectronic materials. Their applications necessitate a detailed understanding of their fundamental carrier dynamics. In this work, femtosecond transient absorption spectroscopy has been employed to unravel the ultrafast carrier nonradiative dynamics in mono- and few-layer TMDs and their vdW heterostructures. The transient experiments provide the direct observation of carrier thermalization, carrier transfer, carrier cooling and band-gap energy evolutions induced by many-body interactions. The carreir-carrier and carrier-phonon scatterings along with the carrier relaxation and charge transfer were studied by pump fluence and sample temperature dependence measurements. These findings are significant for understanding the basic physics of carrier scattering, and also for the development of flexible optoelectronic devices.

Poster Session | 15:30-17:30

Poster | G29114

Proposal of Pulse Compression Brillouin Optical Time Domain Reflectometry

Pengbai Xu, Chao Pang, Yongkang Dong, Xinyong Dong, Jun Yang, Yuwen Qin
GuangDong University of Technology, China

Abstract—We propose pulse compression assisted Brillouin optical time-domain reflectometry, which is an intrinsic one-end-injection system that exhibits high spatial resolution, long sensing range, high measurement speed, and may pave the way for various BOTDR applications.

Poster | G29154

Interfacial Modification by Ionic Liquid for High Efficiency Blue Perovskite Light-Emitting Diodes

Jiayun Sun, Zhenwei Ren, Wallace C.H. Choy, Kai Wang
Southern University of Science and Technology, China

Abstract—Metal halide perovskites are rinsing significant interest due to their promising optoelectrical properties. In perovskite light-emitting diodes (PeLEDs), defects induced non-radiative recombination and poor interface contact at the surface of perovskite films limit the further improvement of device performance. In this work, a bifunctional ionic liquid is introduced to passivate surface defects and enhance interfacial contact simultaneously. Imidazolium cations and hexafluorophosphate anions can effectively passivate halide vacancies, while the contact of the perovskite/electron carrier transport layer interface is enhanced by filling the voids or pin-holes with ionic liquid. With optimization, we improved the performance of blue quasi-two-dimensional PeLEDs (emission peak at 490 nm) with the external quantum efficiency of 5.4% from 4.2%, a maximum luminance of 431 cd m-2 from 322 cd m-2. This work contributes a new type of interfacial modification for high-efficiency blue PeLEDs.

Poster | G29131

Multispectral single-photon detection and imaging

Heqing Wang, Hao Li
Shenzhen University, China

Abstract—Leveraging the optical cavity and ultrasensitive photon response of ultrathin superconducting nanowires has produced superconducting-nanowire single-photon detectors (SNSPDs) with detection efficiency close to unity, thereby enabling numerous applications such as detection-loophole-free local-realism test and quantum random-number generator. However, the wideband response of superconducting nanowire is far less developed because of the resonant effect of the optical cavity. Here, we report multispectral SNSPDs that can simultaneously and efficiently detect single photons in multiple well-separated wavelengths. The detector is fabricated based on a modulated film stack with a thickness-modulation period of two bilayers. The detector exhibits system detection efficiencies over 80% at wavelengths efficiencies of 75.0% at 505 nm, 610 nm, 80.0% at 1030 nm, and 85.0% at 1550 nm. Moreover, a multispectral single photon detector array is demonstrated, a photon number reconstruction experiment is performed with the four-pixel array, and inversion of the input photon number is achieved at the wavelengths of 505 nm, 1030 nm, and 1550 nm with an error of less than 5%. The present multispectral detector and array enrich the available optical architectures and detector types and may have interesting uses for multispectral applications such as multispectral ranging or imaging.

Poster | G2989

Preparation of Erbium-Ytterbium co-doped Muliti-Core Microstructured Fiber

Zengyi Wang, Shizhuo Xi, Jiantao Liu, Guiyao Zhou
South China Normal Universit, China

Abstract—Active fiber plays an vital role in optical communication because the Erbium-Ytterbium co-doped can improve the absorption efficiency of the pump laser. In this paper, we optimized the concentration of Er^{3+}/Yb^{3+} doping in silica glass. We have been prepared the Er^{3+} -Yb^{3+} codoped silica glasses with Al_2O_3-R_2O_3 co-doped system by Non-Chemical Vapor Deposition (Non-CVD) technology, the concentration of Er^{3+} is 3000ppm, and that of Yb^{3+} is 4500ppm. After the glasses processed to the appropriate size, the multi-core microstructured fiber was successfully prepared by the arrangement-drawing method. This fiber has excellent optical properties. It lays a foundation for providing ideal active fiber for future spatial division multiplexing optical communication systems.

Poster | G2990

Irradiated Fiber Based Multi-points Temperature sensors

Haoshi Zhang, Jing Jin, Ningfang Song, Zhizhong Jin
Beihang University, China

Abstract—Power transformer is an important equipment for power system. When the voltage level and capacity in the transformer is increasing, the local temperature is too high, seriously threat the safe operation of power system. Therefore, temperature monitoring in power system is very important. Being immunity to electromagnetic interference, large body of research has been undertaken on fiber-optic temperature sensors, such as distributed temperature sensors (DTS) with Raman scattering and Brillouin scattering, point temperature sensors based on fiber Bragg gratings (FBGs). In the most cases, only some key points in the power system need to be monitored. However, when FBGs based temperature sensors used for multi-points sensing, it is not easy to arrange the sensing line structure as all the sensing points are on one fiber, besides, protection of the

sensing point is also difficult.
According to our previous research, fibers with differnt dopants can be used for temperature sensing after irradiation and sufficient annealing. The radiation induced attenuation (RIA) resulting from color center absorption are temperature dependent according to configurational coordinate model. We have proposed a distributed temperature sensing system based on Rayleigh scattering in irradiated Ge/P co-doped fiber. However, the sensing fiber used is not easily available and cost-efficient compare to commercial single mode fiber (SMF). Then, we studied the RIA of off-the-shelf SMF for temperature sensing. The principle of the sensing system was interpreted by the temperature dependence of color center absorption. Now, for the power system use, we proposed multi-points temperature sensors based on irradiated optic fibers. It can be 3 channels, 7 channels, 15 channels, and all the channels are separately connected to a sensing head.
For one sensing head, standard commercial SMF-28e was selected to be investigated after 10kGy gamma ray irradiation. Thus, temperature sensors work at 980nm were studied. The temperature sensing setup is established and has been used to measure the attenuation of the fiber in a temperature-controlled chamber. Temperature was measured by PT100 platinum resistance thermometer. F1 and F2 are 100m irradiated and 600m pristine fiber coils. A 980nm laser was used to launch light into the coupler. The output was detected by multi-channel optical power meter.
Temperature tests were conducted at the range of -40°C~150°C, and the test results are linearly fitted. The result shows that temperature sensitivity in F1 is 0.02234mW/°C, which is ~20 times greater than that in F2. Given the laser power fluctuated within 50uW, the sensing resolution can reach 0.0026°C. The nonlinearity error is ±2.31%. These experimental results suggest that it is feasible to utilize RIA in irradiated SMF for temperature sensing after sufficient thermal annealing.

Poster | G29119

Recovering the hidden photon bunching from two-photon absorption based on polarization modulation

Sheng Luo, Wanting Xu, Yu Zhou, Yuchen He, Huaibin Zheng
Xi'an Jiaotong University, China

Abstract—The polarization modulation is employed to recover the hidden photon bunching effect of broadband chaotic light at ultrashort timescale based on two-photon absorption detector. Not only the hidden second-order coherence function in the two-photon absorption counting can be obtained, but also the disappeared two-photon interference pattern based on two-photon absorption detection can be recovered. In theory, polarization matrix and two-photon interference probability amplitudes matrix are combined to develop polarized two-photon interference terms, which is in good agreement with the experimental results. The proposed method may help to develop future optical interferometry, optical polarimetry.

Poster | G29152

A pulse-width-tunable continuously, actively mode-locked fiber laser based on Brillouin scattering using compact Brillouin/erbium fiber ring cavity

Hongxu Liu, Mo Chen, Xiaoyang Hu, Zhou Meng
National University of Defense Technology, China

Abstract—A pulse-width-tunable continuously fiber laser is demonstrated in a 11.8m compact Brillouin/erbium fiber ring cavity based on actively mode-locked, only by changing the Brillouin pump power. In the experiment, the width of mode#locked pulse can be adjusted continuously from 5ns to 30.6ns at 16.9MHz repetition rate, when the Brillouin pump power is adjusted from 12mW to 2.5mW. This actively mode-locked laser with continuously tunable-pulse-width is promising in the fields such as optical fiber sensing and communication.

Poster | G2987

A non-mechanical four channel liquid crystal beam steering device

Zhiqing Liang, Xiaoxian He, Xiangru Wang
University Of Electronic Science And Technology Of China, China

Abstract—We proposed a liquid crystal beam steering device with four channel capability in the field of laser communication. The device is composed by a coarse tracking device using liquid crystal polarization grating(LCPG) and a fine tracking device using liquid crystal optical phased array(LCOPA). For coarse tracking procedure, sixteen discrete angles (from -11.25°to 11.25°by step of 1.5°) are controlled by four cascaded LCPG with different angles (±0.75°、±1.5°、±3° and ±6°). An active liquid crystal half wave plate is interposed between two LCPGs, which provides the left and right-hand circular polarization conversion to realize the positive and negative angles switch. The domain field of discrete angles are filled by LCOPA, which equipped with the beam steering precision of 10≠rad.
The total optical aperture of this liquid crystal optical device is 80 mm × 80 mm, which is arranged by 2×2 sub-apertures, each of which is for single wavelength beam occupying the 40 mm × 40mm squared aperture. The configurable wavelength of user terminal can range from visible light to near infrared. For the application of laser communication, we designed the wavelength of the four beams as 1530 nm, 1540 nm, 1550 nm and 1560 nm, respectively. And the polarization states of adjacent beams are orthogonal with each to avoid the optical interference. We test the steering capability of this device. The repeated deflection error of the beam is less than 2urad, and the response time of the device is 15-25ms. The parameters of wavefront distortion, diffraction efficiency and insertion loss are also measured.

Poster | G29109

A Method for Improving the Performance of Fiber-Optic Acceleration Sensors by Adjusting the Prestress

Jiaran Liu, Xuqiang Wu, Wujun Zhang, Shengquan Mu, Cheng Zuo, Jianmin Chen
Anhui University, China

Abstract—A method is proposed to improve the performance of a compliant-cylinder-based fiber-optic acceleration sensor by adjusting the prestress of the elastic mechanism in the sensor. In the experiment, an adjustable torque can be applied through the nut to study the effect of prestress on the sensor. The experimental results show that by applying a certain prestress to the sensing structure, the operating bandwidth of the sensor can be changed effectively. By adjusting the prestress applied to the elastic mechanism, the sensor can achieve the required performance, and the consistency of the performance of the sensor in a large multiplexed array can be improved.

Poster | G29105

High-Sensitivity Temperature Sensor Based on Vernier-effect and cascaded polarization mode interferometers

Xiaonan Zhao, Cheng Zuo, Xuqiang Wu, Jianmin Cheng, Jinhui Shi, Wujun Zhang, Benli Yu
Anhui University, China

Abstract—In this paper, a highly sensitive fiber optic temperature sensor (FOTS) based on two cascaded polarization mode interferometers (PMIs) cascaded is proposed and experimentally demonstrated. One PMI is fabricated by splicing a polarization-maintaining fiber (PMF) with a polarizer by an angle of 45-degree of polarization axes, which is applied as a reference interferometer (RI). The other PMI is constituted by splicing a PMF with the former PMI by an angle of 45-degree of polarization axes, which is used as a sensing interferometer (SI). The end face of the SI is well cleaved, which has a 4% end face reflection. The Vernier effect is generated by controlling the FSR of SI through the PMF length. Experimental results show that the temperature sensitivity of the cascaded sensor can reach 19.067 nm/°C, which is 15.376 times of that of the single SI. The sensor has the advantages of high sensitivity, simple fabrication, and good stability, which has a potential application prospect in aerospace and industrial production.

Poster | G2941

Reconstruction-free Image Segmentation with Single-pixel Imaging and Deep Learning

Shuming Jiao, Wei Huang, Zhuopeng Li
Peng Cheng Laboratory, China

Abstract—In single-pixel imaging (or computational ghost imaging), the object is sequentially illuminated by structured light patterns and the total light intensity of the object scene at each time is recorded as an intensity value by a single-pixel detector. After many illuminations with different patterns, the detector will record a single-pixel intensity sequence. Finally, the object image can be computationally reconstructed when both the illumination patterns and the single-pixel intensity sequence are known. Different from a conventional camera with pixelated sensor array, the senor in single-pixel imaging only has one single pixel. Single-pixel imaging has some unique advantages such as low sensor cost in some invisible wavebands (e.g. infrared, Terahertz and X-ray), imaging in extreme conditions and capturing multi-dimensional light field information.

Image segmentation is a digital image processing technique focusing on partitioning an image into different parts according to their features and properties. Image segmentation has many applications in medical imaging, self-driving cars and security monitoring. Conventionally, an image with good fidelity is captured first and image segmentation is then performed. However, under the framework of single-pixel imaging, we attempt to perform image segmentation without actually recording the whole image information. Only a small number of single-pixel values are recorded at a very low sampling ratio, which is inadequate for image reconstruction. The illumination patterns are optimized by a deep neural network and some critical features in the object image can be extracted in the single-pixel imaging process. Then the recorded single-pixel imaging intensity sequence is post-processed by deep learning as well and the segmentation mask can be directly generated as the network output. The deep learning network is trained by many simulated samples and it has the capability of processing experimental recorded data. The feature of our proposed scheme is that image segmentation is implemented without actual image acquisition and reconstruction. To certain extent, we can perceive the image structure without clearly seeing the image. This scheme is also favorable for data compression and privacy protection.

Poster | G29116

Er doped Fiber Mach–Zehnder Interferometer Based on Up-Taper Structure in Fiber Ring Laser System

Weihao Lin, Liyang Shao, Yibin Liu, Fang Zhao, Shengjie Zhou
Southern University of Science and Technology, China

Abstract—In this paper, an erbium-doped fiber with an upper cone fiber structure which can realize the interference between the cladding mode and the core mode is presented for temperature sensing in fiber ring laser (FRL). Based on this structure, an efficient and inexpensive Mach Zehnder interferometer (MZI) was designed. High signal-to-noise ratio (≈45dB) is realized, and 3dB bandwidth is less than 0.15nm. In addition, compared with MZIS based on misplaced or taper fiber, it has good optical stability. The FRL sensor has a temperature sensitivity of 301 pm/°C. This kind of MZI has great development value in bridge detection and life and health.

Poster | G2983

Automatic Classification of Leukemic Cells by Label-free Light-sheet Flow Cytometry with Machine Learning

Xuantao Su, Zhi Li, Xiaoyu Zhang, Jun Peng
Shandong University, China

Abstract—Accurate imaging detection at single-cell level and fast, label-free identification of leukemia cells are two major goals of research, as early diagnosis and treatment will improve the treatment of leukemia. Recently, we developed a label-free light-sheet flow cytometer to measure the two-dimensional (2D) light scattering of cells. Here we collected 2400 patterns of single cells from healthy human white blood cells, HL-60 cells (human acute myeloid leukemic cells) and K562 cells (human chronic myeloid leukemic cells, respectively. Uniform local binary pattern (LBP) was applied to extract features of the 2D patterns, which were then analyzed by the support vector machine (SVM) algorithm. The label-free classification of healthy human white blood cells with each of the two kinds of leukemia cells can reach an average accuracy rate of 98.88% and 99.38%, respectively. Furthermore, our method was applied to study healthy human white blood cells and K562 cells in cell mixtures, and the results of label-free classification of the cells agreed with the given concentration ratios. The combination of label-free light-sheet flow cytometry with machine learning is expected to realize the classification of cells from clinical leukemia patients.

Poster | G2988

Spatial multiplexing cavity solitons in a monochromatically driven Kerr resonator

Jianxing Pan, Tianye Huang, Zhichao Wu, Perry Ping Shum
China University of Geosciences (Wuhan), China

Abstract—Temporal cavity solitons, relying on the double balance of nonlinearity and dispersion as well as pump and loss, are mainly investigated in the scalar Kerr resonators. Recent works concentrating on the polarization-dependent vectorial cavity report on the generation of scaler and vectorial cavity solitons with asymmetric and symmetric excitation. Moreover, cavity solitons corresponding to distinct spatial modes have been observed in the microresonator through the sideband modulation. Here we report on the generation of spatial multiplexing solitons in a monochromatically driven Kerr resonator. The schematic of the cross-transmission cavity is proposed to eliminate the impact of a large wave vector mismatch. In the cases of symmetric and asymmetric cross-transmission cavity, we can respectively obtain vectorial solitons and coexisted nonlinear states. Our work not only delivers more insights into spatial multiplexing nonlinear dynamics in Kerr passive cavity but also provides a feasible method for the generation of broadband spatial multiplexing laser sources.

Poster | G2949

Optical Frequency Comb Generation Based on DPMZM Cascades FM, EAM and PolM

Xin Wang, Yongfeng Wei, Caili Gong, Sijia Liu, Daoerji Fan
Department of Electronic Information Engineering, Inner Mongolia University, Hohhot, China

Abstract—A novel approach to generating a stable and flat optical frequency comb (OFC) based on DPMZM, FM, EAM and PolM is proposed and demonstrated. DPMZM cascades FM to generate a wide optical frequency comb, EAM is used to optimize flatness and PolM is used to increase the number of comb lines. Result shows that 150- and 198-comb lines with the flatness within 2.54 dB and 2.96 dB can be generated by changing the frequency deviation of FM to 300 GHz, 400 GHz respectively. And 402- and 96-comb lines with flatness within 3.98 dB and 2.32 dB can be generated by changing the frequency of the RF signal to 0.5 GHz and 4 GHz respectively.

Poster | G2934

Surface Plasmon Resonance Refractive Index Sensor Based on Photonic Crystal Fiber with Silver Film and Titanium Dioxide Film

Chi Liu, Tao Shen, Han Liang, Jiao Jiao Chen,Tianyu Yang
Harbin University of Science and Technology, China

Abstract—A surface plasmon resonance (SPR) refractive index (RI) sensor is proposed and analyzed based on D-shaped photonic crystal fiber (PCF). A silver and titanium dioxide layer are coated on the polished surface as a sensitive layer for easy sensing and more practical implementation. The finite element simulation (FES) was applied to analyze the sensitivity of this refractive index sensor. The sensor can operate in the near- and mid-infrared region (2200-2800 nm) with analyte refractive indices in the range of 1.36-1.41. The FES analyzed results show that the resolution of the sensor is 1.35×10-6 RIU and the corresponding maximum wavelength sensitivity is 7400 nm/RIU. The design scheme is simple and highly sensitive, which is agreeable for sensing applications in biomedical, environmental engineering and chemical fields.

Poster | G2921

Multi-Service Provisioning over Endogenous Secure Optical Transport Networks

Huibin Zhang, Fei Xiao, Yuan Cao, Jing Tao, Yongli Zhao
Beijing University of Posts and Telecommunication, China

Abstract—This paper proposes a method for multi-service provisioning over the endogenous secure optical transport network (ESOTN), where the optical channel encryption unit (OEUk) is defined and added between the optical channel data unit (ODUk) and the optical channel transport unit (OTUk) to achieve multi-service secure provisioning over an ESOTN. The proposed method enables the self-generation and the selfconsumption of secure keys, improving the efficiency of multiservice secure provisioning.

Poster | G299

Helical-structure sampled Bragg grating fabricated by femtosecond laser

Xicheng Wang, Yefen Wei, Mingjuan Zhuang, Zhifang Wu, jixiong Pu
Huaqiao University, Xiamen, Fujian, China

Abstract—Objective: Sampled fiber Bragg gratings (SFBGs) have shown a variety of applications such as dense wavelength-division-multiplexed (DWDM) systems, multi-wavelength fiber lasers, and fiber-optic sensors. Point-by-point inscription of a

femtosecond laser offered a remarkable technological flexibility with customized periods, amplitudes and phases. And the resulting gratings demonstrate great high-temperature stability. Here, we demonstrate the fabrication of a novel helical-structure sampled fiber Bragg grating (HSFBG) by using femtosecond laser. Methods: A fs-laser point-by-point inscription system employed in this study. By control the motion path and the velocity of the three-dimensional movement platform, periodically cycled of shutter fabricated a series of HSFBGs. The helical pitch of the fabricated HSFBGs was 50 μm and 100 μm, respectively. The helical radius was 3 μm and the gratings length was 1cm. And the reflected spectrum was received by the OSA to investigate the spectral properties.
Result: The fabricated gratings demonstrate some novel spectral characteristics different from those traditional sampled fiber Bragg gratings. The HSFBGs show a comb-like spectrum in range of 200 nm, much wider than the traditional SFBGs. Besides, the fabricated HSFBGs also shows more than 20 resonance peaks, much more than the traditional SFBGs. Further discussion shows that as the helical pitch increases, the central wavelength shift and the resonances separation becomes smaller. But the number of resonance peaks is increasing. And these parameters could be easily control by change the helical pitch.
Conclusion: It indicates that our structure is featured with simple configuration, easy fabrication, high flexibility, stability, and these results demonstrate the potential of the helical-structure sampled fiber Bragg grating for use in fiber-optic sensors, multi-wavelength fiber laser and filters.

Poster | G29100

Coexistence of circular dichroism and asymmetric transmission in chiral metamaterials

Yu Qu, Lei Lei, Yu Yu, Xinliang Zhang, Zhengfang Qian
ShenZhen University, China

Abstract—Chiroptical response, such as circular dichroism (CD) and asymmetric transmission (AT), attract fabulous attentions for their attractive applications in polarization transformers, circular polarizer, biosensing and negative refractive index media. Chiral metamaterials have larger chiroptical response than chiral biomolecules due to surface plasmon resonance. Over the past decades, many complex 3D nanostructures have been explored to generate CD and AT. Based on the transfer matrix method, a trilayer chiral metamaterial (TCM), which is composed of an Au nanoslit layer and an Au nanorod layer separated from a dielectric nanoslit spacer, is designed to produce a simultaneous CD and AT. To prove the transmission matrix, the TCM arrays are simulated using the finite element method (FEM). The simulated results show that the TCM can simultaneously achieve CD and AT in the near-infrared region. CD and AT strongly depend on the rotation angle of the nanoslit and the distance between the nanoslit and nanorod layer, which is consistent with the theoretical formulas. The associated electric field distributions and the current density prove that the CD and AT arise from the excitation of bonding and anti-bonding modes at resonant wavelengths. Overall, this nanostructure offers a promising alternative to design the chiral metamaterial with large chirality. Such metamaterials will hold great potential in polarization-sensitive device, such as polarization transformers, circular polarizer and beam splitters.

Poster | G298

Design of long-range SPR sensor based on D-shaped honeycomb-structure MOF with Au-graphene hybrid layers

Wenyi Bu, Xi Chen, Haojie Zhang, Zhifang Wu
Huaqiao University, China

Abstract—Objective: Long-range surface plasmon resonances (LRSPRs) are featured with longer propagation and deeper penetration, compared with conventional surface plasmon resonances (SPRs). Thus, LRSPR based fiber sensors are considered to have great potentials for highly sensitive detection in chemistry or biomedicine areas. Method: we propose and numerically investigated a near-infrared LRSPR sensor based on a D-shaped honeycomb-lattice microstructure optical fiber (MOF) coated with Au and graphene film. Different from previous fiber-based LRSPR devices, the long-range surface plasmon polariton (LRSPP) mode in the proposed configuration is obtained without the assistance of additional low-refractive index (RI) buffer layer. By using a full-vector finite-element method (FEM), the electric field distribution, effective refractive index (n_{eff}), confinement loss of the LRSPP mode and core mode are numerically investigated. Although there is no additional heterogeneous buffer layer, the optical field of the LRSPP mode penetrates strongly into the analyte region. Results: It results that the effective refractive index of the LRSPP mode depends highly on the analyte's material refractive index and followed an abnormal dispersion relationship between the LRSPP mode and MOF's y-polarized core mode is observed. The mechanism of the LRSPR excitation in the coupling zone is attributed to an avoided crossing effect between these two modes. It also results in the generation of a narrow-bandwidth peak in the loss spectrum of the core mode. Further discussion shows that the resonance wavelength is mainly determined by the core size that is contributed by the MOF's cladding pitch, silica-web thickness and planar-layer-silica thickness together. Also, using gold and graphene as the sensing layer prevent oxidation of the metal layer and the position of resonance wavelength can be changed effectively with the appropriate number of graphene layers. It indicates that the operation wavelength of the proposed LRSPR device can be flexibly tuned in a broadband wavelength range, even longer than 2 μm, through appropriately designing the MOF's structural parameters. Conclusion: the proposed LRSPR sensor shows that the dynamic detection range of the liquid to be tested from 1.33 to 1.39 and the average wavelength sensitivity of the device is 11567 nm/RIU and the corresponding resolution is 8.65×10^{-7} RIU. Besides, it's highest sensitivity reach 16700 nm/RIU and the minimum resolution is 5.99×10^{-7} RIU. Compared with the previous work, the LRSPR sensor in this work provides much higher sensitivity, better resolution. Thus, the proposed LRSPR sensor is very promising to be applied for highly sensitive measurement in wide areas.

Poster | G2920

Mach-Zehnder interferometer and Bragg Grating Combined fiber device by Femtosecond Laser Inscription

Wenqing Yang, Tianhao Wu, Zhfiang Wu, Yanyan Huang, Liqing Wu, Jixiong Pu
Huaqiao University, China

Abstract—Objective: Optical fiber sensors is drawing extensive attention and applying widely in both chemistry, and biological field, meeting the demand for the ever-growing complexity in fiber optics. Femtosecond (fs) laser direct writing is an advanced technique and possesses considerable features, such as high-peak power and high processing uniformity, which are important for inscribing waveguides of high-performance in fiber core and cladding. With the development of the fs laser inscription technique, many optical fiber in-line interferometer have been successfully demonstrated by using an inner air cavity, a coreless fiber spliced between two single-mode optical fibers (SMFs), a tilted in-fiber beam splitter. However, the above-mentioned fiber MZI devices are usually connected with the disadvantages of large
size, high cost, fragile structures, not sensitive to external environment. Further, multiple variables cannot be monitored at the same time due to their single structures. Thus, by combining with other microstructures such as FBG, the functionality of the optical fiber can be deeply improved and new applications acquired. In this work, we demonstrate the fabrication of a compact fiber device that combines an in-line Mach-Zehnder interferometer (MZI) and a Bragg fiber grating by using fs laser inscription. We have done a great deal of repetitive experiments and tried different femtosecond laser pulse, the length of X-coupler
and the straight waveguide, and velocity of the laser micromachining platform. Firstly, we explored the relationship of distance between the inclined waveguide (X-coupler) and the fiber core axis, which find the greater the distance between the X-coupler and the center of
the fiber axis, the more obvious the interference contrast and the optical path difference (OPD) between the two interferometer arms can be affected by the length of 1+2+3. Then, we proposed a fiber interface MZI sensor with the microstructure of FBG, which is fabricated by using a fs laser pulses are output from a regenerative amplified Ti: sapphire laser. The structure of the device consists of two parts, one of which is fiber surface waveguide for directing part of the propagating light to the cladding-air interface; the other is Bragg grating located on the fiber core. The length of FBG is 5000um, with the periods of 0.54um.
According to the transmission spectrum of the sample, there is a dip at 1550nm. The device is based on inner structures such as the MZI and FBG inside the optical fiber, excellent sensitivity can be guaranteed, compact size can be promised, high precision can be obtained, better than other MZIs. Since the FBG and the MZI have no gap along the fiber core axis direction, a compact and multipurpose sensor is obtained.

Poster | G2959

High Order Resonances in Turning Point Long Period Fiber Grating Fabricated by a Femtosecond Laser

Fangcheng Shen, Haiming Jiang, Hongyan Xia, Kang Xie, Xuewen Shu
Guangdong University of Technology, China

Abstract—Long period fiber grating (LPFG) around the dispersion turning point (DTP) is fabricated with femtosecond laser direct writing. The fabricated grating exhibits dual resonances in its transmission spectrum, which are typical in DTP-LPFG. Resonant peaks generated from high order (3rd) diffraction can be observed when the grating is immersed in aqueous glycerol solution. The resonant wavelengths of experimentally observed peaks agree well with those theoretically predicted by phase matching condition, revealing the correspondence of the peaks with certain cladding modes. The responses of the fabricated grating to surrounding refractive index is also investigated, confirming the high sensitivity of DTP-LPFG. The additional high order resonances can serve as a reference for dual- or multi- parameter sensing applications.

Poster | G2912

Optical fiber strain sensor at 2 μm band with improved sensitivity

Qi Qin, Fengping Yan, Yan Liu, Zhenchen Cui, Ying Guo, Ting Li, Guangde Li, Dan Cheng, Dandan Yang
Institute of Lightwave Technology Beijing Jiaotong University, China

Abstract—Based on the multimode single-mode multimode fiber structure, an optical fiber strain sensor operated at 2 μm band with sensitivity of 1.32 pm/με was realized. Compared with that operated at 1.5 μm band, the sensitivity was improved about 50%.

Poster | G2991

All-Fiber Vector Inclinometer Based on 45° Tilted Fiber Grating Inscribed in a Fiber Ring Laser System

Shengjie Zhou, Weihao Lin, Liyang Shao
southern university of science and technology, China

Abstract—An inclinometer based on tapered fiber grating (TFG) is proposed in fiber ring laser (FRL). The performance of the inclinometer is studied theoretically and analyzed experimentally. Fiber gratings with a length of 8 mm were fabricated and characterized in FRL. The sensitivity is 1.21 dBm/°. In addition, it has a narrow 3 dB bandwidth (< 0.015 nm) and a high optical signal-to-noise ratio (~ 60 dB), which benefits from the laser sensing system. The experimental results show that the designed TFBG inclinometer has a simple structure, compact structure and wide application prospect.

Poster | G2975

A large angle deflection beam splitter designed based on the method of moving asymptotes

Huang Hui, Wang Hui-qin, Feng Yan
Nanchang University, China

Abstract—Optimum structural design is the process of finding a suitable structure which matches the given parameters and satisfies all constraints. When the objective function is set reasonably, it can be used in nanophotonics to quickly and accurately design a device that meets the requirements. A beam splitter that can split the light wavelengths from 800nm to 1100nm fifty-fifty with 180° separation angle designed by we using a new intelligent design method which combining the moving asymptotes and the finite element method. The fundamental transverse electric (TE) mode of the input ports and output ports. The medium of the device is AMTIR-1 and air, and its total efficiency is between 85% to 92%. We also use GaN and air as medium to design the device, its total efficiency has a bit decrease, but still can reach above 83%. This is enough to prove that our algorithm has good universality. The algorithm can be completed with an ordinary personal computer, while the arithmetic speed is quick and the computational complexity is low.

Poster | G2973

A Compact High-Precision Frequency Swept Interferometer (FSI) For Autonomous Ranging Of Satellite Constellation

Yifei Jiang, Shufan Wu, Xiaoliang Wang, Zhong Chao, Wang Wenyan, Qiankun Mo
Shanghai Jiao Tong University, China

Abstract—High precision ranging system is an important part of satellite engineering technologies. Especially, with the rapid developments of satellite constellations, the autonomous laser ranging mechanism becomes the focus of studies. The ranging accuracy which can decide the performance of different functions such as communication, navigation and attitude control systems, is the key of the satellites design indicators. When take into account the load capacity of satellite platforms, the size of ranging instruments can't be ignored. In this article, we design a compact high-precision laser ranging system through the frequency swept interferometer (FSI) technology. Compared to the existing design, our research introduces a bargain between ranging accuracy and the size of system. With a ranging distance of a few hundred meters, our design can reach microns level accuracy in repeating experiments. The realized accuracy level by our design can support high accurate navigation systems and high speed laser communication systems as auxiliary equipment.

Poster | G2938

Research on Hemispherical Receiver for Indoor MIMO Visible Light Communication

Zhongxing Tian, Chenxu Jiang, Shencheng Ni, Feng Wang, Shuying Han, Shanhong You
Soochow University, Suzhou, Jiangsu, China

Abstract—In order to further improve the overall performance of the indoor multiple-input-multiple-output-visible-light-communication (MIMO-VLC) system, we use a hemispherical angle diversity receiver (ADR) to study and analyze the signal-interference-and-noise-ratio (SINR) distribution and area spectral efficiency (ASE) of the ADR at different tilt angles with random rotation. Through the optimization analysis of the tilt angle, we get the optimal tilt angle $\varphi_{ADR} = 25°$. By applying the optimized ADR, the SINR of the inclined ADR is 5dB higher than that of the horizontal ADR. And from the ASE curves, the results show that the indoor none-line-sight (NLOS) link has a certain impact on the performance of an indoor MIMO-VLC system.

Poster | G3001

Endoscopic OCT microprobe for coronary artery imaging

Wenguo Ding
Southern University of Science and Technology, China

Abstract—Nowadays, OCT technology based on low coherence imaging combined with endoscopic technology is increasingly becoming an important tool for diagnosis of cardiovascular diseases. So far, this technique has been able to visualize fine structural changes associated with early-stage tissue lesions with high resolution of 10 μm (or even a few μm), but the disadvantage is that penetration depth is on the order of millimeters. Ultrasound and OCT work in a similar way, compared with OCT, ultrasound's resolution of 200 μm is coarse, but the advantage of ultrasound lies in its strong ability to penetrate tissues, up to about 3cm. Therefore, the IVUS-OCT dual-modality medical imaging system, which combines OCT with intravascular ultrasound, has the potential to become an effective tool assisting clinicians in therapeutic decision. However, considering the fluid environment of the cardiac cavity and the need of ultrasonic transducers for coupling agents, the exploration of a structurally compact microprobe suitable for the IVUS-OCT system without significant degradation of performance in the fluid environment remains an important challenge. Here we present a miniaturized (650 μm outer diameter, 1.2 mm rigid length) dual-modality probe, which consists of a built-in fiber optic ball lens and an ultrasonic transducer. This fiber optic ball lens combined with the OCT endoscopic imaging at 1300 nm can achieve a good balance between working distance and resolution (the transverse resolution of 20 μm was achieved at 1mm outside the catheter sheath). The performance and clinical transformation potential of this probe are demonstrated by resolution target experiments and cardiovascular imaging of swine in vivo.

Poster | G29132

Influence of Temperature on Magnetic Field Sensing with Combined Orbital Angular Momentum Beams

Zhitai Zhou, Yuntian Wang, Huanhuan Liu, Hong Dang, Luoyuan Liao, Jinna Chen,
Longqing Cong, Zhen Gao, Perry Ping Shum
Southern University of Science and Technology, China

Abstract—We have theoretically investigated the influence of temperature on magnetic field (MF) sensing by using orbital angular momentum (OAM) beams in BGO crystals. The results have shown that the ambient temperature variation of 1oC could lead to inaccurate MF extraction of 0.3mT by 50-mm long BGO crystal. Therefore, the temperature factor should be considered in the MF sensing. Our results may contribute to the effort of exploring optical sensing at the onset of OAM beams.

ONSITE TECHNICAL SESSIONS / Sept. 18, 2021

Oral Sessions

S28: Laser Technology - D

Room: LM103-A | Time: 09:00-10:30

Session Chair: **Zhijia Hu**, Anhui University, China

09:00-09:30 | Invited Speaker: Dongmei Huang

Dr. Dongmei Huang received her B.Eng. in Measuring and Control Technology and Instrumentation from Huazhong University of Science and Technology in 2014, Wuhan, China, and M.S. in College of Optoelectronic Engineering from Chongqing University in 2017, Chongqing, China and PhD in the Department of Electronic and Information Engineering from the Hong Kong Polytechnic University in 2020, Hong Kong. Since then she joined the Hong Kong Polytechnic University as a Postdocotral Fellow. Currently, she is a Research Assistant Professor in the Department of Electrical Engineering, the Hong Kong Polytechnic University. Her research focuses on the mode locked fiber lasers, Fourier domain mode locked fiber laser, swept fiber lasers and applications in OCT and LiDAR, WGM microresonator and its applications.

----Invited Talk----

Discrete Fourier domain mode locked fiber laser and its applications in optical coherence tomography

Abstract—Fourier domain mode locked (FDML) laser can avoid laser build up from spontaneous emission by inserting a long fiber delay in the cavity to store all the signal, which is a novel technique to realize fast swept signal. This talk will introduce the discretization of the FDML laser signal in the frequency domain by using a high Q-factor microring comb filter and in the time domain by using an optical modulator. Such discrete FDML laser with long coherence length or high flexibility is also applied in swept source optical coherence tomography systems.

09:30-10:00 | Invited Speaker: Yiyang Luo

Dr. Yiyang Luo received the PhD. in Optical Engineering from Huazhong University of Science and Technology, China in December 2017. And later, he joined in Huazhong University of Science and Technology as an Assistant Researcher till 2018. From September 2018 to December 2020, he worked as a Research Fellow in Nanyang Technological University, Singapore. From January 2021, he joined in Chongqing University as an Associate Professor. He is involved in the research on ultrafast fiber lasers and their transient dynamics. In particular, he developed multiplexed ultrafast fiber lasers for versatile pulse emission. He also gained insight into the internal dynamics of self-assembled pulses by using dispersive Fourier transform based real-time spectroscopy. Till now, he has published more than 40 Refereed Journal articles and possessed 5 patents.

----Invited Talk----

Research on the dynamics and applications of self-assembled pulses in ultrafast lasers

Abstract—In analogy to matter, the interaction of ultrashort pulses induces vivid multi-pulse dynamics. As a result, the ultrashort pulses can evolve into various self-assembled pulses such as soliton molecule, soliton crystal, soliton bunch etc. These pulse complexes will extend the application scenarios of ultrafast lasers. In this talk, we will report on the transient dynamics of the self-assembled pulses assisted with the real-time spectroscopy, particularly revealing the invisible spectral instability and the switching process of bound pulses, molecules and noise-like pulses. We will also present two types of sensing applications based on self-assembled pulses.

10:00-10:30 | Invited Speaker: Zhijia Hu

Zhijia Hu received the Ph.D. degree in chemistry with the University of Science and Technology of China, Hefei, China, in 2014. He is currently a Professor with the School of Physics and Materials Science, Anhui University, Hefei, China. He has authored or co-authored more than 60 papers in high -standard journals and conferences including Phys. Rev. Lett., Light, Opt. Lett., Photonics Res., Opt. Express. His current research interests include fiber optics, fiber sensors random lasers, and polymer optical fibers. From 2017 to 2019, he was a Marie Curie Research Fellow with Aston University, Birmingham, U.K.

----Invited Talk----

Polymer fiber random lasers

Abstract—Polymer optical fiber random lasers (PFRLs) were lucubrated over the last 10 years. Laser emission in scattering gain media, which is not formed by reflection of regular resonant cavity, is known as random laser (RL). High threshold and non-directionality are its main disadvantages. On the one hand, in order to overcome those drawbacks, optical fibers are applied to obtain fiber random lasers (FRLs). One-dimensional confinement of such waveguide geometry makes multiple scattering greatly enhanced by total internal reflection, which leads to much lower threshold, certain directionality, and integration simplicity. On the other hand, among all the systems realized RLs, polymers bring together various kinds of gain materials and scattering

structures by doping materials. The emission of PFRLs contains rich physical connotation, which provides abundant methods for the regulation of RLs. In terms of the generation of PFRLs, a stabilized coherent PFRL reduced the threshold by one order of magnitude than the liquid core FRL reported by us previously, which was obtained by the weak optical multiple scattering of the POSS NPs with ~150 nm in situ formed during polymerization. In 2015, a plasmonic PFRL with high photostability based on localized surface plasmonic resonance is fabricated, Au NPs were doped in the fiber core by us. Recently, a tunable PFRL based on magneto-optical effect was proposed by us. Due to the magneto-optical effect and Mie resonance under the magnetic field, the random lasing intensity can be controlled. Considering the good elasticity and transparency of POFS, PFRLs property will be of great significance to the biomedical applications.

S29: Quantum Optics and Information - B

Room: LM103-B | Time: 09:00-10:30

Session Chair: **Yongmin Li**, Shanxi University, China

09:00-09:30 | Invited Speaker: Yani Zuo

Yani Zuo received a Ph.D. degree in physics from Tsinghua University, Beijing, China, in 2020. Since 2020, she has been working as a Postdoc candidate in the Division of Time and Frequency, National Institute of Metrology, Beijing, China. Her research interests include high-performance atomic clocks based on trapped ions and neutral atoms.

----Invited Talk----

Towards a high-performance optical clock based on single 171-Yb ion

Abstract—With the development of optical frequency comb and ultra-stable laser techniques, the performance of optical frequency standards has been improved significantly over the past decades. Single charged Yb ions have an alkali-like atomic structure and have ultra-long storage time. And the ytterbium single-ion optical frequency standards have two clock transitions (E2 & E3). This paper will introduce the progress in developing a highly accurate optical frequency standard based on a single ytterbium-171 ion at the National Institute of Metrology (NIM), China.

09:30-10:00 | Invited Speaker: Yongmin Li

Yongmin Li received the Ph.D. degree in optics from Shanxi University, Taiyuan, China, in 2003. Since 2003, he has been a Postdoctoral Fellow with the University of Tokyo, and a Visiting Fellow with Australian National University. He is currently a Professor with Shanxi University. His research interests include quantum communications and quantum optics.

----Invited Talk----

Continuous-Variable Measurement-Device-Independent Quantum Key Distribution

Abstract—Measurement-device-independent quantum key distribution (MDI-QKD) can naturally remove all side-channel attacks on detectors. Owing to the critical challenge of continuous-variable (CV) Bell state measurement (BSM) of two remote independent quantum states, experimental demonstration of CV-MDI-QKD over optical fiber has remained elusive. In the present work, a technology for CV-BSM of remote independent quantum states is developed that consists of optical phase locking, phase estimation, real-time phase feedback, and quadrature remapping. With this technology, CV-BSM are accurately implemented and the first CV-MDI-QKD over optical fiber is demonstrated. The achieved secret key rates are 0.43 (0.19) bits per pulse over a 5-km (10-km) optical fiber. The results pave the way for high secret key rate and low-cost metropolitan MDI-QKD network, and serve as a stepping stone to a CV quantum repeater.

10:00-10:30 | Invited Speaker: Jiansheng Wu

Jiansheng Wu got his Ph.D. of physics at University of Illinois at Urbana-Champaign (U.S.A.) in 2009. He worked as postdoctoral scholar at University of California Irvine and Hong Kong University of Science and Technology. He is an assistant professor at Southern University of Science and Technonlogy from 2014.

----Invited Talk----

Uniquely identify topological order by bulk- boundary duality and anyon condensation

Abstract—Topological quantum computation (TQC) is expected to realize universal quantum computation in ten years. The basic elements of TQC are anyons and their braidings which all come from topological order. Topological order is a new kind of order of quantum matter at zero temperature. It not only provides potential applications to fault-tolerant TQC, but also challenge us to find a radically new understanding of phase and phase transition. Then how to experimentally uniquely identify topological order is an extremely important and fundamental topic, which is unknown. We propose a model independent protocol to uniquely identify the topological order, and perform the first experimental measurement using NMR qubit system.

S30: Biophotonics and Optical Biomedicine - C
Room: LM103-C | Time: 08:45-10:30

Session Chair: **Wei Zheng,** Shenzhen institutes of Advanced Technology, Chinese Academy of Sciences, China

08:45-09:15 | Invited Speaker: Aaron H. P. Ho

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). 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. As keen supporter of university-industry collaboration, he has founded of a spin-off company to commercialize phase-sensitive surface plasmon resonance biosensors and lab-on-a-disc. He has published over 400 peer-reviewed articles, 33 Chinese and 6 US patents. He is a Fellow of SPIE and HKIE.

----Invited Talk----

Biosensing Applications Based on Plasmon-assisted Effects: Singularity Phase, Photothermal Excitation and Hot Electron Injection

Abstract—Surface plasmon resonance (SPR) is a well-known physical effect caused by the excitation of free electron oscillations in metallic nanostructures by photons. Because of their unique characteristics including strong localisation and large field enhancement, SPR has been shown to be very useful for biosensing applications. In this paper, we report our recent efforts in the advancement of SPR sensing. First, we show that through the incorporation of a 2-D Ge2Se2Te5 overlayer on the gold sensing surface will lead to close-to-zero attenuated reflectivity, hence singlurity phase performance, which will result in extremely high resolution of target molecule concentration in the femto-molar regime. Second, we report a local plasmon-assisted heating scheme for conducting all-opitcal on-chip total analysis of cells, which include the steps of trapping, cell lysis and amplifcation of target nulceic acid sequence. Third, we demonstrate plasmon-assisted gas sensing using gold nanoisland-coated zinc oxide nanotetrapods at room temperature. The device operates through hot-electrons in the zinc oxide surface which are in turn mediated by photon-induced surface plamons in the gold nanoislands.

09:15-09:45 | Invited Speaker: Hongbao Xin

Dr. Hongbao Xin is currently a professor in the Institute of Nanophotonics, Jinan University, Guangzhou, China. He received his BS degree (2011) and Ph.D degree (2016) at Sun Yat-sen University. After graduation, he continued his research at the University of California, Berkeley and the National University of Singapore. He joined Jinan University in 2018. His research interests focus on biophotonics, such as optical manipulation and detection, bio-micromotor and microrobots, etc. He has published more than 40 peer-reviewed journal articles, including Nature Reviews Materials, Nature Communications, Advanced Materials, Light: Science & Applications, Nano Letters, etc. He was awarded the National Excellent Doctoral Dissertation Award in Optics of China and the Distinguished Young Scholar by the Natural Science Foundation of Guangdong Province.

----Invited Talk----

Single cell optical manipulation and detection

Abstract—Single cell manipulation and molecular detection is of great importance for single cell analysis and biopsy at subcellular or single molecule level. In this talk, I will share our recent work on single cell optical manipulation and detection. Single bacteria detection and single cell surgery will first be discussed based on optical trapping. Indirect manipulation and actuation will then be presented via optical force-controlled bio-micromotor. Finally, I'll talk about enzyme detection and quantum electron transfer detection in living cells via single plasmonic nanoantenna.

09:45-10:15 | Invited Speaker: Bobo Gu

Dr. Bobo Gu received his Ph.D. degree in Optical Engineering from Zhejiang University in 2012. After postdoctoral training at the Nanyang Technological University, he joined Shanghai Jiao Tong University in 2017, where he is currently an Assistant Professor in the School of Biomedical Engineering. His research focuses on the design and synthesis of functional inorganic and organic nanomaterials and exploration of their applications in optical imaging and phototherapy.

----Invited Talk----

Photodynamic anticancer therapy and assessment of cancer prognosis

Abstract—Photodynamic therapy (PDT) can ablate the targeted diseased cells or tissue using photosensitizer (PS) generate reactive oxygen species (ROS) once excited by the light with specific wavelength, while the PS remains benign in the absence of light excitation. As compared with traditional cancer treatments, PDT is featured with remarkable advantages including minimal invasiveness, low side effects, etc., making it a promising treatment strategy. It is worth to note that cancer prognosis is extremely indispensable and important, which could correctly estimate the success with treatment and chances of recovery as well as assist to make subsequent therapeutic schedule. Herein, multi-photon (including second-harmonic generation, multi-photon absorption, upconversion) processes would be employed to excite PDT with improved penetration depth and therapy precision. Moreover, the cancer prognosis was assessed at cytological, sub-cytological, and molecular levels, respectively.

10:15-10:30 | G29145

Enhanced surface plasmonic resonance imaging methods for biosensing

Jiajie CHEN, Yonghong Shao and Youjun Zeng
Shenzhen University, China

Abstract—Surface plasmonic resonance (SPR) has been a cornerstone for approaching single molecular detection due to its high sensitivity capability and simple detection mechanism and has brought major advancements in material science and biotechnology. Over decades, successful integrations of SPR with versatile techniques have been demonstrated. However, several crucial limitations have hindered this technique for practical applications, such as long detection time for high-sensitivity SPR sensors and low sensitivity for high-throughput imaging-based SPR detection. We aim to provide a variety of approaches to enhance the performance of SPR imaging sensors in active and passive ways, such as optothermal, microfluidic, and electrokinetic methods. We believe that our endeavors will inspire and strengthen the researchers' interest in developing SPR related technology with more innovative and impact ideas.

S31: Near-infrared, Mid-infrared and Far-infrared Technologies and Applications - A

Room: LM104-A | Time: 09:00-10:30

Session Chair: **Anbang Wang**, Taiyuan University of Technology, China

09:00-09:30 | Invited Speaker: Song-Sui Li

Dr. Song-Sui Li received the B.Eng. degree in communication engineering from the University of Electronic Science and Technology of China, Chengdu, China, in 2009, and the Ph.D. degree in electronic engineering from the City University of Hong Kong, Hong Kong, China, in 2017. He has worked as a Postdoctral Fellow in the City University of Hong Kong during 2017–2018 and a Senior Research Enginer in Huawei Technologies during 2018–2019. He is currently an Assistant Professor in the School of Information Science and Technology, Southwest Jiaotong University, Chengdu, China. His research interests include nonlinear dynamics of semiconductor lasers, grating-assisted optical chaos generation, and photonic microwave generation.

----Invited Talk----

Nonlinear dynamics of a semiconductor laser under tailored optical feedback from a grating

Abstract—A semiconductor laser under tailored optical feedback from a fiber Bragg grating is a straightforward approach for generating and controlling nonlinear dynamics. One the one hand, by using a grating with narrow bandwidth for suppressing the coherence collapse, stable period-one oscillations are achieved with improved microwave linewidth and side-peak suppression. On the other hand, by using a grating with sufficient dispersive reflection, chaotic dynamics are achieved with improved time-delay signature suppression.

09:30-10:00 | Invited Speaker: Yi Gu

Prof. Yi Gu received his B.S. and Ph. D degree from Nanjing University in 2004 and Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences (CAS) in 2009, respectively. He worked at SIMIT since 2009 and moved to Shanghai Institute of Technical Physics since 2018. His recent research interests include molecular beam epitaxy of III-V semiconductors and short-wave infrared detectors. He has coauthored one book, six book chapters and about 120 papers in peer-reviewed journals. He was elected as the member of Youth Innovation Promotion Association CAS, Shanghai Rising-Star and Shanghai Youth Talent.

----Invited Talk----

Mid-infrared InAs/InGaAs Lasers on InP and Silicon

Abstract—Mid-infrared semiconductor lasers have versatile applications in the region of active sensing. The InGaAs(P) quantum well (QW) laser structures on InP have been well-developed for near-infrared wavelength and widely applied in optical communications. By increasing the indium composition in the QW layer, the emission wavelength can be extended longer to mid-infrared range. However, the lattice mismatch and material strain restrain the further increase of indium composition and thus the wavelength.
In this presentation, I will introduce our work on mid-infrared InAs/InGaAs QW lasers on InP and silicon substrates. The triangular shape of QW was designed to reduce the effect of compressive strain. The parameters of QW active region as well as the

waveguide and cladding layers were optimized. The devices with high performances have been demonstrated for emission at 1.9-2.4 μm. Furthermore, we have demonstrated the lasers up to 3 μm by using the metamorphic In0.8Al0.2As buffers on InP. Recently, we demonstrated the InAs/InGaAs QW lasers at 2.1 μm on Si substrate by using InP/SiO2/Si composite structures.

10:00-10:30 | Invited Speaker: Anbang Wang

Anbang Wang received the Ph.D. degree in electronic circuits and systems from Taiyuan University of Technology in 2014. He is currently a Professor in Taiyuan University of Technology and a deputy dean of College of Physics and Optoelectronics. In 2014, he was a Visiting Scholar with the School of Electronic Engineering, Bangor University. In 2018, he has received the National Natural Science Fund for Excellent Young
Scholars of China. His research interests include laser dynamics, wideband chaos generation and applications including communication and measurement.

----Invited Talk----

Periodic dynamics in mutually-coupled quantum cascade lasers

Abstract—Periodic dynamics in mutual-coupled DFB QCLs are numerically investigated. Three types of periodic oscillations with different period are found, which are equal to τ(coupling delay), 2τ, and reciprocal of detuning frequency. By adjusting the injection ratio and detuning frequency, square wave, quasi period and pulse burst can be observed.

S32: Near-infrared, Mid-infrared and Far-infrared Technologies and Applications - B

Room: LM104-B | Time: 09:00-10:30

Session Chair: **Xiaolong Chen**, Southern University of Science and Technology, China

09:00-09:30 | Invited Speaker: Xiaolong Chen

CHEN Xiaolong, received undergraduate training in Optics & Optical Engineering from the University of Science and Technology of China in 2010, got the Ph. D. from the Hong Kong University of Science and Technology in 2014, and now works as an assistant professor at Department of Electrical and Electronic Engineering in the Southern University of Science and Technology (SUStech). From 2015 to 2016, he worked as postdoctoral researcher in Cambridge Graphene Center in the University of Cambridge. From 2016 to 2018, he worked as postdoctoral researcher in Prof. XIA Fengnian's research group in Yale University. In September 2018, he joined SUStech. At present, he is mainly engaged in the research of black phosphorus-based microelectronic and optoelectronic devices, including mid-infrared photodetector and mid-infrared light-emitting devices.

In recent years, he has published more than 40 SCI academic papers in Light: Science & Applications, Nature Communications, Science Advances, Nano Today, ACS Nano and other journals. He was selected as Guangdong Zhujiang Young Talent Program 2019.

----Invited Talk----

Recent advances in black phosphorus mid-infrared light emission properties and devices

Abstract—Mid-infrared light sources have been widely used in optical communications, thermal imaging and material analysis. Due to the dangling-bond-free surface and high compatibility with silicon technology, van der Waals layered materials offer another promising platform for mid-infrared devices and applications. Among them, black phosphorus (BP) is most investigated due to its high carrier mobility, tunable bandgap and desirable mid-infrared luminescence properties. In this talk, I will introduce the recent important research progress on BP mid-infrared light emission properties and devices.

09:30-10:00 | Invited Speaker: Yandong Gong

The corresponding author Yandong Gong received his Ph.D. degree from Beijing Jiaotong University, China in 1998. He worked as post-doc on ultrashort fiber laser in Nanyang Technological University, Singapore from 2000 to 2002. Later he joined Institute for Infocomm Research, A-STAR, Singapore. From 2019, he joined Beijing Information Science & Technology University as a full professor, his current research area includes Terahertz technology and fiber-optic sensors. Till now, he has authored or coauthored a total of more than 200 papers on reputable international journals and conferences.

----Invited Talk----

Porosity Detection in composite with THz Imaging

Abstract—Terahertz ray has a potential, safe and industrial usage. THz Time Domain Spectroscopy is demonstrated as a fast, highly accurate, non-contact and non-destructive inspection approach to evaluate the porosity distribution of composite materials. Our tests show that THz imaging of both THz amplitude and Time of Flight can be used to evaluate the porosity

accurately.

10:00-10:15 | G29113

Particle detection supported by the photon statistics of laser emission with feedback

Tao Wang, Can Jiang, Junlong Zou, Hanxu Zhou, Xiao Lin, Hongsheng Chen, Gian Piero Puccioni, Gaofeng Wang, and Gian Luca Lippi
Hangzhou Dianzi University, China

Abstract—Monitoring of small objects plays a significant role in extensive fields such as environmental sensing, industrial purification, and public health directing. However, most of micro-/nanoscale particles have weak polarizabilities due to their small size and low refractive index contrast with the surrounding medium which blocks their detectability. In order to solve this problem, various optical sensing methods, featured by low cost, real time and label free, have been developed for particles detection. Nevertheless, direct spectral response for feedback caused by small particles is too weak to be detected, which are down to several picometers and even femtometers, so that high requirement for noise-control and high precision for detection device are entailed.

In recent years, photon statistics has been fully developed and widely used in the detection of squeezed states and antibunching, ghost imaging, improving the sensitivity of gravitational wave detectors, particle sizing, and dynamic light scattering, etc. The advantage of this technique is its ability to detect extremely low light levels, down to the single photon. In this work, we propose one kind of new optical method based on the photon statistics measurements of laser emission with feedback. The sensing function is reflected by the feedback-induced threshold shift. The specific response enables different applications for different kinds of sensors. We present two kinds of measurement methods which can offer quantitative sensing signal and broad range of feedback level. Detail discussions will be presented.

10:15-10:30 | G29103

Modulation of Quantum Cascade Lasers Using Period-One Dynamics for Spectroscopy

Binbin Zhao, Yi-bo Peng, Cheng Wang
ShanghaiTech University, China

Abstract—Quantum cascade lasers (QCLs) are major mid-infrared laser sources for gas spectroscopy applications. A large variety of spectroscopy methods have been developed based on the QCLs. Among these, techniques including wavelength modulation spectroscopy, frequency modulation spectroscopy, and heterodyne phase-sensitive dispersion spectroscopy require sinusoidal modulation of QCLs with modulation frequency ranging from kHz up to GHz. In order to achieve this modulation, radio-frequency (RF) package of either the QCLs or the optical modulators is required, which is technically challenging. This work proposes a modulation technique of QCLs using the period-one dynamics, which does not require any RF components.

Semiconductor lasers subject to external optical feedback usually produce rich nonlinear dynamics, including periodic oscillations, quasi-periodic oscillations, and chaotic oscillations. Chaos has been extensively investigated and has been used in secure optical communication, chaotic Lidar, and in random bit generation. On the other hand, period-one (P1) oscillations, which have a single period in the time series, have been explored for the generation of high-quality photonic microwaves. Although QCLs are highly stable against optical feedback, our recent work demonstrated that tilted optical feedback could trigger QCLs for the production of periodic oscillations, quasi-periodic oscillations, and low-frequency oscillations.

The QCL under study is a distributed feedback laser, which has a cavity length of 2.0 mm and a ridge width of 8.5 μm. The front facet is anti-reflection coated with a reflectivity of 1% and the rear facet is high-reflection coated with a reflectivity of 95%. The active region of the QCL consists of 30 cascading stages of InGAs/InAlAs quantum wells. The operation temperature is maintained at 20 ℃ by using a thermo-electric cooler. The optical feedback is provided by a partial reflector with a reflectivity of 47.5%. The reflector is placed about 60 cm away from the QCL, which yields an external cavity frequency of 246.5 MHz. The tilt angle of the reflector is finely tuned for the excitation of P1 oscillations. The QCL exhibits a lasing threshold of 245 mA, and emits a single mode around 2210 /cm. At 280 mA, the free-running laser shows a spectral linewidth of about 16.7 MHz, which is extracted from the measurement of the frequency noise spectrum. When the QCL is subject to the tilt optical feedback, the P1 oscillation excites sinusoidal waveform in the time series. In addition, the corresponding electrical spectrum shows a sharp peak at the external cavity frequency. Both the time series and the electrical spectrum suggest that the QCL is sinusoidally modulated by the P1 oscillations. Particularly, the electrical linewidth of the electrical spectrum is as narrow as about 1.5 kHz, which is four orders of magnitude narrower than the optical linewidth. Therefore, it is deduced that the P1 induced sideband in the optical spectrum is highly correlated with the main mode, which is similar to the case of direct current modulation.

In summary, we propose a method to modulate QCLs using the P1 oscillation dynamics, instead of the current modulation. This method can be used in multiple spectroscopy applications.

S33: Perovskite Materials and Optoelectronic Applications - D

Room: LM104-C | Time: 09:00-10:00

Session Chair: **Aung Ko Ko Kyaw**, Southern University of Science and Technology, China

09:00-09:30 | Invited Speaker: Rui Zhu

Dr. Rui Zhu has been focusing on the researches of novel optoelectronic materials and device physics. Specifically, he is working on the “next-generation” solar cells, such as perovskite solar cells, organic solar cells, and related research fields. His achievements in the research of perovskite solar cells and device physics are summarized as follows. (1) Develop a series of innovative strategies to continuously boost the device performance and create a world record in the power conversion efficiency of inverted-structure perovskite solar cells. (2) Develop a variety of advanced optical characterization technologies to clarify the device physics and mechanisms in perovskite solar cells. (3) Pioneer the innovative concept of applying perovskite solar cells in near-space vehicles and explore the device stability in near space (35 km above the ground). He has authored more than 80 papers in the domestic and foreign high-level academic journals such as Science, Nature Reviews Materials, Nature Photonics, Nature Energy, Nature Communications, Advanced Materials series and SCIENCE CHINA series, etc., with a total other-citation times of >8000. Among the papers, 12 have been selected as Essential Science Indicators (ESI) highly cited papers, 2 have been selected as ESI hot papers, and some have also been selected as "Top 100 Most Important International Academic Papers in China", "Most Read Academic Papers in Beijing Area" and "Outstanding Papers Published in Science China: Physics, Mechanics and Astronomy in 2020". He was granted by the Outstanding Youth Foundation from National Natural Science Foundation of China. He was also awarded the RaoYutai Prize of Fundamental Optics (Second Class) and won the award of Supervisor of Outstanding Doctoral Thesis in Peking University.

----Invited Talk----

Uncovering the Buried Secrets in Halide Perovskite Photovoltaics

Abstract—Understanding the fundamental properties of buried interfaces in perovskite photovoltaics is of paramount importance to the enhancement of device efficiency and stability. Nevertheless, accessing buried interfaces poses a sizeable challenge because of their non-exposed feature. In this presentation, the buried mysteries in full device stacks will be unveiled by a series of dedicated techniques including the lift-off strategy, the in-situ mapping spectroscopy, and the cross-sectional high-resolution microscopy. By establishing the microstructure–property relations, the basic losses at the contact interfaces are systematically presented, which are induced by both the sub-microscale extended imperfections and lead-halide inhomogeneities. Furthermore, a brand new mechanism for the most popular ammonium-halide post-treatment is explored and called the molecule-assisted microstructural reconstruction. The losses can be considerably mitigated by the use of the passivation-molecule-assisted microstructural reconstruction, which unlocks the full potential for improving device performance.

09:30-10:00 | Invited Speaker: Yuelong Li

Prof. Yuelong Li received Ph.D. from the Korea Institute of Science and Technology (KIST/UST, South Korea) in 2012, and started his postdocs at the University of California-San Diego (UCSD, US) and then the Spanish National Research Council (CSIC, Spain) as the Marie Curie Fellow. He stayed at the University of Oxford (2015) and the University of Cambridge (2018) as the visiting scholar. In 2016, he joined Nankai University as an associate professor. His research focuses on optoelectronic materials and devices such as perovskite solar cells, tandem solar cells, perovskite single crystals, flexible energy electronics, etc.

----Invited Talk----

Metal Halide Perovskite Single Crystals and Novel Devices

Abstract—Metal halide perovskites are considered as the emerging semiconductors and have been applied into diverse optoelectronic devices including the most successful examples such as perovskite solar cells and light-emitting diode. There are still great potential to explore the surprising world based on metal halide perovskite, for instance, the perovskite single crystals and devices. Experimentally, perovskite single crystals show longer diffusion length (up to 175 μm vs 2μm of polycrystalline films), lower defect density (1010/cm3, compared with 1016/cm3 polycrystalline counterpart) and thus improved stability under external stresses (moisture, heat and electric filed, etc). Therefore, growth of monocrystalline perovskite film or particle and understanding the charge transport mechanism are urgently required for highly efficient optoelectronics. Herein, we synthesized high-quality quantum dots based on MAPbX3 (X=Cl, Br, I) and utilized the mechanical control break junction (MCBJ) technique to explore the conductance of single quantum dot through the perovskite junction, and eventually found the quantum interference phenomenon at room temperature for the first time in metal halide perovskite materials. Secondly, we prepared submicro-thin perovskite platelets for their application in artificial synapse device and observed typical synaptic behavior signal from those artificial devices with pA-level operating current and ultra-low energy consumption (14.3 fJ/spike). Furthermore, we observed the effect of crystal size on charge transport behavior within thin perovskite platelets with liquid metal and graphene electrode, and negative differential resistance phenomenon on relatively smaller crystals with detail mechanism discussed.

S34: Translational Photomedicine and Biophotonics

Room: LM105 | Time: 09:00-10:30

Session Chair: **Guanghui Wang,** Nan Jing University, China

09:00-09:30 | Invited Speaker: Kai Li

LI Kai, Associate Professor at Southern University of Science and Technology (SUSTech). His research interests focus on the exploration of optical nanoprobes for regenerative medicine and cancer theranostics. He received his Ph.D. degree in the Department of Chemical and Biomolecular Engineering (Prof. Bin Liu's group) from the National University of Singapore in 2011. He then joined the Institute of Materials Research and Engineering (A*STAR) as a Scientist. He reported a class of advanced organic cell trackers featured in a Nature article: 'The nanolight revolution is coming'. From 2013, he became an independent PI with the support from A*STAR Career Development Award. He was a Visiting Scholar in the Molecular Imaging Program at Stanford (MIPS) in the Daldrup-Link Lab from 2015-2017. In 2018, he joined the Department of Biomedical Engineering in SUSTech as an Associate Professor with the financial support from Thousand Young Talents Program. He has published more than 80 papers in peer-reviewed journals with a total citation of over 7500 times and a H-index of 46 (Google Scholar).

----Invited Talk----

Exploration of novel optical imaging probes for in vivo biomedical applications

Abstract—The continuous or real-time tracking of biological processes using biocompatible contrast agents over a certain period of time is vital for precise diagnosis and treatment, such as monitoring tissue regeneration after stem cell transplantation, understanding the genesis, development, invasion and metastasis of cancer and so on. Recently, fluorescence imaging and photoacoustic imaging have attracted great attention, enjoying the advantage of high resolution and sensitivity. To acquire desired functional information, researchers have been dedicated to exploring novel contrast agents based on molecular engineering. For instance, it is generally considered that the large absorption coefficient at long wavelength and high nonradiative nature of contrast agents are two dominant factors to yield strong photoacoustic signals. Guided by a molecular designing mechanism, we have designed a series of semiconducting polymers with large absorption coefficient in the near-infrared (NIR) I and II regions. In addition, we have demonstrated their exciting performance in stem cell tracking, tumor detection and treatment, and precise nanoparticle delivery.1-4 On the other hand, we also discovered that NIR light can facilitate the precise and efficient delivery of photoacoustic nanoparticles to specific tumor tissues via a transient vascular barrier opening process, which opening a new door in nanoparticle-based delivery system. In this talk, the speaker will introduce recent progresses of exploring advanced fluorescence and photoacoustic nanoprobes and their biomedical application in his lab.

09:30-10:00 | Invited Speaker: Lingjie Kong

Dr. Lingjie Kong is an associate professor at Tsinghua University, Beijing. He received PhD degree from Tsinghua University in 2012. After that, he continued the postdoctoral research at Harvard University, Janelia Research Campus/Howard Hughes Medical Institute, and Purdue University, sequentially. Since 2017, he joined the faculty of the Department of Precision Instrument, Tsinghua University. His research interests include biomedical optics and its biomedical applications.

----Invited Talk----

Speed up volumetric recording of neural activity via computational imaging

Abstract—To understand the orchestrating mechanisms of neural network in vivo, high-speed volumetric imaging is critical in neuroscience study. However, limited by the inertia of imaging hardware, current optical imaging methods meet physical bottlenecks in improving imaging speed. Here we exploit computational imaging as the solution to push speed limit in functional imaging of neural circuits in vivo.

10:00-10:30 | Invited Speaker: Qiongyu Guo

Dr. Qiongyu Guo is an Assistant Professor in Biomedical Engineering at the Southern University of Science and Technology (SUSTech). She got bachelor's degree in Polymer Engineering from the University of Science and Technology of China (USTC) in 2004, and PhD degree from the Case Western Reserve University in 2010. She got her postdoctoral training in Biomedical Engineering at the Johns Hopkins University under the supervision of Prof. Jennifer Elisseeff. Her research focuses on engineering biomaterials through translational approaches in the fields of implantable artificial cornea, shape memory nanomaterials and drug delivery systems.

----Invited Talk----

Shape Memory Polymeric Particles with Photothermal Actuation for Biomedical Applications

Abstract—Transcatheter medical micro-/nano-devices have recently attracted tremendous attentions due to their potential to revolutionize minimal-invasive interventions by enabling medical procedures in confined small spaces. Developing efficient tools to control the miniaturized devices in situ may enable various clinical applications through the circulatory systems that are hardly accessible by conventional tools. Here we developed light-inducible shape memory polymeric microparticles being able to actuated in a spatiotemporally controlled manner. This shape-memory polymeric system for the first time demonstrates the capability of maintaining an anisotropic shape at body temperature with triggered shape-memory effect back to a spherical shape at a narrow temperature range above body temperature with a proper shape recovery speed (37 < T < 45 °C). Accordingly, we successfully achieved shape memory microparticles with controlled radial expansion to facilitate transcatheter navigation and localization for embolization treatments. We also utilized the rapid shape reversion capability of the microparticles to control macrophage phagocytosis.

S35: Fiber-Based Technologies and Applications - F

Room: LM103-A | Time: 10:45-12:00

Session Chair: **Hong Dang,** Southern University of Science and Technology, China

10:45-11:15 | Invited Speaker: Qi Wu

Qi Wu was born in Zhejiang, China in 1986. He received the B.S. and M.S. degrees in optical engineering from the Huazhong University of Science and Technology in 2011 and the Ph.D. degree in systems innovation from The University of Tokyo in 2014. Then, he worked in the UK, Australia, and Japan before he came back to China. Now he is a professor at State Key Laboratory of Mechanics and Mechanical Structures, Nanjing University of Aeronautics and Astronautics. He contributed more than 45 articles and more than 5 patents. His research interests include optical fiber sensor and its application in structural health monitoring.

----Invited Talk----

Ultrasonic optical fiber sensor and its application in composite health monitoring

Abstract—Fiber Bragg grating sensor has been widely used to detect static measurands like strain and temperature but is still difficult to detect ultrasonic guided wave because of the limited sensitivity and bandwidth. In this talk, we will introduce a phase-shifted fiber Bragg grating with a short effective grating length and steep slope, which is suitable for ultrasonic Lamb wave detection. After integrating with a high-speed interrogator and feedback controller, the system can detect passive linear and nonlinear ultrasonic waves, and active acoustic emissions with ultra-low energy and megahertz frequency. It is then demonstrated that the system can be used in ultrasonic health monitoring of various composite structures, such as laminate, T-joint, high-pressure vessel, and composite propeller.

11:15-11:45 | Invited Speaker: Yuanhong Yang

Prof. Yuanhong Yang received his B.Sc. degree in Optical Engineering from Huazhong University of Science and Technology, Wuhan, an M.Sc. in Instrumental Science and a Ph.D. degree in Material from Beihang University, Beijing. Currently, he is a Professor at Beihang University, Beijing. His main research interests include optical gyroscopes, optical fiber sensing, optical fiber laser, and Quantum sensing. He is the author and co-author of more than 180 publications and holds more than 50 patents.

----Invited Talk----

Atomic Spin Precession Detection with Fiber Optic Saganc Interferometer

Abstract—We propose and experimentally demonstrate an atomic spin precession detection technique using a modified reflective closed-loop fiber-optic Saganc interferometer with circularly polarized light. Preliminary tests for the measurements of magnetic field and rotation rate based on the polarized K-Rb-21Ne comagnetometer achieve a magnetic field sensitivity of 1.2 pT/Hz1/2 and a rotation sensitivity about 1.65×10−5 rad/s/Hz1/2, respectively. The nonlinear response of the atomic gyroscope

is also investigated.

11:45-12:00 | G29103

Long-Distance Pipeline Safety Early Warning: A Distributed Optical Fiber Sensor Deep Learning Approach

Yang Yiyuan, Yi Li, Haifeng Zhang
Tsinghua University, China

Abstract—Distributed optical fiber sensors (DOFS) have the advantages of high sensitivity, antielectron magnetic interference, and long-distance distributed detection. And pipeline safety early warning (PSEW) systems based on DOFS are used to recognize and locate the events that may damage long-distance transportation pipes. In this study, we proposed a novel real-time method, combining with a pioneering industrial signal processing approach and a deep learning model, based on coherent Rayleigh scattering DOFS to monitor the safety of pipelines. Specifically, we put forward two complementary features to describe signals of DOFS and built a new action recognition deep learning network based on those features. Besides, experiments were carried out at two different real PipeChina pipelines with different deployments, environmental conditions, signal frequencies, and pipeline lengths (48 km and 85 km). The total dataset was 2.17 TB and took us nearly five months to collect them with over $100,000. The figure below shows the experimental facilities of our PSEW system.

Encouraging empirical results from the above tests indicate that the proposed scheme can identify and locate damage events with good robustness. It demonstrates a high average accuracy of 95.86% for 100 Hz signal and 97.53% for 500 Hz data. Besides, the proposed feature generator can effectively extract features in a short period and has a good visualization effect. More importantly, our system fully meets the industry standards of model size, real-time performance, and adaptability to different deployment conditions and environments, and has already been deployed in a real long-distance energy transportation pipeline for half a year. The figure below shows the features (upper) and identification results (lower) from an operational PipeChina pipe. Our scheme provides a reference for third-party damage event recognition based on DOFS in an open environment. In future, we are interested in exploring higher spatial-temporal resolution by optimizing sampling frequency and sensing mechanism of DOFS and exploring the applications of DOFS early warning system in other areas, such as early warning of undersea and land earthquakes and traffic flow statistic for urban road networks.

S36: Quantum Optics and Information - C

Room: LM103-B | Time: 10:45-12:00

Session Chair: **Feng Li**, Xi'an Jiaotong University, China

10:45-11:15 | Invited Speaker: Jin Wang

Jin Wang, a professor of Innovation Academy for Precision Measurement Science and Technology, CAS. He graduated from Anhui Institute of Optics and Fine Mechanics, CAS in 1999 with a doctorate degree. He was engaged in cooperative research in the Blackett Laboratory of Imperial College London in 1999, and was a senior visiting scholar at Stanford University in the United States from 2006 to 2007. He mainly engaged in the experimental research of cold atom interferometer, designed and realized a 10-meter atom interferometer and tested equivalence principle using atoms at a high level. He applied atom interferometer technology to inertial measurement, and successfully developed atom sensors. He published more than 70 SCI papers, 1 monograph, 2 chapters, and obtained 16 authorized invention patents.

----Invited Talk----

Development of a transportable atom gravimeter and its field test

Abstract—The cold atom interferometer based absolute gravimeter has the characteristics of high sensitivity, high sampling rate and continuous operation, and has broad application prospects in the field of gravity precision measurement. At present, limited by the complexity of the system, large size, heavy weight, poor environmental adaptability and other factors, the popularization and application of the cold atom interferometer absolute gravimeter is subject to certain restrictions. In order to solve these application problems, based on the development of high-precision rubidium-85 atom absolute gravimeter, we solve the key integration technology of atom gravimeter, which effectively reducing the volume and weight of the instrument, and realizing a transportable atom absolute gravimeter. We carried out static and dynamic gravity measurement experiments in an external field environment, and the main technical indicators were better than expected. In talk, I will introduce the development of the transportable atom absolute gravimeter and the results of the field test.

11:15-11:45 | Invited Speaker: Feng Li

Feng Li got his bachelor's and master's degree at Tianjin University in China in 2006 and 2008. He got his PhD at CNRS and the University of Nice Sophia-Antipolis in France in 2013, supported by the European Marie-Curie ITN project CLERMONT4. Then he worked as a research associate at the University of Sheffield in UK from January 2014 to May 2017. Feng Li joined Xi'an Jiaotong University (China) as a professor in June 2017, with main research interest in light-matter interaction in microcavities and nanostructures.

----Invited Talk----

Direct Measurement of Berry Curvature and Quantum Metric Tensor in an Organic Optical Microcavity

Abstract—Fabry-Perrot (FP) microcavities with metal or DBR (distributed Bragg reflector)-coated mirrors provide an excellent platform for investigating the collective behavior of confined 2-dimensional photons and polaritons. The TE-TM mode splitting in such cavities acts as an effective magnetic field, leading to photonic spin-orbit (SO) coupling effect that the pseudospin of cavity photons changes anisotropically with their momenta. Such mechanism has led to interesting observations including optical spin-Hall effect, magnetic-monopole-like half solitons, spinor condensate with half-quantum circulation, and polaritonic topological insulators.

We report the direct measurement of the Berry curvature and quantum metric of the photonic modes of a FP cavity containing an optically active (OA) organic microcrystal (Perylene). Photonic spin-orbit-coupling induced by the cavity results in the action of an effective gauge field on photons. The addition of high OA makes emerge geometrically non-trivial bands containing two gapped Dirac cones with opposite topological charges. This experiment performed at room temperature and at visible wavelength establishes the potential of optically active organic materials for implementing non-magnetic and low-cost topological photonic devices.

11:45-12:00 | Invited Speaker: Honglei Yang

Honglei Yang received the B.S. degree in Optical information science and technology from Nanjing University of Science and technology, Nanjing, in 2012, and received the Ph.D. degree in optical engineering from Tsinghua University, Beijing, China, in 2017. He is currently a senior scientist at Beijing Institute of Radio Metrology and Measurement. He has authored more than 20 peer-reviewed articles. His current research interests include narrow-linewidth cavity-stabilized laser, ultra-low noise frequency comb, dual-comb applications, and optical time and frequency transfer with coherent laser.

----Invited Talk----

Timing jitter characterization of dual-comb time and frequency transfer system for precision dissemination of optical frequency standard

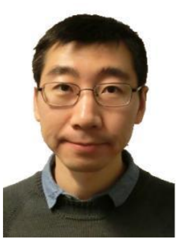
Abstract—Time and frequency transfer via asynchronous optical sampling technique benefitting from dual-comb system owning unprecedented high precision has shown an attractive potential in ultra-precision spatial and temporal reference frame establishment in future. Mutual phase coherence is the utmost crucial factor in asynchronous optical sampling. Here we report a dual-comb asynchronous optical sampling system with a low residual optical phase jitter less than 0.04 rad in a noise band from 1 Hz to 5 MHz around 1.55 μm, which implies a timing jitter at around 30 as. The Fourier frequency, at which the residual phase jitter reaches 1 rad, is between 0.06 Hz and 0.1 Hz. Therefore, the coherence time is greater than 10 s. The residual frequency stability of the system reaches 1.2×10-16 at an averaging time of 1 s.

S37: Optoelectronic Devices and Applications - C

Room: LM103-C | Time: 10:45-12:00

Session Chair: **Ruoming Li**, Chinese Academy of Sciences, China

10:45-11:15 | Invited Speaker: Ruoming Li



RUOMING LI (M'16) received the Ph.D. degree in optical engineering from Nanjing University, in 2015, as a joint training student in the College of Engineering and Applied Sciences, Nanjing University, Nanjing, China, and the School of Electrical Engineering and Computer Science, University of Ottawa, Ottawa, ON, Canada. He currently works with Aerospace Information Research Institute, Chinese Academy of Sciences as an Associate Research Professor. His current research interests include photonic-assisted microwave mixer, photonic-assisted synthetic aperture radar, photonic generation of microwave and millimeter-wave signals, and radio over fiber.

----Invited Talk----

An Ultrahigh-Resolution Continuous Wave Synthetic Aperture Radar with Photonic-Assisted Signal Generation and Dechirp Processing

Abstract—A ultrahigh-resolution continuous wave (CW) synthetic aperture radar (SAR) is developed and demonstrated. In the transmitter, photonic frequency-quadruple is used to generate a linearly-frequency-modulated (LFM) radar signal; while in the receiver, photonic dechirp processing is employed to receive the reflection signal. The presented LFM-CW SAR operates in Ku band with a bandwidth of 5700 MHz and is evaluated through a series of imaging tests. The results show photonic technologies are able to handle of transmission and reception of very large bandwidth for ultrahigh-resolution imaging radar.

11:15-11:30 | G29144

A nucleic acid amplification-on-a-disc System for Rapid On-site Inspection of Infectious Diseases

Wanyi Zhang, Yuanyuan Wei, Yuye Wang, Zhenming Xie, Lili Cui, Ho-Pui Ho, and Dayong Gu

The Chinese University of Hong Kong, China

Abstract—Rapid on-site inspection is an important issue, particularly for disease control and prevention. Although microfluidics has been reported as a viable tool for various bioassays, there is not much progress as far as an all-in-one nucleic acid amplification device for convenient on-site disease detection concerned. This work focuses on developing an all-in-one sample-to-answer device for rapid on-site diseases detection, which has the advantages of ease of operation, portability, and high integration compared to conventional detection systems.

We proposed an integrated nucleic acid amplification-on-a-disc device for on-site inspection of infectious diseases. This platform is based on a centrifugal lab-on-a-disc system, microfluidic chip, on-disc automated sample processing, and image fluorescence signal analysis, which will lead to sample-to-answer operation by measuring the absolute quantity of molecular genetic products amplified through nucleic acid amplification detection. By spinning the disc, reaction cocktail can be uniformly partitioned in the microfluidics chip. After going through thermocycling by the heat-transferring system, the target gene can be successfully amplified on the disc.

We put forward a portable, convenient, absolute quantitative scheme, which is useful for point of care applications in on-site disease detection of virus samples. Our work also reveals great potential of using an integrated centrifugal microfluidic platform for conducting complex assays in portable biomedical inspection instruments.

11:30-11:45 | G29161

Thermal management for high power and large area VCSEL arrays package

Dezhen Li, Tian Lan, Rui Huang, Ying Li, Zhiyong Wang

Beijing University of Technology, China

Abstract—Vertical-cavity surface-emitting lasers (VCSELs) are quite attractive for many direct-diode applications due to combined advantages in high power scalability, high reliability and easy system integration, etc. However, to alleviate thermal impact on power-conversion efficiency has been an open critical concern for high power and large area VCSEL arrays. Here we report the use of liquid metal and water as compound fluid working mediums. Experimental measures were performed on a gyratory interlock microchannel heat sink. Theoretical predictions were made using finite element method simulations. We find that the thermal conductivity of fluid working mediums increase by 60 - 70% depending on the liquid metal. Our findings demonstrate heat flux treatment level achieves surprising result – about 1500W/cm^2/s within 0.25cm^2. These results, achieved on 0.25cm^{2}area, have the potential to solve the difficulty on a larger scale.

11:45-12:00 | G2918

Reliability analysis of MEMS micromirror under vibration environment

Xiaoyong Fang, Ao Chen, Chuncheng Liu, Kaiming Hu, Wenming Zhang

Shanghai Jiao Tong University, China

Abstract—This paper explores the reliability of MEMS magnetoelectric micromirror under vibration environment. Firstly, in the finite element software, COMSOL Multiphysics, the modal analysis of simplified chip model is carried out from 20 Hz to 2000 Hz according to JESD22-B103B standard. There are three modes in the frequency range, and the micromirror chip is prone to

fracture when the piston mode is excited around 1164 Hz. Based on the FEA results, the dynamic model of MEMS micromirror near the second eigenfrequency is established. Then, the numerical analysis of displacement response is performed with the established dynamic model under different amplitudes. The displacement response begins to increase linearly with the amplitude, and then decreases, which is caused by the nonlinear behavior of stiffness hardening. Finally, the MEMS micromirrors are tested with the vibration system. In the sweep excitation test of the frequency from 100 Hz to 2000 Hz, the excitation frequency is 1198 Hz when the sample is damaged. 1198 Hz is consistent with the piston mode, which verifies the correctness of the FEA results. The displacement response of the experimental results under sweep excitation with different amplitudes is in good agreement with the numerical results. The analysis of the damaged samples reveals that the fracture position of the micromirror is at the chamfer of the slow axis root, which is consistent with the maximum VON Mises stress position in the FEA. Based on the results of theoretical and experimental analysis, some valuable suggestions for the optimization design of MEMS micromirror are put forward.

S38: Optical Fiber Upgrade - C
Room: LM104-A | Time: 10:45-12:00

Session Chair: **Zhenggang Lian**, Yangtze Optical Electronics Co., China

10:45-11:15 | Invited Speaker: Meisong Liao

Liao Meisong, male, born in 1974, professor. Now he is the Director of High Power Laser Components Laboratory of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. His research interests include photonic crystal fibers, soft glass microstructure fibers, nonlinear optical fibers and components, mode-locked fiber lasers and supercontinuum lasers.

----Invited Talk----

Research progress of special optical fiber and supercontinuum laser

Abstract—Supercontinuum laser is a new type of broadband fiber laser light source, which has important applications in biomedicine, cutting-edge technology, national defense and other fields. Specialty fiber is the core component of supercontinuum. We have been engaged in the research of special optical fiber and supercontinuum laser technology for more than 15 years. This report reviews our research progress in recent years on the new type of highly nonlinear photonic crystal fiber and its supercontinuum generation, and discusses the potential applications.

11:15-11:45 | Invited Speaker: Shuhui Li

Shuhui Li received the Ph.D. degree in optical engineering from Huazhong University of Science and Technology, China in 2016. From Nov. 2018 to Nov. 2019, he was a visiting scholar at the University of Exeter, Uk. He is currently a Lecturer at Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China. His research interests include multimode fiber-based imaging, communication, and sensing. He has authored and/coauthored over 100 journal and conference papers.

----Invited Talk----

Imaging through multimode optical fibers using transmission matrix approaches

Abstract—When light propagates through a multimode fiber (MMF), the spatialinformation it holds becomes scrambled, but not necessarily lost. Themeasurement of the transmission matrix (TM) of the MMF is a powerfulway to recover this scrambled information enabling minimally invasiveMMF micro-endoscopy. In this talk, we will review our recent work onMMF imaging using the compressively TM measuring approach and theguide-star assisted memory effect method.

11:45-12:00 | G29101

Generating all-fiber doughnut beam arrays and hollow Bessel-like beams based on fiber mode selective couplers

Ao Yang, Mengjun Xu, Jie Zhu, Fufei Pang, Xianglong Zeng

Shanghai University, China

Abstract—A compact and efficient all-fiber method to generate the visible doughnut beam arrays based on a multi-core coupling mechanism is proposed and demonstrated. An effective doughnut beam coupling approach is demonstrated by tapering a multi-core fiber (MCF), which is spiced with the few mode fiber output port of a mode selective coupler (MSC). The doughnut beam array with a nearly even power distribution can be generated from a tapered MCF output port. This all-fiber structure for generating the doughnut beam array not only has the advantages of compactness, flexibility and easy integration but also has great application prospects in the fields of super-resolution microscopy/nanoscopy, laser material processing and high-capacity optical fiber communication. In addition, the hollow Bessel-like beams with different cylindrical vector modes and orbital angular momentums are acquired by combining the MSC with a micro-tip structure on the output fiber facet. Both experimental setups for generating doughnut beam arrays and hollow Bessel-like beams based on all-fiber structures have the advantages of compactness, flexibility and easy integration to fibers or silicon-based waveguides.

S39: Optical Communication and Networks - A

Room: LM104-B | Time: 10:45-12:00

Session Chair: **Junwen Zhang,** Fudan University, China

10:45-11:15 | Invited Speaker: Quan Pan

Quan Pan received his B.S degree in Electrical Engineering (EE) at University of Science and Technology of China (USTC) in 2005, and his Ph.D. degree in Electronics and Computer Engineering (ECE) at the Hong Kong University of Science and Technology (HKUST) in 2014.

From 2014 to 2018, he was Senior Staff Engineer in one Silicon Valley startup company, working on 400GbE high-speed SerDes. He is now an Assistant Professor at School of Microelectronics, Southern University of Science and Technology since 2018. His research interests include High-speed optical transceiver, wireless and wireline circuit design.

Dr. Pan has contributed to more than 50 peer-reviewed articles. He was awarded the Pearl River Young Talent in 2019. He received the 2017 Outstanding Young Author Award of IEEE Circuits and System Society. He was also the Innovation Prize Winner of the 4th Annual HKUST One Million Dollar Entrepreneurship Competition in 2014. He serves as an active reviewer for many international journals, including JSSC, TCAS, TVLSI, JLT, PTL, JoS, and et al.

----Invited Talk----

Research of High-Speed Low-Power Optoelectronic Transceivers

Abstract—Complementary metal-oxide-semiconductor (CMOS) optoelectronic integrated circuits (OEICs) have become extremely attractive since they are extensively adopted in optical communications, such as local area networks, board-to-board, and data center-to-data centers. Energy-efficient 100Gb 、 s+ systems with sophisticated equalization are studied and implemented.

11:15-11:45 | Invited Speaker: Guijun Hu

Hu Guijun, male, born in 1970. He is a professor of the college of communication and engineering in Jilin University. In 2001, he graduated from Jilin University and received his Ph.D. in microelectronics and solid state electronics. In 2004, He achieved the postdoctoral work at Changchun Institute of optics, mechanics and physics, Chinese Academy of Sciences. From August 2004 to August 2009, he worked as a visiting scholar at the Korean Academy of science and technology, and from April 2009 to April 2010, he worked as a visiting scholar at the optical center of the University of Central Florida in the United States. From December 2016 to June 2017, he worked as a senior researcher at Bangor University in the UK. He has been engaged in the research of optical communication and optoelectronic devices. He has successively undertaken more than 20 scientific research projects and published more than 100 papers, 8 authorized invention patents and 1 second prize for scientific and technological progress of Jilin Province.

----Invited Talk----

Few Mode Polymer Waveguide Amplifier for Low Differential Modal Gain

Abstract—Few-mode waveguide amplifier with tunable modal gain can effectively compensate the coupling and transmission loss of on-chip mode division multiplexing system, which is of great significance to promote the industrialization of mode division multiplexing system. We propose a few-mode erbium-ytterbium co-doped polymer optical waveguide amplifier supporting three spatial modes with low DMG. A copropagating pumping scheme is proposed to equalize the modal gain with mode selective photonic lantern.

11:45-12:00 | G29142

ROADM Traversal Improvement Enabled by Optical Domain Equalization

Zhenhua Feng, Huan Chen, Feng Shi, Yinqiu Jia, Qiong Wu, Hu Shi

ZTE Corp., China

Abstract—Real-time transmission of 200Gb/s and 400Gb/s channels within 37.5/50/75 GHz grid over up to 24 cascaded WSSs is achieved with only 0.6dB penalty using optical domain equalization (ODE), which nearly doubles the ROADM traversal capability.

S40: Optical Communication and Networks - C

Room: LM105 | Time: 10:45-12:00

Session Chair: **Qi Yang**, Huazhong University of Science and Technology, China

10:45-11:15 | Invited Speaker: Fan Zhang

Fan Zhang received the Ph.D. degree from the Beijing University of Posts and Telecommunications, China, in 2002. From 2002 to 2004, he was at the Optoelectronics Research Centre, City University of Hong Kong, China, as a Senior Research Associate. From 2004 to 2006, he was at the Technische Universität Berlin, Germany, as a Humboldt Research Fellow. In 2006, he joined Peking University, China, where he is currently a full professor. He has published more than 150 academic articles in peer-reviewed journals and prestigious conferences. His research interests include high-speed optical transmission, optical interconnects, on-chip photonic communication and digital signal processing. He is serving or has served on the Technical Program Committees of various technical conferences, including Optical Fiber Communication Conference from 2019 to 2021, IEEE Photonics Conference from 2014 to 2018, Asia Communications and Photonics Conference 2016/2020/2021, and OptoElectronics and Communications Conference 2015/2021/2022. He is a senior member of The Optical Society and a senior member of IEEE.

----Invited Talk----

Neural networks for fiber nonlinearity mitigation in coherent optical transmission systems

Abstract—We review the recent progress of neural networks based fiber nonlinearity mitigation in coherent optical transmission systems. The experiments of high speed optical transmission with neural network assisted equalization are demonstrated. The low complexity neural network equalization is discussed.

11:15-11:45 | Invited Speaker: Fan Li

Fan Li received the B.S. degree in communication engineering from the Hunan University, Changsha, China, in 2008 and the Ph.D. degree in optical communication from Hunan University, China, in 2014. From 2012 to 2014, he was a Research Assistant with the Georgia Institute of Technology, Atlanta, GA, USA. From 2014 to 2016, he worked as a Research Engineer in Optical Transmission Lab. in ZTE TX, Morristown, New Jersey, USA. Since 2016, he has been an Associate Professor with the School of Electronics and Information Technology, Sun Yat-sen University, Guangzhou, China. He is the author of one book, more than 100 journal and conference papers, and fivepatents. His research interests include high speed coherent optical transmission, optical OFDM, fiber wireless integration, optical interconnection. He is a member of the OSA. He is serving as an Associate Editor for Optical Fiber Technology and an Associate Editor for Optics Express.

----Invited Talk----

Quantization Noise Suppression with Noise-shaping Technique in Optical Interconnects utilizing Low-resolution DAC

Abstract—Low-resolution digital-to-analog converters (DACs) with high integration and low power consumption are preferred to meet the requirement of data center interconnects (DCIs). However, plenty of quantization noise will be inevitably induced and seriously decrease the signal-to-noise ratio (SNR) of the generated signal and then deteriorate the system performance, especially for high-speed DCI systems. To be cost-effective and energy-efficient, a low-cost noise shaping technique is investigated to redistribute quantization noise, and a 100 Gb/s intensity modulation and direct detection (IM/DD) system using pulse amplitude modulation (PAM) and discrete multitone (DMT) signal generated by 4-bit DAC are experimentally demonstrated to illustrate the effectiveness of noise shaping technique in this work. After 2/40/80-km single-mode fiber (SMF) transmission, signal generated by 4-bit DAC and noise shaping technique presents the same performance as signal generated by 8-bit DAC at bit error ratio (BER) of 3.8×10^(-3).

11:45-12:00 | G29150

Spectrum Continuity and Contiguity Aware State Representation for Deep Reinforcement Learning-based Routing of EONs

Liufei XU, Yue-Cai Huang, Yun Xue, Xiaohui Hu

South China Normal University, China

Abstract—We study the deep reinforcement learning-based routing scheme for elastic optical networks. We claim the importance of proper state representation and propose a state representation with awareness of the spectrum continuity and contiguity constraints. Simulation results on NSFNet show our method outperforms previous approaches by 11.6%.

WORKSHOP / Sept. 17, 2021

<Workshop> Computational Imaging

Room LM106 (1F) | 一楼会议室 LM106

9:00-9:30 | Invited Speech: Jiamin Wu

Tsinghua University

Jiamin Wu is a Postdoctoral Fellow within the Institute for Brain and Cognitive Sciences at Tsinghua University. His current research interests focus on optical computing and biomedical imaging. He has published various papers in Cell, Nature Photonics, Nature Machine Intelligence, Physical Review Letters, and so on. He received his PhD degree (2019) and bachelor's degree (2014) in the Department of Automation from Tsinghua University under the supervisor of Professor Qionghai Dai. He has served as the Associate Editor of IEEE Transactions on Circuits and Systems for Video Technology.

----Invited Talk----

Scanning light-field microscopy with digital adaptive optics

Abstract—The rapid developments of artificial intelligence (AI) facilitate various applications from all walks of life, but also pose great challenges in its hardware implementation in terms of speed and energy with the explosive growth of data. Optical computing provides a distinctive perspective to address this bottleneck by harnessing the unique properties of photons including broad bandwidth, low latency, and high energy efficiency. In this talk, I will share our recent progress on large-scale neuromorphic optoelectronic computing in terms of reconfigurability, scalability, and robustness. I will also show that optoelectronic computing is well suited for several specific applications, which may be the entry points of optical computing in practice.

9:30-10:00 | Invited Speech: Xiaoli Liu

Shenzhen University

Xiaoli Liu is currently a professor and doctoral supervisor at Shenzhen University. He is mainly engaged in 3D structured light imaging and metrology, light filed 3D imaging. He has presided over 3 national-level projects research projects about multi-sensors network for high-efficiency 3D measurement. He published more than 100 papers, and won the Shenzhen Technology Invention Award and Guangdong Science and Technology Award.

----Invited Talk----

Active structured light field three-dimensional imaging and measurement method

Abstract—For optical three-dimensional (3D) imaging and measurement, light field (LF) imaging and structured illumination have their own advantages, but they also face their own problems to be solved. For this reason, we combined LF imaging and structured illumination, and studied the active structured LF 3D imaging and measurement methods. The LF imaging and structured illumination can be regarded as different encoding methods of the light signal in the detection and illumination process, respectively. The recording LF under structured illumination, that is, the structured LF, carries light direction information and phase encoding information at the same time. In the structured LF, on the one hand, the phase information carried by the LF can construct intensity-insensitive matching features, while providing coded information related to the depth of the measured scene; on the other hand, the phase information has the LF structure, and the LF imaging features can provide sufficient constraints for fringe analysis. We focus on the two main aspects of structured LF imaging calibration and phase encoding, mainly involving three parts: ray calibration and phase mapping, depth metric calibration and phase unwrapping.

10:00-10:30 | Invited Speech: Lu Rong

Beijing University of Technology

Dr. Lu Rong is an associate professor of Beijing University of Technology. He received B.S. degree in 2006 and Ph.D. degree in 2012 from Beihang University, China. From 2009 to 2011, he was a jointly Ph.D. student of University of California, Los Angeles. He is the dean of the Department of Optical Information, College of Physics and Optoelectronics. His research interests include optical information processing, digital holography, ptychography and terahertz imaging. He is the member of OSA, SPIE and COS.

----Invited Talk----

Continuous-wave terahertz lensless full-field imaging

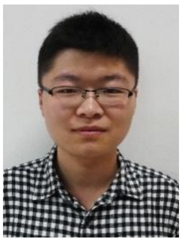
Abstract—With the development of THz sources and array detectors, continuous-wave (CW) THz full-field phase imaging widely applied in numerous scenarios. In this presentation, two lensless phase imaging approaches, i.e., THz digital holography (TDH) and THz ptychography, are introduced. The former method is capable of reconstruct the amplitude and phase distributions of the object wavefront which can be applied for real-time imaging. The latter one can get both the illumination distribution and large-size object's complex transmissive function simultaneously. Different recording configuration and reconstruction algorithms

are presented and compared.

10:30-10:45 | Coffee break

10:45-11:15 | Invited Speech: Shoucong Ning

National University of Singapore



Dr. Ning Shoucong got his bachelor's degree in 2013 at University of Science and Technology of China. Under prof. Zhang Tong-Yi's supervision, he got his Ph. D in mechanical engineering at Hong Kong University of Science and Technology in 2017. Currently, he works with Prof. Stephen Pennycook at the National University of Singapore, focusing on advanced electron microscopy techniques. His main research fields are electron ptychography/4D-STEM, atomic-scale 3D reconstruction using optical depth sectioning, in addition to quantitative analysis of electron microscopy data.

----Invited Talk----

Accurate Geometrical Calibration of Atom-resolved In-focus 4D-STEM Datasets

Abstract—Accurate calibration of geometrical parameters is critical in four-dimensional scanning transmission electron microscopy (4D-STEM) experiments for both quantitative imaging and electron ptychography reconstruction. Environmental disturbances such as mechanical vibrations make the well-defined geometric relationships between scanning positions and electron detectors vary for different 4D STEM datasets. Here, we propose an approach that consists of two key steps for the calibration of atom-resolved in-focus experimental datasets without priori-knowledge of imaged specimens and microscopes. The robustness of this approach will be quantitatively evaluated by introducing scanning distortions, lens aberrations, and other factors during 4D-STEM simulation. In addition, ptychography reconstruction will greatly benefit from our approach as will be shown during the experimental dataset processing. We believe the development of this approach will improve the quality and reproducibility of 4D-STEM data analysis, and hopefully accelerates the adoption of the 4D-STEM technique for material and biological research.

11:15-11:30 | G2946

White-light Non-line-of-sight Imaging via a Two-step Deep Learning Strategy

Shanshan Zheng, Meihua Liao, Fei Wang, Xiang Peng, Guohai Situ

Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

Abst—Non-line-of-sight (NLOS) imaging has recently received considerable attention for its ability to recover occluded objects from an indirect view. Different types of NLOS imaging techniques have emerged and have shown great potential for many applications as evidenced by recent advances. Also, a growing number of studies are progressing to meet the challenge of practical, real-time imaging. In view of the current research status, we naturally think about the situations that need to be considered in the practical application scenario, such as the motion/vibration of observers or surfaces, broad spectrum natural light, which would not allow for overly complex system structures or excessive data acquisition time. Here, we try to address the white-light NLOS imaging equipped only with an ordinary camera, which is outside of the usual laboratory constraints, especially the requirements of light coherence and system complexity. For the realistic incoherent systems, it's necessary to analyze the different contributions generated by various wavelengths of light and develop a scalable imaging method to deal with unknown or nonstatic scattering media. The general idea is that we consider combining deep learning with the physical model to provide better solutions and develop a robust two-step deep learning strategy, which allows real-time NLOS imaging even in the case of unknown or nonstatic surfaces.

In our scheme, we analyze the problem of wide-spectrum NLOS imaging in the actual experimental system, and attempt to demonstrate that it is still possible to realize white-light NLOS imaging without the geometric prior of the scene or complicated measurement systems. For the natural white-light illumination, as used in our experiments, there is a large broad spectrum ranging from 350 to 700nm, which is tens or even hundreds of times wider than speckle spectral decorrelation bandwidth. In our approach, the severe ill-posed NLOS inverse problem is decomposed into two slightly ill-conditioned problems: speckle autocorrelation procession and object image reconstruction. The former is supposed to solve the auto-correlation image degradation caused by multispectral aliasing, large object size and background noise, so as to enhance and identify the previously indistinguishable details, which can help the latter step to avoid the influence of useless background and learn more features during the training process to realize phase retrieval from the corresponding optimized autocorrelation, that is, to recover the occluded target information. In our method, two convolutional neural networks are employed to deal with them, respectively. Then, these two trained neural networks can be used to retrieve the hidden objects in real-time way. Optical experiments show that the two-step DL strategy has the unique advantages of generalization to new "walls" and other types of objects, as well as the robustness to the rotation and motion of objects/camera. That is, our proposed method has outstanding performance for white-light NLOS imaging with great flexibility and versatility.

11:30-12:00 | Invited Speech: Liangcai Cao

Tsinghua University

Liangcai Cao received his BS/MS and PhD degree from Harbin Institute of Technology and Tsinghua University, in 1999/2001 and 2005, respectively. Then he became an assistant professor at Department of Precision Instruments, Tsinghua University. He is now tenured professor and director of the Institute of Opto-electronic Engineering, Tsinghua University. He was a visiting scholar at UC Santa Cruz and MIT in 2009 and 2014, respectively. His research interests are holographic imaging and holographic display. He is SPIE fellow and OSA fellow.

----Invited Talk----

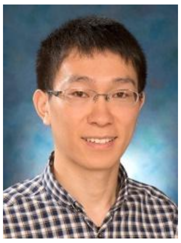
Lensless imaging based on compressive sensing and deep learning

Abstract—Lensless diffractive imaging records diffraction patterns without using lenses and recovers the complex field of object via holography or phase retrieval. The typical phase retrieval algorithms are very robust but still have limited noise suppression and long iteration time in some special cases. A challenging inverse problem remains due to the low reconstructed signal-to-noise ratio. We developed a couple of computational imaging algorithms using compressive sensing and deep learning. Compressive sensing imaging exploit the sparsity of target to eliminate the crosstalk and twin-image noise for digital holographic imaging. Compressive sensing imaging exploit the sparsity of target to eliminate the crosstalk and twin-image noise for Fresnel zone aperture (FZA) lensless imaging. Deep learning-based FZA imaging could achieve both high-quality and high-speed reconstruction.

12:20-13:30 | Lunch @ L3 of Hall 6 | 六号馆三楼

13:30-14:00 | Invited Speech: Zhen Chen

Cornell University



Zhen Chen is currently a Postdoctoral Associate in David A. Muller Group at Cornell University. He obtained his PhD degree from the Institute of Physics, Chinese Academy of Sciences in 2014. After that, he went to Monash University in Australia as a Research Fellow in 2014-2016. He has been awarded the Postdoctoral Awards and Microscopy Today Innovation Awards of Microscopy and Microanalysis Society of America.

----Invited Talk----

Lattice-vibration-limited resolution and depth sectioning enabled by multislice electron ptychography

Abstract—Ptychography is a quantitative phase contrast imaging technique and has been widely used in visible light and X-ray microscopy communities. Although initially proposed for electron microscopy, it has not been widely recognized in electron microscopy community until recently due to the instrumental limitations. In this talk, I will show our recent breakthroughs in resolution improvement using electron ptychography in transmission electron microscopy (TEM). We also demonstrate that high dose-efficiency of this technique enables atomic resolution imaging of fragile materials, such as 2D materials, energy materials, and biological macromolecules

Due to the strong electron-sample interaction in TEM, the multiplicative approximation required by conventional ptychography fails for samples thicker than a few nanometers, which are technically demanding to make for most of our samples. This multiple scattering dramatically hinders wide applications of ptychography in TEM. Maiden, et al. proposed a multislice extension of ptychography to solve the multiple scattering problem. We improved the robustness of multislice ptychography by overcoming many experimental imperfections. In this talk, I will also demonstrate our successful realization of atomic resolution ptychographic reconstructions of many layers in thick samples with a spatial resolution better than 20 pm. This resolution is very close to the thermal vibration limit of atoms in the sample at room temperature. Multislice electron ptychography also allows for directly detection of single atomic dopants embedded in crystalline samples. Therefore, this technique provides new opportunities in three-dimensional imaging of the atomic displacements near dopants, interfaces, and precipitates in semiconductors, catalysts, and quantum materials.

14:00-14:30 | Invited Speech: Huaidong Jiang

ShanghaiTech University

Huaidong Jiang is a professor of physics at the School of Physical Science and Technology in ShanghaiTech University, deputy general manager of Shanghai soft X-ray free electron laser beamline project. He obtained his PhD degree in materials science from the Shandong University in 2003. He then pursued his research in the National University of Singapore and the University of California Los Angeles as postdoctoral research fellow and assistant research professor from 2003 to 2010. He joined Shandong University as a professor in 2010. Since September of 2016, he joined ShanghaiTech University as a professor. His current research interests include quantitative 3D X-ray imaging with nano-resolution, biophysics, and optical functional materials.

----Invited Talk----

High-resolution coherent diffraction imaging with synchrotron and XFELs

Abstract—Coherent X-ray diffraction imaging, as a novel lensless imaging technique, provides a path to high-resolution

structural determination of noncrystalline specimens by using intensities of diffraction patterns. Since the first experimental demonstration in 1999, coherent diffraction imaging has been widely used in materials science and structural biology. Here, we illustrate a few applications of coherent X-ray diffraction microscopy to imaging single nanoscale particles and biomaterials, such as nanocrystals, virus, and cells. With coherent X-rays from 3rd generation synchrotron radiation sources and X-ray free electron lasers (XFEL), quantitative imaging experiments were performed using this technique, in which X-ray diffraction patterns are directly inverted to high-resolution images by using the oversampling iterative method. These results indicate that coherent diffraction imaging can provide a new tool for nondestructive and quantitative 3D characterization of a wide range of materials at nanometer-scale resolution.

14:30-15:00 | Invited Speech: Jinli Suo

Tsinghua University

Jinli Suo has obtained her MS from Shandong University in 2004 and PhD from Graduate University of Chinese Academy of Sciences in 2010. She is currently a tenured associate professor at Departmentof Automation, Tsinghua University. Her research interest mainly include computational imaging, both photography and microscopy. In the past decade, Dr. Suo has published around 60 academic papers and holds more than 20 invention patents in this field.

----Invited Talk----

Compressive Computational Photography beyond Megapixels

Abstract—High throughput imaging is benefical for efficient scene recording and successive analysis, and thus crucial for a diversity of applications. A camera's throughput is constrained by the physical limitations of the imaging systems, from lens SBP, storage and transmission bandwidth. Compressive computational imaging can increase the throughput of a camera by optically encoding the high dimentional high resolution visual information and computational decoding. However, the spatial light modulators widely used in compressive computational imaging are often limted to megapixels, and the reconstruction algorithms can not address such large scale data. In this talk I will present two recent work addressing the resolution limitation in current compressive cameras: (i)A bi-plane spatial light modulation for 10-Mega-pixel compressive imaging. (ii) A plug-and-play framework for large scale singleshot compressive imaging.

15:00-15:30 | Invited Speech: Zibang Zhang

Jinan University

Dr. Zibang Zhang is currently with the Department of Optoelectronic Engineering in Jinan University, Guangzhou, China. He mainly focuses on computational imaging and measurement, including single-pixel imaging, lensless computational microscopy, and fringe projection profilometry.

----Invited Talk----

Single-pixel imaging and single-pixel imaging-free techniques

Abstract—Single-pixel imaging is a computational imaging technique that allows image acquisition by using a spatially unresolvable detector (such as, photodiode). Benefiting from the removal of pixelated detectors, single-pixel imaging achieves imaging at non-visible wavebands in a low-cost manner, imaging under weak-light conditions, and other imaging schemes that tackle some limitations in conventional imaging. The key to single-pixel imaging is spatial information encoding through spatial light modulation. By employing proper spatial light modulation in illumination, detection, or both, 2D spatial information, 3D spatial information, multi-spectral information, or even multi-modality information can be encoded and acquired by using a single-pixel detector. The careful design of the structured patterns used in spatial light modulation also enables efficient spatial information acquisition. Benefiting from high-speed spatial light modulation techniques, single-pixel imaging can even capture images of fast-moving objects, or achieve fast-moving object detection, tracking, and classification in an imaging-free manner.

15:30-15:45 | Coffee Break

15:45-16:15 | Invited Speech: Michal Odstrcil

Zeiss SMT

Michal Odstrcil is a researcher at Zeiss SMT, where he develops algorithms for measurement of high-NA EUV free-form mirrors. Michal graduated from the University of Southampton, UK in the topic of laboratory-based EUV ptychography. His postdoctoral research was conducted at the Paul Scherrer Institute, Switzerland, in development of novel approaches for X-ray 3D ptychographic imaging.

----Invited Talk----

Ptychography for future high-brighness X-ray sources: Bigger, Better, Faster

Abstract—Ptychographic imaging with future generation X-ray sources will present many challenges in reduction of scanning overhead, effective use of photons and radiation damage-limited resolutionand ever increasing requirements on quantiativness of tomograms. Possible solutions of these issues will be discussed.

16:15-16:45 | Invited Speech: Andrew Maiden

University of Sheffield

Dr. Andrew Maiden is a Lecturer in Computational Imaging at the Unviersity of Sheffield, UK, and a Research Fellow at the Diamond Light Source, UK. He works on novel implementations and algorithms for coherent diffractive imaging and in particular ptychography.

----Invited Talk----

Electron ptychography using structured illumination

Abstract—Ptychography on the electron microscope has seen rapid progress over the last few years, thanks to new direct detection, ultra-fast, and highly sensitive "4DSTEM" detectors. Much of the research in the area focusses on atomic resolution imaging, where ptychography offers unique advantages of high contrast (especially for lighter elements) and insensitivity to lens aberrations. Parallel to this, however, ptychography can also provide high accuracy phase images at medium resolution, around the nanometre level, with a wealth of potential applications in material charaterisation and field measurement. We have shown recently how this medium scale phase imaging can be accomplished using near-field ptychography, adapted from the x-ray and visible light regimes for use on the transmission electron microscope. Our first proof-of-principle images demonstrate quantitative electron phase mapping over extremely large fields of view and at nanometer resolutions. In this talk I will present our latest results, suggest how our method can be improved, and explain the potential advantages of our approach.

16:45-17:15 | Invited Speech: Fucai Zhang

Southern university of science and technology

Dr Fucai Zhang holds the BSc and MSc degrees in Electronic Engineering from North China Electric Power University and PhD degree from Gunma University, Japan. He worked in the Institute of Applied Optics, University of Stuttgart, from 2004-2007, the University of Sheffield from 2007-2011, and then University College London, from 2011-2017. He moved to Southern University of Science and Technology and joined the Department of Electrical and Electronic Engineering as an Associate Professor in 2017. Current research interests are on method development for high-resolution microscopy at short wavelengths with synchrotron x-rays and electrons, particularly on the development phase retrieval algorithm and a new scheme of coherent diffractive imaging to meet the ever-increasing needs in biology and materials sciences.

----Invited Talk----

Novel approaches to coherent diffraction imaging

Abstract—In this talk, I will present some of our efforts in addressing the issues with single-shot conventional coherent diffraction imaging. This includes modulation-based methods, a multiple-illumination method, and a double detector distance method. We found that the introduction of modulation on diffracted object wavefield or the use of a more-than-two-plane algorithm in reconstruction can lead to a much-improved imaging technique with fast convergence and high robustness to data defects.

WORKSHOP / Sept. 18, 2021

<Workshop> Computational Imaging

Room LM106 (1F) | 一楼会议室 LM106

9:00-9:30 | Invited Speech: Jinyang Liang

INRS - University of Quebec

Dr. Jinyang Liang is an Assistant Professor at the Institut National de la Recherche Scientifique (INRS) – Université du Québec. He directs the Laboratory of Applied Computational Imaging (LACI). His research interests cover ultrafast imaging, high-precision laser beam shaping, and photoacoustic microscopy. His research primarily focuses on implementing optical modulation techniques to develop new optical instruments for applications in physics and biology. He has published over 60 journal papers and conference proceedings, including the ones in Nature (cover story), Nature Photonics, Nature Communications, Science Advances, Light: Science and Applications, Reports on Progress in Physics, Laser & Photonics Reviews (cover story), and Optica. He holds 4 patents on high-speed optical imaging technologies. He received the 2019 – 2022 Research Scholarship from FRQS, the 2019 Young Scientist Prize from IUPAP, the 2017 Educational Award–Gold from Edmund Optics, and the 2017 Discovery Accelerator Supplement Award from NSERC. He received his B.E. degree in Optoelectronic Engineering from Beijing Institute of Technology in 2007, and his M.S. and Ph.D. degrees in Electrical Engineering from the University of Texas at Austin, in 2009 and 2012. From 2012 to 2017, he was a postdoctoral trainee at Washington University in St. Louis and California Institute of Technology.

----Invited Talk----

Compressed ultrafast photography in the ultraviolet spectrum and for picosecond stereo-polarimetric imaging

Abstract—Compressed ultrafast photography (CUP) is a novel computational imaging modality that synergizes compressed sensing with streak imaging. It currently holds the world record of the fastest receive-only photographic technique with an imaging speed of 10 trillion frames per second. This talk will briefly review the working principle of CUP technologies and discuss two recent advances. First, we will present the development of a new streak tube for CUP in the ultraviolet spectral range [Laser Photonics Rev 14, 2000122 (2020)]. We will also discuss the ultrafast imaging of polarization dynamics in 2D/3D space using CUP [Nat. Commun. 11, 5252 (2020)]. It is envisaged that CUP will continuously advance in hardware improvement, software development, and application exploration.

9:30-10:00 | Invited Speech: Guoan Zheng

University of Connecticut

Dr. Guoan Zheng received the B.S. degree in Electrical Engineering from Zhejiang University in 2007, M.S. and Ph.D. degrees in Electrical Engineering from Caltech in 2008 and 2013. He joined the University of Connecticut in 2013 as an assistant professor. Currently, he is the United Technologies Corporation Associate Professor in the areas of Biomedical Engineering and Electrical Engineering. His current research efforts focus on the development of novel imaging tools to tackle measurement problems in biology and medicine. The Fourier ptychography approach he developed with his colleagues is now a subchapter in Goodman's textbook, "Introduction to Fourier Optics (4 edition)".

----Invited Talk----

Ptychographic structured modulation for super-resolution imaging

Abstract—Achieving high spatial resolution is the goal of many imaging systems. Designing a high-resolution lens with diffraction-limited performance over a large field of view remains a difficult task in optical system design. In this talk, I will discuss a coherent imaging technique, termed ptychographic structured modulation, for quantitative super-resolution microscopy. In this technique, we place a thin diffuser in between the sample and the detection optics to modulate the complex light waves from the object. The otherwise inaccessible high-resolution object information can thus be encoded into the captured images. We then employ a ptychographic phase retrieval process to jointly recover the exit wavefront of the complex object and the unknown diffuser profile. Unlike the illumination-based super-resolution approach, the recovered image of our approach depends upon how the complex wavefront exits the sample -- not enters it. Therefore, the sample thickness becomes irrelevant during reconstruction. After recovery, we can propagate the super-resolution complex wavefront to any position along the optical axis. We validate our approach using both a lens-based and a lensless setup. We demonstrate a 4.5-fold resolution gain over the diffraction limit in the lens-based setup. We also demonstrate a half-pitch resolution of 308 nm in the lensless setup. The reported approach may provide new super-resolution imaging strategies for coherent light, X-ray, and electron microscopy.

10:00-10:30 | Invited Speech: Chao Zuo

Nanjing University of Science and Technology

Dr. Chao Zuo is a professor at the department of Electronic and Optical Engineering, Nanjing University of Science and Technology (NJUST). He is the principal investigator of the Smart Computational Imaging Laboratory (SCILab: www.scilaboratory.com) at NJUST where the research interest focuses on computational imaging and optical information processing. He has authored over 140 peer-reviewed journals publications, including more than 80 papers published in JCR Q1 journals with over 7,000 citations. He is Topical Editor of PhotoniX (10/2019-), Associate Editor of IEEE Access (03/2019-), Microwave and Optical Technology Letters (03/2019-). He has been selected into the Natural Science Foundation of China (NSFC) for Excellent Young Scholars and Outstanding Youth Foundation of Jiangsu Province.

----Invited Talk----

Intensity diffraction tomography (IDT)

Abstract—When it comes to ``phase measurement'' or ``quantitative phase imaging'', many people will automatically connect them with ``laser'' and ``interferometry''. Indeed, conventional quantitative phase imaging and phase measurement techniques generally rely on the superposition of two beams with a high degree of coherence: complex interferometric configurations, stringent requirements on the environmental stabilities, and associated laser speckle noise severely limit their applications in optical imaging and microscopy. On a different note, as one of the most well-known phase retrieval approaches, the transport of intensity equation (TIE) provides a new non-interferometric way to access quantitative phase information through intensity only measurement. Despite the insufficiency for interferometry, TIE is applicable under partially coherent illuminations (like the Kohler's illumination in a conventional microscope), permitting optimum spatial resolution, higher signal-to-noise ratio, and better image quality. In this talk, we provide an overview of the basic principle, research fields, and representative applications of TIE, focusing particularly on optical imaging, metrology, and microscopy. These results highlight a new era in which strict coherence and interferometry are no longer prerequisites for quantitative phase imaging and diffraction tomography, paving the way toward new generation label-free three-dimensional microscopy, with applications in all branches of biomedicine.

10:30-11:00 | Coffee Break

11:00-11:30 | Invited Speech: Kedar Khare

Indian Institute of Technology Delhi

Kedar Khare is an Associate Professor and Institute Chair at Indian Institute of Technology Delhi. He has wide ranging interests in computational imaging - both in terms of system and algorithm development. In recent years he has made a number of contributions to the problem of interferometric and non-interferometric phase retrieval as well as engineered laser beam propagation through random media. He serves as an Associate Editor for Journal of Modern Optics. Prof. Khare completed his early education with highest honors from Indian Institute of Technology Kharagpur and earned a PhD from The Institute of Optics, Univerity of Rochester, USA. Prior to becoming a faculty member at IIT Delhi, he also spent several years at General Electric Global Research, USA in the Imaging Technologies division.

----Invited Talk----

Complexity guided Fourier phase retrieval

Abstract—We will describe an improved phase retrieval strategy refferred to as "complexity guidance" that may be used wth any phase retrieval algorithm such as the HIO method to recover stagnation artefact free image recoveries. The main idea behind this method is the use of a complexity parameter which measures the expected fluctuation in the phase retrieval solution. The complexity parameter can be estimated directly from the raw Fourier magnitude data and can be used as a guidance mechanism for applying constraints (e.g. sparsity) in the object domain. The noise-robust nture of complexity guided Fourier phase retrieval will be illustrated with simulations and some initial experimental results.

11:30-12:00 | Invited Speech: Guohai Situ

Shanghai Institute of Optics and Fine Mechanics

Prof. Guohai Situ is a professor with the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences (CAS) since 2012, leading a CAS Interdisciplinary Innovation Group of Computational Optical Imaging. His research interests include a wide range of computational optical imaging in particular based on deep learning, with current focus on imaging through optically thick scattering media, computational ghost imaging, and phase imaging. So far he has published 70 papers in leading journals including Nature Photonics and Light, receiving more than 4600 citations according to Google Scholar. He has delivered more than 30 Plenary, Keynote, Tutorial, and Invited conference talks, and served as chair, program chair, and program committee member in many conferences around the world. He is currently a committee member of the SPIE Dennis Gabor Award.

----Invited Talk----

Physics Enhanced Deep Neural Networks for Computational Imaging

Recently we have witnessed the impact of deep neural networks (DNN) to the field of computational imaging (CI). Usually, a DNN should be trained on a specific training dataset before it can be used to solve the corresponding CI problem. The DNN trained in this way is fundamentally a black box, lack of deep understanding of its applicability. Here we report our recent works on physics-driven untrained deep neural networks (PhysenNet) for computational imaging. The PhysenNet employs a strategy that incorporates a physical imaging model into a conventional DNN. PhysenNet has two apparent advantages. First, it does not need to be trained on any dataset. Instead, it just requires the data to be process as its input. The interplay between the physical model and the randomly initialized DNN provides a mechanism to optimize the DNN, and produce a good reconstruction. Second, the reconstructed image satisfies the constraint imposed by the physical model so that it is interpretable. We will take phase imaging and computational ghost imaging as examples to demonstrate the principle.

12:20-13:30 Lunch @ L3 of Hall 6 | 六号馆三楼

AGENDA OVERVIEW (Virtual Part)

Sept. 15, 2021

10:00-17:00

Zoom Meeting ID	*Room 1* *ID: 979 0046 1385*	*Room 2* *ID: 930 3313 8929*
Item	**Invited Speaker Equipment Test**	**Authors Equipment Test**

Sept. 16, 2021

14:30-17:00 Virtual Sessions

Zoom Meeting ID	*Room 1* *ID: 979 0046 1385*	*Room 2* *ID: 930 3313 8929*	*Room 3* *ID: 827 9043 9167*	*Room 4* *ID: 816 7808 8000*
Session No.	V01	V02	V03	V04

***V01: Laser Technology** <Chair: Longqing Cong>
Invited Speeches (Mohammed Zahed Mustafa Khan; Yanhua Luo);
Oral Presentations (G2977, G2952, G2929, G295)

***V02: Optical Communication and Networks - A** <Chair: Biao Chen>
Invited Speeches (Wenjia Zhang; Chongfu Zhang); Oral Presentations (G2955, G29151, G2974, G2935)

***V03: Near-infrared, Mid-infrared and Far-infrared Technologies and Applications** <Chair: Chuantao Zheng>
Invited Speeches (Yuan Ren; Chuantao Zheng; Wenxue Li); Oral Presentation (G29125)

***V04: Quantum Optics and Information** <Chair: Qiang Zhou>
Invited Speeches (Jie Zhao); Oral Presentations (G2944, G2979, G2958, G2954)

Sept. 17, 2021

10:00-12:15 Virtual Sessions

Zoom Meeting ID	*Room 1* *ID: 979 0046 1385*	*Room 2* *ID: 930 3313 8929*	*Room 3* *ID: 827 9043 9167*	*Room 4* *ID: 816 7808 8000*
Session No.	V05	V06	V07	V08

***V05: Biophotonics and Optical Biomedicine** <Chair: Wenjun Ni>
Invited Speeches (Quan Liu; Zhenhua Hu; Tzuen-Rong Jeremy Tzeng);
Oral Presentations (G29139, G2916)

***V06: Optoelectronic Devices and Applications** <Chair: Mengyuan Ye>
Invited Speeches (Changzheng Sun; Mengyuan Ye; Weiqiang Xie; Sunny)

***V07: Perovskite Materials and Optoelectronic Applications** <Chair: Aung Ko Ko Kyaw>
Invited Speeches (Jia Lin; Yongbo Yuan; Hin-Lap Yip); Oral Presentation (G2911)

***V08: AI Photonics** <Chair: Hongwei Chen>
Invited Speeches (Sabidur Rahman; Avishek Nag; Bhavin J. Shastri; Tian Zhang);
Oral Presentation(G29118)

12:00-13:30 Break

14:30-17:00 Virtual Sessions

Zoom Meeting ID	*Room 1 ID: 979 0046 1385*	*Room 2 ID: 930 3313 8929*	*Room 3 ID: 827 9043 9167*	*Room 4 ID: 816 7808 8000*
Session No.	V09	V10	V11	V12

***V09: Silicon Photonics** <Chair: Wei Jiang>
Invited Speeches (Yating Wan; Huang Ying; Xu Wang; Wei Jiang); Oral Presentation (G29143)

***V10: Fiber-Based Technologies and Applications** <Chair: Yunqi Liu>
Invited Speeches (Wei Yan; Yu Cheng); Oral Presentations (G29115, G2957, G29123, G2999)

***V11: Near-infrared, Mid-infrared and Far-infrared Technologies and Applications** <Chair: Jiagui Wu>
Invited Speeches (Jiagui Wu; Peng Wang; Xiaoqiong Qi; Hairui Guo); Oral Presentation (G2951)

***V12: Optical Communication and Networks** <Chair: Chen Chen>
Invited Speeches (Chen Chen; Fangzheng Zhang; Biao Chen; Xian Zhou);
Oral Presentations (G2978, G2933, G2917)

Sept. 18, 2021

10:00-12:00 Virtual Sessions

Zoom Meeting ID	*Room 1 ID: 979 0046 1385*	*Room 2 ID: 930 3313 8929*	*Room 3 ID: 827 9043 9167*	*Room 4 ID: 816 7808 8000*
Session No.	V13	V14	V15	V16

***V13: Translational Photomedicine and Biophotonics** <Chair: Wenbo Hu>
Invited Speeches (Huilin Shao; Wenbo Hu); Oral Presentations (G2931; G2932)

***V14: Quantum Optics and Information** <Chair: Xuejian Wu>
Invited Speeches (Saijun Wu; Yogesh S. S. Patil; Tongcang Li; Jiafeng Cui)

***V15: AI Photonics** <Chair: Jianqiang Li>
Invited Speeches (Hsuan-Tung Peng; Nan Hua; Ching Eng PNG)

***V16: THz Metamaterials and Device Applications** <Chair: Jingbo Wu>
Invited Speeches (Yihao Yang; Jingbo Wu; Kaveh Delfanazari)

14:30-17:30 Virtual Sessions

Zoom Meeting ID	*Room 1 ID: 979 0046 1385*	*Room 2 ID: 930 3313 8929*	*Room 3 ID: 827 9043 9167*	*Room 4 ID: 816 7808 8000*	*Room 5 ID: 896 3784 6459*
Session No.	V17	V18	V19	V20	V21

***V17: Perovskite Materials and Optoelectronic Applications** <Chair: Aung Ko Ko Kyaw>
Invited Speeches (Wei Lin Leong; Vincenzo Pecunia; Yuxi Tian, Bo Xu, Zhanhua Wei); Oral Presentation (G29159)

***V18: Quantum Optics and Information** <Chair: Yong-Chun Liu>
Invited Speeches (Shau-Yu Lan; Xuejian Wu; Wei Zhang; Chunlei Qu; Victoria Xu; Yong-Chun Liu)

***V19: Fiber-Based Technologies and Applications** <Chair: Xia Yu>
Invited Speeches (Wonkeun Chang; Shifeng Zhou); Oral Presentations (G2961, G2940, G2948, G2928)

***V20: AI Photonics** <Chair: Chaoran Huang>
Invited Speeches (Xin Yuan; Jianning Lu; Chaoran Huang; Shi Yan; Yubin Zang)

***V21: Liquid Crystal Photonics** <Chair: Jiangang Lu>
Invited Speeches (Jiangang Lu; Lishuang Yao; Yong Xie; Jingxia Wang)

Guideline of Virtual Talks

1. **Time Zone**
   - China Standard Time (CST) UTC/GMT+08:00
   - Please make sure that both the clock and the time zone on your computer are set to the correct China Time
2. **Equipment Needed**
   - A computer with an internet connection (wired connection recommended)
   - USB plug-in headset with a microphone (recommended for optimal audio quality)
   - Webcam(optional): built-in or USB plug-in
3. **Environment Requirement**
   - Quiet Environment
   - Stable Internet Connection
   - Proper lighting
4. **Platform: ZOOM**
   - For Users from mainland China: www.zoom.com.cn/download
   - For General Users: https://zoom.us/support/download
5. **Zoom Help Center**
   - https://support.zoom.us/hc/en-us/articles/206175806
6. **Sign In and Join**
   - Join a meeting without signing in: A Zoom account is not required if you join a meeting as a participant, but you cannot change the virtual background or edit the profile picture
   - Sign in with a Zoom account: All the functions are available
7. **Additional Suggestions**
   - A computer with an internet connection (wired connection recommended)
   - USB plug-in headset with a microphone (recommended for optimal audio quality)
   - Webcam (optional): built-in or USB plug-in
   - Stable Internet Connection
   - Quiet environment
   - Proper lighting
   - Formal dress
8. **Voice Control Rules**
   - The host will mute all participants while entering the meeting.
   - Speakers can unmute microphone when it is turn for his or her presentation.
   - Q&A goes after each speaker, the participant can raise questions.
9. **Oral Presentation**
   - Regular Author Presentation: a maximum of 15 minutes in total.
   - Invited talk: a maximum of 30 minutes in total.
   - Please join the meeting room 10 minutes in advance.
10. **Conference Recording**
    - The whole conference will be recorded. We appreciate you proper behavior and appearance.
    - The recording will be used for the conference reports among the committee. It won't be distributed to or shared with anyone else, and it shall not be used for commercial nor illegal purpose. It will only be recorded by the staff, the presenters are not allowed to record.

VIRTUAL SESSIONS / Sept. 16, 2021

V01: Laser Technology
Zoom Meeting Room 1
ID: 979 0046 1385 | Time: 14:30~16:30
Session Chair: **Longqing Cong**, Southern University of Science and Technology, China

14:30~15:00 | Invited Speaker: Mohammed Zahed Mustafa Khan

MOHAMMED ZAHED MUSTAFA KHAN received the B.E. degree from Osmania University, India, in 2001, and the M.S. and Ph.D. degrees in electrical engineering from King Fahd University of Petroleum and Minerals (KFUPM) and King Abdullah University of Science and Technology (KAUST), Saudi Arabia, in 2004 and 2013, respectively.

From 2014 to 2015, he was a SABIC Postdoctoral Research Fellow with Photonics Laboratory, KAUST. Since 2015, he is with Electrical Engineering Department, KFUPM, where he is currently an Associate Professor. His prior research involved developing numerical models for integrated optical device simulation. His current research focuses on the development of near-infrared and visible semiconductor lasers and systems for applications in optical communications. Dr. Khan is a senior member of the IEEE and OSA.

----Invited Talk----
Semiconductor InAs/InP Quantum-dash Lasers in Tbit/s Optical and 5G Wireless Networks

Abstract—InAs/InP Quantum-dash (Qdash) nanostructure-based semiconductor lasers has shown tremendous progress in the past decade with application spanning from a wavelength division multiplexed green optical communication to very recently, millimeter-wave (MMW) applications. This waveguide-based laser has demonstrated a rule-changing broad multiwavelength lasing spectrum, thanks to the inherent and wavelength tunable broad gain profile offered by the Qdash active-gain region covering C- and L-band regions. Moreover, exploiting mode-locking and injection locking, highly coherent Qdash comb laser have been realized that opened a new paradigm for deployment of this new class of semiconductor device in green optical and 5G wireless networks. In this talk, recent progress on utilization of InAs/InP Qdash laser source, supporting several sub-carriers, in energy-efficient 1550 and 1610 nm wavelength division multiplexed optical networks will be discussed, exhibiting data capacity in Tbits/s. Moreover, very recent deployment in radio-over-fiber and millimeter wave (MMW) wireless networks will also be presented, concentrating on the 28-60 GHz frequency spectrum.

15:00~15:30 | Invited Speaker: Yanhua Luo

Dr Yanhua Luo received his B.E and PhD degrees from University of Science and Technology of China (UTSC) in 2004 and 2009, respectively. Currently, he works as a deputy director of Photonics & Optical Communications at University of New South Wales (UNSW) to maintain the National Joint Fibre Facility at UNSW and develop the next generation functional specialty optical fibers and their devices. So far he has held 2 China patents and co-authored over 200 refereed journal/conference papers and 10 book chapters on these subjects. In 2018, Dr. Luo was elected as both IEEE Senior Member and OSA Senior Member.

----Invited Talk----
3D Printing Based Specialty Optical Fibers and Their Photonics Applications

Abstract—Traditional optical fiber manufacturing processes, such as chemical vapor deposition (CVD) and stacking processes, are generally limited by the centered design or centered symmetry. With the development of information society, there is more and more demand for specialty optical fibers with more complex structures. The traditional technology can no longer meet the application requirements. Meanwhile, 3D printing technology, as a disruptive manufacturing technology, offers greater flexibility and diversity in material and structure designs. It has become a key enabling technology, allowing the manufacture of polymer optical fibers (POF), soft glass fibers and silica optical fibers. This technology not only realizes the arbitrary design and manufacture of specialty optical fiber, but also realizes the manufacture of diversified optical fiber materials. Therefore, 3D printing optical fiber technology enables a new generation of specialty optical fiber with materials and structures that have been impossible so far. In addition, these 3D printed specialty optical fibers offer more opportunities and applications for the development of the specialty optical fiber devices, like fiber sensor, fiber splitter, fiber filter, etc. It is expected to bring a major breakthrough in optical fiber manufacturing, Internet of Things, optical communications, etc.

15:30~15:45 | G2977

High-Power Multi-wavelength DFB Laser Array

Yuxin Ma, Xingtao Zeng, Yuechun Shi, Zhenxing Sun and Xiangfei Chen
Nanjing university, China

Abstract—We have fabricated a 16-wavelength 1200um DFB laser array with high precision channel spacing based on the reconstruction-equivalent-chirp (REC) technique. High power efficiency is obtained by utilizing the high-reflective coating and anti-reflective coating at both facets of the laser array. Good single-longitudinal-mode (SLM) operations are obtained by introducing equivalent π phase shifts by REC technique. Equivalent π phase shifts are implemented in the 1/5 laser cavity, which is close to the high-reflective coating. Due to the nanoscale of grating period, high precision control of grating phase structure is required in the practical fabrication. Therefore, the REC technique can provide the fabrication of high-precision grating. In terms of fabrication with REC technique, only holographic exposure is needed to produce a uniform basic grating and a micron-scale lithography to produce a sampling structure, instead of nanoscale fabrication with electron beam lithography. REC technique simplifies the fabrication and reduces the cost. Moreover, the feature manufacturing of sampling structure is extended from nanometer to micron, the precision of wavelength control is significantly improved 2 orders of magnitude and higher than that of traditional methods (such as electron beam lithography) in the theory. The average channel-spacing of the proposed high-power laser array is 1.63 nm, which is on 0.03 nm deviated from our design. The output power of all the 16 channels are above 100 mW at the biasing current of 350 mA and the average slope efficiency is 0.58 W/A at the temperature of 25 °C. Good single mode operations are obtained for all the 16 channels with the side mode suppression ratios of above 45dB. Besides, the relative intensity noise of the high output-power laser array is below -150 dB/Hz.

15:45~16:00 | G2952

Mode-locked thulium-doped fiber laser in multi-wavelength operation regime

Jincan Lin, Zilong Li, Zimin Zha, Huanhuan Liu and Hairun Guo
Shanghai University, China

Abstract—We demonstrate a tunable mode-locked thulium-doped fiber laser within a wide wavelength range 1880-1990 nm, in the regime of soliton mode-locking and multi-wavelength operation. The gain spectrum of the laser cavity is periodically modulated induced by the nonlinear polarization rotation (NPR) effect, which enables mode-locking at a number of selected wavelengths, individually and simultaneously. With Kelly sidebands in the soliton spectrum, we further extract a wavelength-dependent cavity net dispersion that may contribute to the knowledge of thulium-doped fiber laser systems as well as cavity dissipative soliton dynamics at the onset of mid-infrared range.

16:00~16:15 | G2929

Optimal design of high-speed electro-absorption modulated laser based on double stack active layer structure

Yuanxin Sun, Huayu Jia, Yonghua Xiong and Dengao Li
Taiyuan University of Technology, China

Abstract—This paper aims to further improve the response speed of the selective area growth double-stack active layer structure electro-absorption modulated laser (SAG-DSAL-EML) in a high-frequency modulation environment and improve the far-field divergence angle characteristics of the laser. We present a new structure of SAG-DSAL-EML. The new structure SAG-DSAL-EML active area into mesa structure and adopts iron-doped buried technology to complete the waveguide structure design. Iron-doped InP layers are grown on both sides of the active zone, which can effectively improve the high-speed frequency response characteristics of the modulator while improving the far-field divergence angle characteristics of the chip. In this paper, the Advanced Laser Diode Simulation (ALDS) software is used for simulation analysis, and it is compared and verified with the fabricated high-speed electro-absorption modulated laser sample chip with double active area laminated structure. Software analysis shows that compared with the ridge waveguide structure, the iron-doped buried structure has a smaller difference between the lateral and longitudinal angles of the far-field divergence angle, and the optical field coupling efficiency is better. Experiments show that the threshold current of the laser is 14.5mA at room temperature, and the side-mode suppression ratio of the laser at 1310nm is 45.64dB. The extinction ratio of the modulator under 3v reverse bias exceeds 16dB, and when the bias voltage is 0.9V, the modulation bandwidth under -3dB exceeds 40Ghz, which meets the basic requirements of high-speed laser communication.

16:15~16:30 | G295

Modeling and measurements of metastable argon atoms in a radio-frequency capacitive discharge

Zhifan Zhang, Zhifan Zhang, Pengfei Sun, Peng Lei, Duluo Zuo and Xinbing Wang,
Huazhong University of Science and Technology, China

Abstract—The metastable rare gas atoms are used as lasing species for optically-pumped rare gas laser (OPRGL), which are mainly produced by electrical discharge. Radio-frequency (RF) capacitive discharge is a promising technique for the continued production of the large volume needed for OPRGL systems. In this work, we examined the feasibility of using a RF discharge to produce a continuous gain medium with a gain volume of 4 cm3. Metastable argon atoms were measured using tunable Ti: sapphire laser absorption spectroscopy. Simulations of an -mode RF discharge are performed for varying mixtures of argon and helium using a one-dimensional model. The model is validated qualitatively and quantitatively by measurement in many aspects. The measured and simulated results indicated that the metastable densities decrease with the pressure and reach a peak as the Ar-fraction increases. The model predicted a 35 times increase in peak power with respect to the continuous wave power by use of the cavity dumping technique.

V02: Optical Communication and Networks
Zoom Meeting Room 2
ID: 930 3313 8929 | Time: 15:00~17:00

Session Chair: **Biao Chen**, Zhejiang University, China

15:00~15:30 | Invited Speaker: Wenjia Zhang

Wenjia Zhang received the B.S.E degree (2007) and PhD (2012) from Beijing University of Posts and Telecommunications. He visited the Lightwave Research Laboratory at Columbia University from Sep. 2010 to Mar. 2012. He was with Singapore-MIT Alliance for Research and Technology (SMART) as a postdoc researcher from Aug.2012 to Jun.2014 and with Finisar Shanghai as a senior optical engineer from Jun.2014 to Nov.2015. He joined Shanghai Jiao Tong University at Dec.2015 now as an associate professor. His research interests include integrated optical interconnect and computing.

----Invited Talk----

Compressed Nonlinear Equalization for Short Reach Optical Interconnects

Abstract—The ever-increasing bandwidth requirement in data centers will demand for 100 and 200 Gbps/lane intensity modulation and direct detection (IM/DD) technologies to provide high energy and cost-efficient data connectivity. In order for reliable data communication, digital signal processing (DSP) technologies such as maximum likelihood sequence estimation (MLSE), Volterra-series based equalization (VE) and neural network based equalization (NNE) have been proposed to provide powerful and flexible compensation capability for dealing with linear and nonlinear signaling impairments. In this talk, we will discuss the compressed nonlinear equalization including VE and NNE for short reach optical interconnects. In order to implement nonlinear equalizers for real-time applications, we will comment on the equalization performance and stability of pruning algorithms, and the challenges of hardware implementation. We believe that the smart algorithms implemented in the advanced processing chip will become a disruptive solution for optical module architecture.

15:30~16:00 | Invited Speaker: Chongfu Zhang

Dr. Chongfu Zhang, received the Ph.D. degree from the University of Electronic Science and Technology of China (UESTC), China, in 2009. From 2013 to 2014, he was a Visiting Scholar with OCLAB, University of Southern California. He is currently a full Professor of Communication and Information System with UESTC. He was selected by the program for new century excellent talents in university by the Chinese Ministry of Education. He has authored or co-authored over 100 papers, and has over 60 patents. His current research focuses on broadband access networks, optical wireless communications, and optical signal processing. He is a senior member of the IEEE and member of the OSA. Along with colleagues, he has received six awards of science and technology from nation, province or ministry.

----Invited Talk----

Fiber-Wireless Technologies with Reconfigurable Intelligent Surfaces for Millimeter-wave C-RAN

Abstract—To achieve the required capacity KPIs, many works favor ultra-dense millimeter-wave (mmWave) small cells. Consequently, the cloud radio access network (C-RAN) provides an efficient solution to connect these dense mmWave small cells. Analog-Radio-over-Fiber (A-RoF) can employ all major hardware within the centralized BBUs, and thus it is essential to implement the C-RAN, i.e., the fiber-wireless systems. The integration of multiple-input multiple-output (MIMO) and mmWave communications is one of the key technologies for future fiber-wireless access networks. Moreover, reconfigurable intelligent surfaces (RISs), as the extension of MIMO technologies for fiber-wireless access networks, have received considerable attention recently. Introducing the RISs into the mmWave C-RAN makes the training and feedback overheads increase dramatically. The low-complexity precoding and the cost-effective beamforming implementation are still major challenges in the RIS-empowered mmWave C-RAN. Herein, some heuristic schemes about the limited feedback for the RIS-empowered mmWave C-RAN are discussed and the future development of RIS-based fiber-wireless systems is also prospected.

16:00~16:15 | G2955

Investigation of InAs/InP Quantum-dash Laser as a Source in 28 GHz MMW wireless QPSK Transmission

Mohammed Zahed Mustafa Khan, Q. Tareq, A. Ragheb, M. Esmail, S. Alshebeili
King Fahd University of Petroleum and Minerals, Saudi Arabia

Abstract—Generation and transmission of 28 GHz millimeter-wave signal are reported from a simple and costeffective self-injection-locked InAs/InP quantum-dash-laser based dual-wavelength source emitting in mid-L-band. arrowlinewidth with low phase-noise of ~-120 dBc/Hz and successful transmission of 2Gbps QPSK signal over 2 m wireless channel is demonstrated

16:15~16:30 | G29151

Design of Visible Light Communication Transceiver System

Han Liu, Fanshu MA
University of Science and Technology Beijing, Beijing, China

Abstract—Visible light communication technology is a wireless optical communication technology based on LED lighting.

Making use of the high speed response characteristic of LED, visible light communication technology can realize the dual functions of lighting and communication. As a new way of data access and a supplement to radio frequency communication, visible light communication has been widely concerned. This paper is based on the development of application-oriented visible light communication system based on intelligent terminal, in order to accelerate the practical process of visible light communication. By changing the traditional visible light receiving scheme and using smart phone as the receiving device of the visible light system, a visible light communication system based on intelligent terminal is built. Through the research on the existing receiving algorithm, a new receiving algorithm is proposed to improve the adaptability and BER performance of the system.

16:30~16:45 | G2974

Analysis of THz Earth-Satellite Link Capacity in the Mid-Latitude Regions

Muhammad Saqlain, Nazar Muhammad Idrees, Shiwei Wang, Lu Zhang, Xianbin Yu
Zhejiang University, Hangzhou, China

Abstract—Terahertz (THz) communication is considered a
favorable technology for future non-terrestrial high data-rate applications due to huge bandwidth available. However, THz signals suffer from scattering loss due to clouds, rain, and snow, along with water vapor attenuation in the path, particularly when establishing a geostationary-satellite-to-earth-station (GEO-ES) THz link. In this work, we theoretically analyze the effect of snow and rain particle scattering on the communication capacity
of GEO-ES links in the selective THz bands (140 GHz, 220 GHz, and 345 GHz), and evaluate the data capacity of a GEO-ES optoelectronic link in the mid-latitude regions. The analysis results show that under the cloud and dry snow scenarios, the capacity has some potential to support reasonable data rates in the 140 and 220 GHz bands for a GEO-ES link.

16:45~17:00 | G2935

Adaptive Diversity Combining Technology with Deep Neural Network for High-Speed and Reliable Underwater Visible Light Communication System

Wangwei Shen, Hui Chen, Zhongya Li, Junhui Hu, Sizhe Xing, Chao Shen, Ziwei Li, Junwen Zhang and Nan Chi
Fudan University, China

Abstract—We proposed and experimentally demonstrated a high-speed and reliable underwater visible light communication (UVLC) system using single-input multi-output (SIMO)-based adaptive diversity combining technology (ADCT) with deep neural network (DNN) for performance enhancements. The Maximum Ration Combine (MRC) algorithm is used for ADCT with SIMO receiver-array to combat the underwater turbulence, and the multi-layer perception (MLP)-based DNN is employed to compensate the nonlinearity impairments. To the best of our knowledge, this is the first study to combine SIMO system, MRC algorithm and MLP in the UVLC system, achieving a maximum 2.4Gbps data transmission in balanced received-power case and a 0.25 Gbit/s data-rate increase while maintaining system stability in unbalanced received-power case under the BER threshold of 1x10-2.

V03: Near-infrared, Mid-infrared and Far-infrared Technologies and Applications

Zoom Meeting Room 3

ID: 827 9043 9167 | Time: 14:30~16:15

Session Chair: **Chuantao Zheng,** Jilin University, China

14:30~15:00 | Invited Speaker: Yuan Ren

Yuan Ren received the Ph.D degree in astrophysics from the Delft University of Technology, Delft, The Netherlands, in 2012, and from the Purple Mountain Observatory, Nanjing, China, in 2013.
From 2013 to 2016, he was a Research Associate with the Cavendish Laboratory, University of Cambridge, Cambridge, U.K. Since 2017, he has been a Professor with the Purple Mountain Observatory. His research interests include the development of terahertz heterodyne spectrometer for astronomic and atmospheric applications.

----Invited Talk----

Terahertz Two-dimensional Phase Gratings

Abstract—High efficiency and accuracy phase gratings are of crucial importance for large format heterodyne array receivers at terahertz frequencies. Here, we report the development of a design approach that can create gratings with arbitrary two-dimensional diffraction distributions. In addition, we report the realization of up to 10×10 diffraction beam two-dimensional phase grating designs at terahertz wavelengths, using an adaptation of the Gerchberg-Saxton (GS) scheme known as the Mixed-Region-Amplitude-Freedom algorithm. Rigorous full wave simulation proves the efficiency and accuracy of the design, which overcomes the inaccurate intensity of the beam distribution drawbacks originated from the standard GS algorithm. The results pave the way for the development of large-pixel terahertz multi-beam heterodyne receivers.

15:00~15:30 | Invited Speaker: Chuantao Zheng

Chuantao Zheng is a Professor in State Key Laboratory of Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, China. His research interests includeinfrared laser spectroscopy and gas sensing system. He achieved the young and middle-aged leading scientific and technological innovation talents in Jilin Province in 2018. He is a senior member of China Optical Society, a senior member and director of the Optical Society. Jilin province, and also a member of organizing committee of national laser spectral technology academic forum. In 2005, 2007 and 2010 he obtained the Bachelor, Master and Ph. D degree from Jilin University. In September 2013, he became an associate professor. In December 2016, he became a Ph.D supervisor. From September 2015 to September 2016, he went to Rice University as a visiting scholar. He was appointed as a full professor in September 2018. He has undertaken 19 projects supported by National Natural Science Foundation of China, National Key R & D Program. As a first or corresponding author, he has published over 170 peer-reviewed papers. He has applied for 12 national invention patents (8 authorized), published one academic monograph, and won the Jilin Natural Science Academic Achievement Award in 2014.

----Invited Talk----

Quartz-enhanced photothermal and photoacoustic spectroscopy in the near-infrared for gas sensing

Abstract—Gas sensors are important for multiple application scenarios, such as chemical substance detection and environmental pollution monitoring. The development of quartz tuning fork (QTF) based quartz-enhanced photoacoustic and photothermal spectroscopy (QEPAS/QEPTS) was reported. With respect to QEPAS, a novel QTF-embedded off-beam QEPAS (E-OB-QEPAS) spectrophone configuration was used to improve sensitivity and the optical-acoustic couplingstrength , and decrease the difficulty in assembly process and alignment process. Based on E-OB-QEPAS spectrophone, a sensitive methane sensor system and a dual-gas methane/acetylene sensor system were developed. With respect to QEPTS, an all-fiber QEPTS configuration was used to solve the problems of large size, optical light path alignment and integration process in free-space QEPTS. Then, a wavelength-locked QEPTS-based methane sensor system was proposed by utilizing a fiber-coupled sensing probe for long-distance in-situ gas sensing. At last, a double spot-ring Herriott-cell was used to realize a wide detection range and high detection sensitivity simultaneously in the QEPTS-based gas sensor system.

15:30~16:00 | Invited Speaker: Wenxue Li

Wenxue Li received the Ph.D. degree in physics from East China Normal University. In 2008, she joined East China Normal University as assistant professor, where she became full Researcher in 2014. Dr. Li's Current research interests include high power lasers, precision measurement and ultrafast science.

----Invited Talk----

Femtosecond Optical Frequency Combs and Dual-comb Spectroscopy

Abstract—Fiber optical frequency comb (OFC) system has attracted much attention on science applications such as distance measurement, coherent anti-stokes Raman scattering spectroscopy (CARS), and atomic spectroscopy. Especially, high-power infrared fiber OFCs can provide a high-resolution potential to molecular spectroscopy, sensing, and imaging based on a developing dual-comb technique. We propose a low-noise high-power fiber amplifier. Through OFC locking technique, we control the repetition rate and carrier envelop phase, and realize a high-power broadband ultrafast fiber OFC. Moreover, we construct a dual-comb measurement system consisting of two homemade broadband OFCs, an interferometer unit, an imaging unit and a spectroscopy unit. We demonstrate a spectrum-encoded three-dimensional imaging research. We also realize a dual-comb molecular spectroscopy of ethylene via an optically modulation dual-comb system with a teeth resolution.

16:00~16:15 | G29125

Long wavelength (λ>13 μm) quantum cascade laser based on diagonal transition and three-phonon-resonance design

Yuhao Jin, Qi Jie Wang

Nanyang Technological University, Singapore

Abstract—An InP-based quantum cascade laser structure emitting at a wavelength of 13.6 μm is proposed and demonstrated. The active region is based on a diagonal transition and three-phonon-resonance design. A 5 mm long, 30 μm wide high-reflection (HR) coated device with a double channel ridge waveguide structure has shown a threshold current density of 3.0 kA/cm2, a dynamic range of 4.4 kA/cm2, a peak output power close to 1 W, and an average optical power up to 11.7 mW at 3% duty cycle, at 293 K. The laser shows a characteristic temperature T0 of 314 K and T1 of 336 K over a temperature range from 283 to 313 K.

This work was partially supported by National Research Foundation Singapore programme (NRF-CRP18-2017-02 and NRF–CRP19–2017–01), and Singapore Ministry of Education Tier 2 MOE2018-T2-1-176.

V04: Quantum Optics and Information
Zoom Meeting Room 4
ID: 816 7808 8000 | Time: 15:00~16:30

Session Chair: Qiang Zhou, University of Electronic Science and Technology of China, China

15:00~15:30 | Invited Speaker: Jie Zhao

Jie Zhao is currently a Photonics researcher at Nokia Bell Labs, USA. Before joining Bell Labs, She received her Ph.D. in Photonics from University of California San Diego in 2020. Her research focuses on integrated nonlinear photonic devices based on the thin-film lithium niobate material platform. She is particularly interested in the quasi-phase-matched three-wave mixing processes and their applications in both classical and quantum communications. She is a recipient of the Dean's Office Fellowship from UCSD in 2015 and the China National Scholarship from 2010 to 2013.

----Invited Talk----

Periodic poling of thin-film Lithium Niobate for second-harmonic generation and entangled photon-pair generation

Abstract—High-fidelity periodic poling of thin film lithium niobate (TFLN) waveguides is critical for robust, quasi-phase-matched three-wave mixing process such as second-harmonic generation and spontaneous parametric down conversion. Over the past decade, extensive research has been performed on design and fabrication of TFLN based optical waveguides, demonstrating high performance electro-optic modulators, efficient wavelength converters and revealing their great potentials in heterogeneous integration with the conventional silicon photonic material platform. However, studies on poling of TFLN are still lacking, and uniformity of TFLN poling needs to be further improved, to achieve a comparable conversion efficiency as in its bulk counterparts. This talk discusses evaluation and optimization of TFLN poling, waveguide design, and device demonstration through characterization of efficient second-harmonic generation and high-quality entangled photon-pair generation. The results presented here indicate promising applications for robust and efficient TFLN devices in nonlinear and quantum optics in the telecommunications regime.

15:30~15:45 | G2944

Generation of discrete frequency-bin entangled two-photon state via cascaded second-order nonlinear processes

Jiarui Li, Jia-Rui Li, Chen-Zhi Yuan, Si Shen, Zi-Chang Zhang, He-Qing Wang, Hao Li, Li-Xing You, Zhen Wang, You Wang, Guang-Wei Deng, Hai-Zhi Song and Qiang Zhou

University of Electronic Science and Technology of China, China

Abstract—By using the cascaded second-order nonlinear optical processes in a periodically poled lithium niobate waveguide, we generate 1.5 μm discrete frequency-bin entangled two-photon state with a spatial quantum beating visibility of 93.0 ± 5.2%.

15:45~16:00 | G2979

Hong-Ou-Mandel Interference between surface plasmon polariton and photon

Tao Tang, Boyu Fan, Haizhi Song, You Wang, Guangwei Deng, Qiang Zhou

University of Electronic Science and Technology of China, China

Abstract—In this paper, we provide a theoretical design of hybrid coupler for investigating the Hong-Ou-Mandel interference between a single-long-range-surface-plasmonpolariton (LRSPP) and a single-photon. With the help of coupling between LRSPP and single photon, our method opens a way to study the intrinsic properties of LRSPPs and the indistinguishability between single-photon and LRSPP.

16:00~16:15 | G2958

Multi-wavelength correlated photon pairs generation in Si3N4 microring resonator

Yunru Fan, Chen Lyu, Chen-Zhi Yuan, Bo-Yu Fan, Bo Jing, Dian-Li Zhou, Guang-Wei Deng, Qiang Zhou

University of Electronic Science and Technology of China, China

Abstract—Based on Si3N4 microring resonator, the generation of multi-wavelength correlated photon pairs is investigated. We demonstrate the single-photon spectrum from 1480 nm to 1620 nm, and study the photon pair generation rate, CAR, and the collection efficiency at different pump powers.

16:15~16:30 | G2954

Microwave Quantum Illumination via Cavity Magnonics

Qizhi Cai, Jinkun Liao, Bohai Shen, Guangcan Guo, and Qiang Zhou

University of Electronic Science and Technology of China, China

Abstract—Quantum illumination (QI) is a quantum sensing protocol mainly for target detection which uses entangled signal-idler photon pairs to enhance the detection efficiency of low-reflectivity objects that are immersed in thermal noisy environments. Especially, due to the naturally occurring background radiation, the photon emitted toward potential targets more appropriately lies in the microwave region. Here, we propose a hybrid quantum source based on cavity magnonics for microwave QI, where the medium that bridges the optical and the microwave modes is magnon, the quanta of spin wave. Within experimentally accessible parameters, significant microwave-optical quantum resources of interest can be generated, leading to

orders of magnitude lower detecting error probability compared with the electro-optomechanical prototype quantum radar and any classical microwave radar with equal transmitted energy.

VIRTUAL SESSIONS / Sept. 17, 2021

V05: Biophotonics and Optical Biomedicine

Zoom Meeting Room 1

ID: 979 0046 1385 | Time: 10:00~12:00

Session Chair: **Wenjun Ni**, South-Central University for Nationalities, China

10:00~10:30 | Invited Speaker: Quan Liu

Dr. Quan Liu received a bachelor's degree in electrical engineering from Xidian University, Xi'an, China, a master's degree in electrical engineering from the Graduate School of University of Science and Technology of China in Beijing, China and a PhD degree in biomedical engineering from the University of Wisconsin, Madison, USA. He is currently an associate professor in the School of Chemical and Biomedical Engineering at Nanyang Technological University in Singapore. His research interest is focused on hyperspectral imaging and optical spectroscopy for medical diagnostics.

Dr. Liu has published more than 60 journal papers and held 21 patents/patent applications in the field of biomedical optics. Dr. Liu is a senior member of SPIE.

----Invited Talk----

A cost effective chip towards malaria field diagnosis based on surface-enhanced Raman scattering

Abstract—We report a chip based on surface-enhanced Raman scattering (SERS) developed towards malaria field diagnosis. Only a mixture of 10-ml water and 10-ml blood is required as the sample input to the chip. Water is the only lysing agent to hemolyze blood cells while keeping the malaria biomarkers, hemozoin biocrystals, at locally high concentrations within parasites and/or their vacuoles. Then, SERS-active silver nanoparticles are synthesized on site near hemozoin in these concentrated regions when the blood/water mixture flows through and dissolves dried chemical patches that are earlier deposited inside the channel, which subsequently arrives at the detection region for SERS measurements. It should be highlighted that the procedure can be accomplished without a laboratory requirement and the risk of exposure to hazardous chemicals. Additionally, raw chemicals deposited inside the chip are chemically more stable than those readymade SERS substrates, thus the shelf life of the chip can be much longer. These results show the feasibility to exploit this cost-effective yet highly sensitive SERS-based technique for malaria field diagnosis.

10:30~11:00 | Invited Speaker: Zhenhua Hu

Zhenhua Hu is a professor and doctoral supervisor of the Institute of Automation, Chinese Academy of Sciences, winner of the National Science Fund for Excellent Young Scholars and the Beijing Natural Science Fund for Distinguished Young Scholars. She specializes in optical molecular imaging and the related techniques. Besides, she has carried out the research and development of new optical molecular imaging techniques and successfully translated them into the clinic. In the past five years, she has published over 20 SCI papers as the first author and the corresponding author (including co-author), including 2 papers published on Nature Biomedical Engineering, and several papers on IEEE Transactions, Trends in Molecular Medicine, and Advanced Materials. Her work received a special review on the Nature sub-journal and the "first-in-human" evaluation unanimously from several experts in different fields. She has been invited to give oral presentations at international conferences many times. Until now, she has presided over 8 national and provincial-level projects such as the State Key Program of National Natural Science of China, programs from the Ministry of Science and Technology of China, and the Beijing Natural Science Fund for Distinguished Young Scholars. She has published thirteen US patents and national invention patents. Besides, she serves as the standing director of the first council of the Chinese Nuclear Society Radiopharmaceutical Branch, the standing member of the Digestive Endoscopy and Molecular Imaging Professional Committee of the Chinese Research Hospital Association, etc. She is also the editor and reviewer of several international academic journals.

----Invited Talk----

Research and clinical transformation of novel in vivo optical molecular imaging technology

Abstract—The difficulty in detecting small tumor lesions with conventional methods has become an important reason for tumor recurrence. Optical molecular imaging is often used for intraoperative detection of small tumor lesions because of its advantages such as high resolution and sensitivity. On the subject of small tumor lesions detection, the reporter will first introduce the international research advances that have been achieved so far, and then the reporter will introduce the work done by the team in recent years, which include Cherenkov luminescence tomography (CLT), optical imaging derived from Cerenkov luminescence imaging, and NIR-II multi-spectrum fluorescence imaging. Aiming to further improve the detection ability of small tumor lesions, the team focused on creating novel imaging methods, developing imaging systems for small animals and clinical use, and promoting biomedical applications, which finally facilitated the clinical application of the technologies developed by the team. To summarize, the work of the team formed a full research chain of "imaging method-imaging system-clinical application-

industrialization".

11:00~11:30 | Invited Speaker: Tzuen-Rong Jeremy Tzeng

Dr. Tzeng is currently an associate professor in the Department of Biological Sciences. Dr. Tzeng holds a B.S. in Food Science from Tungahi University, Taiwan, and a Ph.D. in Microbiology from Clemson University. The long-term goal of Dr. Tzeng's research is to develop prevention and therapeutic approaches to reduce, augment, enhance, or replace the use of antibiotics. He studies the microbe and host interactions as well as the mechanisms enabling the microorganisms to be resistant to the actions of antibiotics. His team has developed nanoparticles that display multivalent bacterial adhesin-specific receptors, mimicking host cell surface, to facilitate their bindings to targeted bacteria. In addition, he has functionalized iron-oxide nanoparticles with adhesin-specific receptors and demonstrated the feasibility of using such magnetic nanoparticles for inactivation of targeted microorganisms via magnetic-mediated energy delivery. Dr. Tzeng is an active member of the NC1194: Nanotechnology and Biosensors Committee and the ISO/TC 189 Committee.

----Invited Talk----

X-ray excited luminescent chemical imaging (XELCI) for non-invasive imaging of implant infections

Abstract—Diagnosis and treatment of medical implant associated infections can be challenging, as clinical symptoms are often delayed or, sometime, asymptomatic until infection reaches a later stage. Early diagnosis of implant associated infections and non-invasive continuous monitoring of infection to assess treatment effectiveness has not been established yet. We have developed a pH sensor based on X-ray Excited Luminescence Chemical Imaging (XELCI) to non-invasively monitor pH changes of a surface with high spatial and pH resolution while minimizing tissue scattering effects. Our pH sensor can be attached to the implant surface to non-invasively diagnose and monitor implant associated infection in situ. Bacteria and inflammatory responses cause a pH drop in the area and pH shifts to acidic from in situ pH (~7.3). Our pH sensor consists of a layered structure of a pH sensitive polymer film over radioluminescent particles. The pH sensor is characterized for reversibility, sensitivity and resolution. XELCI provides high spatial resolution images mainly limited by X-ray beam width with minimum increase from X-ray scattering in the tissue. It allows point by point mapping of the surface with minimum background. We studied pH changes during the formation of biofilm on the pH sensitive sensor film. In summary, our sensor provides a novel approach to non-invasively image surface pH to diagnose implant infection and assess treatment. This work makes treatment of implant infection without implant removal a possibility when infection can be diagnosed at its onset.

11:30~11:45 | G29139

Feasibility Study of Spectral Detection Bovine Serum Albumin

PO-JU WU, Zhi-Ting Ye, Hsin-Ching Kuo
National Chung Cheng University, Taiwan, China

Abstract—The optical spectrum detection method of albumin proposed in this study can help patients find proteinuria problems in the early stage, which can be detected in the early stage of microalbumin. The absorption coefficient relationship is used to determine the specific gravity of proteinuria in urine. The minimum linear error rate at 264nm in the best linear region of the albumin absorption band is 1.4%, and the correlation coefficient is 0.9860. The linear error rate of the albumin optical spectrum concentration corresponding to the peak absorption band 285nm is 4.98%, and the correlation coefficient is 0.9502. In addition, the timeliness of albumin was discussed according to the attenuation of the absorbance corresponding to the number of days the albumin was stored. It is hoped that this research will be used as a reference cornerstone for the future development of portable LED biomedical optical systems.

11:45~12:00 | G2916

ADGAN: An Asymmetric Despeckling Generative Adversarial Network for Unpaired OCT Image Speckle Noise Reduction

Xiaojun Yu, Zixuan Fu, Chenkun Ge, Muhammad Zulkifal Aziz and Linbo Liu
Northwestern Polytechnical University, China

Abstract—Optical coherence tomography (OCT) suffers from the inherent speckle noise in its imaging process, which severely degrades the quality of OCT images. To address such an issue, this paper proposes an asymmetric despeckling generative adversarial network (AD-GAN) for OCT speckle noise reduction, based on an unsupervised learning scheme utilizing unpaired clean and noisy images. Specifically, the OCT image despeckling problem is treated as an image-to-image translation problem first, and then the speckle noise reduction is achieved by transferring the noisy images from the noisy domain to the clean domain. Moreover, considering the fact that the information within the clean domain and the noisy domain are imbalanced, an information balancing factor is introduced to capture residual noisy information and help to generate high quality despeckling results. Experimental results show our method surpasses the other state-of-the-art despeckling methods regarding quantitative evaluation metrics and visual qualities.

V06: Optoelectronic Devices and Applications

Zoom Meeting Room 2

ID: 930 3313 8929 | Time: 10:00~11:15

Session Chair: **Mengyuan Ye**, Sun Yat-Sen University, China

10:00~10:30 | Invited Speaker: Mengyuan Ye

Mengyuan Ye received a B.E degree from Sun Yat-Sen University, a Ph.D. degree in optical engineering from Huazhong University of Science and Technology and is now an Associate Professor in China University of Geosciences. His research interests include silicon photonics, multi-mode manipulation and photonics integration.

----Invited Talk----

Silicon integrated multimode components

Abstract—As an effective way to increase transmission capacity, multimode photonics has attracted increasing attentions in past decades. On the other hand, silicon photonis is of significant interest for its compatibility with the mature CMOS technology. Ramarkable progress on silicon integrated multimode photonics has been made over 10 years, and continuous researches on new material, novel structure, intelligent design are still highly desired. Here we demonstrate recent progress on silicon integrated multimode conponents and discuss the future challenges on this topic.

10:30~11:00 | Invited Speaker: Weiqiang Xie

Xie Weiqiang received a Bachelor's Degree in Applied Physics from Xi'an Jiao tong University in 2008, and a Master's Degree in Condensed Matter Physics from Shanghai Jiao tong University in 2011. Then he joined the Photonics Research Group in Ghent University and obtained his PhD degree in Photonics Engineering in 2016. From 2017 to 2021, he worked as a postdoctoral researcher in heterogeneous photonics integration with the group of Prof. John Bowers at University of California, Santa Barbara. Now he is an Associate Professor in Shanghai Jiao Tong University. Dr. Xie's research focuses on silicon/silicon nitride photonics and their heterogeneous integration with novel materials (III-V, quantum dots, etc.), including design, fabrication and characterization of integrated passive/active photonic devices (low-loss waveguides, high-Q microresonators, modulators, integrated nonlinear photonics, lasers, optical phased arrays for LiDAR, etc.). His research involves applications such as telecom, optical interconnect and sensing. He has authored and coauthored over 30 journal papers including Nature Communication, Advanced Materials, Nano Letter, Laser & Photonics Reviews and so on. He is a recipient of 2016 Chinese Government Award for Outstanding self-financed Students Abroad.

----Invited Talk----

III-V/Si Heterogeneous Integration for Ultra-efficient Nonlinear Photonics

Abstract—III-V semiconductors have excellent optoelectronic properties. They also possess strong material nonlinearity as well as high refractive indices, for example, (Al)GaAs has much stronger nonlinearity than the dielectrics (SiO2, Si, or Si3N4). Therefore, they hold great potentials for high-confinement, ultrahigh-efficiency, compact nonlinear photonic integrated circuits (PICs). While nonlinear studies on III-V platforms have gained increasing interests over the past few years, it remains a challenge to develop a low-loss nonlinear photonic waveguide platform. In this talk, we present our recent work on heterogeneously integrated low-loss AlGaAs nanowaveguide platform on Si and show ultra-high quality (Q) AlGaAs nonlinear microresonators with Q factors >3×10^6 and demonstrate ultra-efficient frequency comb generation with a world-record low threshold of pump power of only a few tens of microwatts. We also talk about the full integration of InP lasers and AlGaAs high-Q nonlinear microresonators aiming for chip-scale nonlinear sources and show some preliminary results.

11:00~11:30 | Invited Speaker: Changzheng Sun

Changzheng SUN received the B.E., M.E. and Ph.D. degrees in electronic engineering from Tsinghua University, 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 100 scientific papers.

----Invited Talk----

High Performance Modulators and Photodetectors for Microwave Photonics Applications

Abstract—Thin-film lithium niobate (TFLN) modulators with capacitively loaded traveling-wave electrodes are fabricated, exhibiting a bandwidth over 67 GHz as well as a half-wave voltage of 3.4 V. Uni-traveling-carrier photodiodes (UTC-PDs) with a bandwidth over 150 GHz and a saturation power of 1.93 dBm are demonstrated by incorporating inductive peaking.

11:30~11:45 | G29117

Photo-response Analysis of Oxygenated $Ge_2Sb_2Te_5$

Sunny, Vibhu Srivastava

Indian Institute of information Technology, Allahabad, Prayagraj (India), India

Abstract—Among various available phase-change materials, ternary chalcogenide $Ge_2Sb_2Te_5$ (GST) is the most popular one due to its excellent electrical and optical properties. Enormous investigations have been performed to alter or modulate its properties further by incorporating some foreign elements by various methods including oxygen. Oxygenated GST is of interest due to its higher compatibility with Si/SOI technology along with modulation in phase-change behavior for different photonic applications. This work presents the photodetection behavior of oxygenated GST in the simple metal-semiconductor-metal structure. The photo-response of the oxidized GST thin films in both the amorphous and crystalline phases has been measured. It is found that the electrical along with photo-conductivity of both phases of GST reduce upon the increasing extent of oxidation due to an increase in bonding lattices. A proper shifting of the bandgap has also been observed while increasing the amount of oxidation.

V07: Perovskite Materials and Optoelectronic Applications

Zoom Meeting Room 3

ID: 827 9043 9167 | Time: 10:00~11:45

Session Chair: **Aung Ko Ko Kyaw**, Southern University of Science and Technology, China

10:00~10:30 | Invited Speaker: Jia Lin

Jia Lin obtained his PhD in 2013 from Shanghai Jiao Tong University. He is a Distinguished Professor at the Department of Physics, Shanghai University of Electric Power. His research interests include optics, photonics, optoelectronics, and energy materials.

----Invited Talk----

Structures and optoelectronic properties of new type of halide perovskite materials

Abstract—Halide perovskite materials have attracted more and more attention in recent years due to their unique optical, electronic, magnetic, and optoelectronic properties, and potential applications in optoelectronic devices. The halide perovskite and perovskite analogues are a class of ionic material with a 'soft' lattice, which results in a highly reconfigurable crystal structure with relatively easy structural rearrangements. Our research focuses on the development of new composition and new structure perovskite materials, and exploration of structure-related unique optoelectronic properties. We mainly discuss the development of new structure of halide perovskites and the connection between the structure and properties of bulk materials; mixed halide perovskite for solar cells; controlled synthesis of low-dimensional halide perovskites and light-emitting behaviors; the emission mechanism of new type of inorganic lead-free halide perovskite; and the exploration of the applications of functional halide perovskite materials.

10:30~11:00 | Invited Speaker: Yongbo Yuan

Yongbo Yuan is a Professor in the Hunan Key Laboratory of Super-microstructure and Ultrafast Process and the School of Physics and Electronics in Central South University (CSU). He got his B.S. degree of physics in 2004 and Ph.D. degree of condensed matter physics in 2009 from Zhongshan University. He then joined Prof. Jinsong Huang's research group at University of Nebraska-Lincoln as a postdoctor in 2009. He joined CSU in 2016 as full Professor. His current research interests include perovskite/ polymer solar cells, organic thin film transistors and hybrid photodetectors. He had published more than 50 scientific papers with citations over 10000 and H-index of 35. He was listed as "Highly Cited Researchers"by Thomson Reuters in 2018 and 2019.

----Invited Talk----

Ion migration in hybrid perovskites and its impacts on photo-oxygen-induced degradation

Abstract—Compared with other photovoltaic materials, hybrid perovskites have significant ion migration, which impacts on the electrical properties of perovskites and influence the device working mechanisms. Generally, defects in perovskite crystal are responsible to the initial degradation of perovskite solar cells due to its nonideality. The migration of charged ions or defects under applied electric field may accelerate the degradation of perovskite solar cells since it increases local defect concentration in the active layer. From this point of view, insights on the synergistic effect between ion migration and other device failure mechanism is desired. In recent study, we demonstrated that mobile defects can significantly accelerate the reactions between oxygen and perovskites in light condition, leading to addition pathway for materials decay. Meanwhile, A-site cation engineering was developed to suppress such detrimental synergistic effect. We will show that there is a repulsion effect between doped Cs^+ cations and iodine vacancy, which enhances the intrinsic stability of perovskite materials by suppressing mobile ions and superoxide ions.

11:00~11:30 | Invited Speaker: Hin-Lap Yip


(Angus) Hin-Lap Yip joined the Department of Materials Science and Engineering and School of Energy and Environment at City University of Hong Kong as Professor in 2021. From 2013-2020, he was a Professor in the State Key Laboratory of Luminescent Materials and Devices (SKLLMD) and the School of Materials Science and Engineering (MSE) in South China University of Technology (SCUT). He got his BSc (2001) and MPhil (2003) degrees in Materials Science from the Chinese University of Hong Kong (CUHK), and completed his PhD degree in MSE in 2008 at the University of Washington (UW), Seattle. His research focuses on the use of an integrated approach combining materials, interface, and device engineering to improve both polymer and perovskite optoelectronic devices. He had published more than 220 scientific papers with citations over 25000 and a H-index of 81. He was also honored as ESI "Highly Cited Researcher" for 7 times from 2014-2020. He was a co-founder of Soluxra, LLC (2010-2018). In 2018, He was appointed as the Director for the Innovation Center for Printed Organic Photovoltaics in Dongguan, which focuses on translational research and commercialization of new generation photovoltaic technology. He currently serves as an editorial board member of Science Bulletin and Journal of Semiconductors, and international advisory board member for Matter.

----Invited Talk----

Optical Engineering for Efficient White Perovskite Light-Emitting Devices

Abstract—Metal halide perovskite light-emitting diodes (PeLEDs) show great potentials to be the next-generation lighting technology, with external quantum efficiencies (EQEs) exceeding 20% for infrared, red and green LEDs. However, the efficiencies of blue and white devices severely lag behind. To improve the performance of blue PeLEDs, we employed an integrated strategy combining dimensional engineering of perovskite film and recombination zone modulation in the LED device to obtain an EQE up to 5 %. While further incorporating the strategy of interfacial engineering, highly efficient blue PeLEDs with EQEs over 10% have been successfully realized in our group, establishing an excellent platform for white-light emission. In our latest work, we demonstrated efficient white PeLEDs by optically coupling a blue PeLED with a red emitting perovskite nanocrystal layer in an advanced device structure, which allows to extract the trapped optical modes (waveguide and SPP modes) of blue photons in the device to the red perovskite layer via near-field effects. As a result, a white PeLEDs with EQE over 10% is achieved, which represents the state-of-the-art performance for white PeLEDs.

11:30~11:45 | G2911

Optimization of Annealing Treatment for CsSnI3-Based Solar Cells with Enhanced Efficiency

Shaoyang Ma, Hailong Li, Ran Yao, Haoran Zhang, Tao Ye
Beijing Jiaotong University, China

Abstract—We demonstrate that the optimized two-step annealing treatment can effectively improve the quality of CsSnI3 perovskite film. The corresponding CsSnI3 solar cell yields an enhanced efficiency of 2.10% in ambient-air condition with increased photovoltaic parameters, especially the short-circuit current density (Jsc), compared with the control group device.

V08: AI Photonics

Zoom Meeting Room 4

ID: 816 7808 8000 | Time: 10:00~12:15

Session Chair: **Hongwei Chen**, Tsinghua University, China

10:00~10:30 | Invited Speaker: Sabidur Rahman


Bio: Dr. Sabidur Rahman has recently completed his PhD in computer science from University of California Davis (2020). He received his MS and BS degree in computer science from the University of Texas at San Antonio (2014) and Bangladesh University of Engineering and Technology (2011), respectively. Dr. Sabidur is currently a tenure-track assistant professor at the department of computer science, Sonoma State University, CA, USA. He also has industry research and development experience with AT&T Labs, Epic Systems, and Samsung R&D. His research interests include cost-efficient network automation, computer network virtualization, use of machine learning, and data-driven solutions to solve practical problems. His research has been published in flagship IEEE conferences (IEEE ICC, IEEE Globecom, IEEE CloudNet, etc.) and high-impact IEEE Transactions (TNSM, TGCN, etc.). His research has gained invitation for talks at prestigious venues, including Lawrence Berkeley National Laboratory, USA; University of California Berkeley, USA; 8th Big Data Finance 2020 (Cornell Engineering); Asia Communications and Photonics Conference 2020; etc. He has also served as reviewer of IEEE/ACM Transactions on Networking; Elsevier Computer Networks Journal; IEEE Communications Surveys & Tutorials; IEEE Transactions on Services Computing, Springer Journal of Grid Computing; IEEE/OSA Journal of Optical Communications and Networking; IEEE Intl. Conference on Cloud Networking; etc.

LinkedIn: http://www.linkedin.com/in/kmsabidurrahman/

Google Scholar: https://scholar.google.com/citations?user=sk7J-OwAAAAJ&hl=en

----Invited Talk----

Machine learning and data-driven solutions for network automation

Abstract—Although a "Self-Driving" optical communication network is still a long way to go, many time-consuming complex tasks and decision making in photonic networks can be automated using machine learning, and other data-driven solutions. This talk explores recent contributions towards photonic network automation, such as alarm prediction, fault localization, resource auto-scaling, quality of transmission prediction, dynamic controller placement, automated service restoration, resource allocation and optimization, minimization of electricity and power supply cost minimization, user data analysis, etc. The studies explored in this talk, provide solution approaches to these problems using wide range of data-driven methods, machine learning, AI and deep learning based methods. This talk also discusses different challenges involving this interesting research areas, and provides the directions for future research opportunities.

10:30~11:00 | Invited Speaker: Avishek Nag

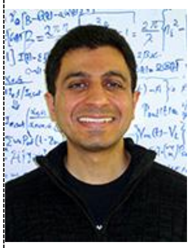
Dr Avishek Nag is currently an Assistant Professor in the School of Electrical and Electronic Engineering at UCD. Dr Nag received his PhD degree from the University of California, Davis in 2012. He worked as a research associate at the CONNECT Centre for future networks and communication in Trinity College Dublin. Dr Nag has published over 65 publications that include journals, conference proceedings, and book chapters. His research interests include Optical Networks, Software-Defined Networks, Machine Learning, Blockchain, and the Internet of Things. Dr Nag is a senior member of the IEEE and also the outreach lead for Ireland for the IEEE UK and Ireland Blockchain Group. He also serves on the editorial boards for the IEEE Transactions on Green Communications and Networking, Frontiers in Blockchain, and Frontiers in Communications and Networks.

----Invited Talk----

The Role of AI in Network Engineering

Abstract—Due to the continuing expansion of users with numerous smart gadgets, i.e., the 'smart world' surge, the network's complexity continues to rise. This creates a continual demand for a seamless end-to-end connection for all users, resulting in increased network operations scope and scale, as well as higher operational cost. Each piece of data gathered contains crucial information about the network as well as the user's behaviour. Predictive analysis of users and networks based on applications, dynamic resource allocation for network components (functions), root cause analysis and event correlation, and resolving the compromised parts of the network without disrupting the equilibrium would all benefit from learning from the parsed data. A network team can take hours or days to manually analyse a few of this information or find the root cause of the disruption, especially like a malware attack or natural cause destruction of the network nodes. Training the ML models like Deep Learning or Reinforcement Learning will provide more profound and insightful information about the problem by exploring numerous possibilities within a reasonable time. Detection becomes a much faster process. Thus some of these elements are encouraging AI adoption in day-to-day operations. This talk will focus on the general applicability of ML/AI models in network engineering and then discuss a specific application area in network function virtualisation.

11:00~11:30 | Invited Speaker: Bhavin J. Shastri



Dr. Bhavin J. Shastri is an Assistant Professor of Engineering Physics at Queen's University, Canada, and a Faculty Affiliate at the Vector Institute for Artificial Intelligence. With research interests in silicon photonics, photonic integrated circuits, neuromorphic computing, and machine learning, he has published more than 68 journal articles and 87 conference proceeding, 7 book chapters, and given over 40 invited talks and lectures including 2 Keynotes. He is a co-author of the book, Neuromorphic Photonics (Taylor & Francis, CRC Press, 2017).

Dr. Shastri is the winner of the 2020 IUPAP Young Scientist Prize in Optics "for his pioneering contributions to neuromorphic photonics" from the ICO. He is a Senior Member of OSA and IEEE, recipient of the 2014 Banting Postdoctoral Fellowship from the Government of Canada, the 2012 D. W. Ambridge Prize for the top graduating Ph.D. student, an IEEE Photonics Society 2011 Graduate Student Fellowship amongst others awards.

----Invited Talk----

Silicon photonics for AI and neuromorphic computing

Abstract—Artificial intelligence enabled by neural networks has enabled applications in many fields (e.g. medicine, finance, autonomous vehicles). Software implementations of neural networks on conventional computers are limited in speed and energy efficiency. Neuromorphic engineering aims to build processors in which hardware mimic neurons and synapses in brain for distributed and parallel processing. Neuromorphic engineering enabled by silicon photonics can offer sub nanosecond latencies, and can extend the domain of artificial intelligence and neuromorphic computing applications to machine learning acceleration (vector-matrix multiplications, inference and ultrafast training), nonlinear programming (nonlinear optimization problem and differential equation solving) and intelligent signal processing (wideband RF and fiber-optic communications). We will discuss current progress and some challenges of neuromorphic photonics to scale to practical systems.

11:30~12:00 | Invited Speaker: Tian Zhang

Zhang Tian, got a Ph. D. from Huazhong University of Science and Technology in 2016, now works as an associate researcher at School of Electronic Engineering in Beijing University of Posts and Telecommunications. From November 2016 to January 2019, she worked as postdoctoral researcher in BUPT. At present, she is mainly engaged in the research of intelligent optical computing, inverse design of photonic devices, and micro-nano photonics. In recent years, she has published more than 50 SCI academic papers in Photonics Research, Optics Letters, Optics Express, Journal of Lightwave Technology, etc., and are cited more than 750 in Google Scholar. She is responsible for National Natural Science Foundation of China, General Program and Special Program of Chinese Postdoctoral Science Foundation, and is as a main participator in Beijing Municipal Science and Technology Project and other projects.

----Invited Talk----

The combination of the micro/nanophotonics and artificial intelligence

Abstract—Owing to the increasing of computing capability and the supporting of big data, artificial intelligence (AI) has stepped into a new era and influenced many other fields. The collision of AI and integrated photonics has brought new vitality to these two fields. On one hand, due to the separating of computing and store, traditional Von Neumann architecture can't meet current computing speed requirement. Although many different electronically architectures have been designed, including GPU, TPU, TrueNorth, and so on, their computing speed are limited by the electronic mobility, clock frequency and the slowing down of Moore law. While benefit from the advantage of integrated photonic information process system, which is with high bandwidth, low loss and low crosstalk, substituting electric means by optical means can greatly improve the computing speed and reduce computing power consumption. Therefore, employing integrated photonic devices to construct neural network is of great importance. On the other hand, the design and optimization of integrated photonic device are limited by computationally expensive and time-inefficient. AI provide a highly efficient way for exploiting the tremendous parameter space. This report will introduce our works on these two aspects.

12:00~12:15 | G29118

The Parallel Optoelectronic Reservoir Computing based Nonlinear Channel Equalization

Xingxing Feng, Lu Zhang, Xiaodan Pang, Xiazhen Gu, Xianbin Yu
Zhejiang University, China

Abstract—The optoelectronic reservoir computing (RC) is considered as a promising optical signal processing technique for nonlinear channel equalization. In this paper, a parallel optoelectronic RC scheme with a dual-polarization Mach-Zehnder modulator (DPol-MZM) is proposed and demonstrated numerically. The nonlinear channel equalization performance is greatly enhanced compared with the traditional optoelectronic RC scheme and Volterra-based DSP scheme, since the nonlinear dynamics of RC are enriched from the dual-polarization methodology. Besides, the system efficiency is improved with a single DPol-MZM.

V09: Silicon Photonics

Zoom Meeting Room 1

ID: 979 0046 1385 | Time: 14:30~16:45

Session Chair: **Wei Jiang**, Nanjing University, China

14:30~15:00 | Invited Speaker: Yating Wan

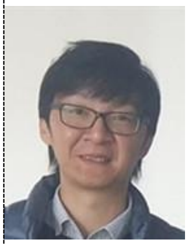
Yating Wan obtained received Ph.D. (2017) in the Department of Electrical and Computer Engineering from Hong Kong University of Science and Technology and was selected as the winner of the School of Engineering PhD Research Excellence Award 2016-17. She has published 32 first-author journal (22)/conference(10) papers, including 6 prestigious covers (Optica, Laser & Photonics Review(3), Applied Physics Letter, Photonics Research), 3 invited talks (2018 CLEO, 2018 PIERS, 2018 ACP), 1 postdeadline conference paper (2017 CLEO), and 1 book chapter (selected as the cover of 《Future Directions in Silicon Photonics》). She has also published 20 other co-authored papers and served as a referee for more than 37 peer-reviewed journals in IEEE, OSA, and the Nature Publishing Group (Google Scholar Citations on 07/20/2021: 1424, h-index: 21). For her pioneering work in integration of long wavelength quantum dot devices on Si, she received 2016-17 School of Engineering PhD Research Excellence Award in HKUST, 2021 CLEO Tingye Li Innovation Prize, 2018 PIERS Young Scientist Award, 2018 Rising Stars Women in Engineering Asia, and 2020 Rising Stars 2020 Women in EECS. She is now a Postdoctoral fellow at of University of California, Santa Barbara in Prof. John Bowers' group, and is in the process of being promoted to a scientist position. Her feature story was reported in http://pgnews.ust.hk/feb-2018-feature-stories-part-2. Her current research includes Si photonics, optical communications, photonic integrated circuits, and quantum photonics.

----Invited Talk----

Advances in quantum dot lasers and integration with Si photonic integrated circuits

Abstract—Si photonics has emerged as a disruptive opto-electronic device technology with a scaling capability on integration and energy efficiency. As the most promising integration platform, Si photonics demands on-chip laser sources that dramatically improve capability, while trimming size and power dissipation in a cost-effective way for volume manufacturability. The central theme of my research is to develop high-performance quantum dot (QD) lasers directly integrated on industry standard Si substrates for on-chip optical interconnects. A subset of recent advances includes record-long device lifetime on Si, isolator-free system demonstration, ultra-low dark current QD photodetectors, submilliamp threshold microcavity lasers, first tunable single wavelength QD lasers, a pathway towards high-volume, low-cost transceivers that can be scaled to beyond 1 Tbit/s, and device integration with waveguides, amplifiers, photodetectors, and lasers on a single chip. A number of breakthroughs have now made Si photonics an appealing platform for photonic integration from both the cost and the performance standpoint. The same forces that drove the evolution of discrete optical modules to photonic integration on a single chip will continue to shape the evolution of photonic integrated circuits to meet the ever-increasing demands on lower cost, size, weight, and power (cSWaP) while delivering equal or better performance than their predecessors.

15:00~15:30 | Invited Speaker: Huang Ying



Dr. Huang Ying has over 15 years of experience in silicon photonics research and product development. He has led the development of around 10 silicon photonics products entering the market, with some of them in volume production. He received the B.E. and Ph.D. degree in Electrical and Electronic Engineering from Nanyang Technological University (NTU), Singapore, in 2007 and 2011, respectively. From 2011-2017, he was with the Institute of Microelectronics, A*STAR, Singapore, as a research scientist for silicon photonics product development. He was the principal investigator for three research grants with more than SGD $10M cumulative fundings. In 2017, Dr. Huang co-founded Rain Tree Photonics, Singapore, a start-up leveraging silicon photonics technology to enable the next waves of computing (5G, IoTs, AI and Cloud). Within 2 years of its establishment, the company has rolled out multiple customer-qualified products in hyperscale data-center (400G) and 5G market. He has authored and co-authored more than 50 journal and conference publications, 7 U.S. patents. Dr. Huang is currently the vice-president for IEEE Photonics Society Singapore and used to hold Executive Committee member position in IEEE Singapore Section.

----Invited Talk----

Challenges for Silicon Photonics as We Approach Terabit Modules and Co-Packaged Optics

Abstract—As we approach terabit modules and co-packaged optics, solutions utilizing discrete optics become increasingly impractical. The industry consensus is that integrated photonics or silicon photonics will pave the way forward. This has given rise to a number of proposed solutions with somewhat diverse architectures. In order for a particular solution to be feasible, low power and high performance needs to be achieved at low cost. Besides technological advancement to meet the power and performance requirements, manufacturability is a key concern as it impacts cost and volume scalability. In this talk, we seek to examine the challenges and solutions from a pragmatic perspective.

15:30~16:00 | Invited Speaker: Xu Wang

Dr. Xu Wang is Senior Manager R&D at Ansys, leading the Lumerical Solutions Group. He has been focusing on integrated photonic design and simulation solutions. He also leads Lumerical's ecosystem partnerships with foundries, EDA companies, and strategic customers. He has authored more than 60 publications and delivered many invited talks at conferences. He received his Ph.D. from the University of British Columbia.

----Invited Talk----

Silicon Photonics Design for Manufacturability

Abstract—We will discuss the challenges in silicon photonic design with respect to foundry manufacturing, and how to address them with state-of-the-art design automation and simulation solutions.

16:00~16:30 | Invited Speaker: Wei Jiang

Wei Jiang is a professor of optical engineering at Nanjing University. Prior to working at NJU, he was an associate professor at Rutgers, the State University of New Jersey, USA. His research interests include silicon photonics and photonic crystals and their applications in optical interconnects, optical communications, LIDAR, and optical computing. He proposed novel waveguide superlattices and demonstrated high-density low-crosstalk waveguide integration with half-wavelength pitches, which opened the door to half-wavelength pitch optical phased arrays and high-performance solid-state lidars. He contributed to the fundamental understanding of silicon electro-optic and thermo-optic devices, slow light, superprism effects, and photonic crystal surface physics. In 2007, the first high-speed photonic crystal modulator was demonstrated on silicon through his research project. Prof. Jiang received the DARPA Young Faculty Award, IEEE Region I Outstanding Teaching Award, among other honors.

----Invited Talk----

Waveguide Superlattice-Based Optical Phased Array

Abstract—Optical phased arrays can steer light beams non-mechanically, which may open up new opportunities for a wide variety of applications such as lidars for self-driving cars, wireless optical communications, and biomedical imaging. Traditionally,

optical phased arrays suffer from large pitches for their emitters. This results in unwanted secondary beams (called grating lobes) that split energy from the main beam, and limits the beam steering angles to a small range. Theoretically, reducing the pitch to half wavelength would solve these problems, and this has been achieved in radio-frequency phased arrays decades ago and is widely used today. Yet achieving half-wavelength pitch for optical phased arrays has been difficult. We reported half-wavelength pitch waveguide superlattices with low crosstalk in 2015, which reveals a new path towards half-wavelength pitch optical phased arrays. We have continued to explore the fundamental properties of such a waveguide superlattice in beam forming through an optical phased array. It is found that low crosstalk and near-ideal beam forming can co-exist in a properly constructed waveguide superlattice. Recently, we have reported experimental demonstration of a waveguide superlattice-based optical phased array whose characteristics approach those of an ideal half-wavelength pitch optical phased array. High main beam energy ratio, low sidelobes and a wide beam steering angular range over 150 degrees have been achieved, with no secondary beams in the full 180-degree field.

16:30~16:45 | G29143

High sensitivity refractive index and temperature sensors with tunable multiple Fano resonances

Yanping Xu, Zetao Ou, Jianyun Chen, Gongli Xiao, Hongyan Yang

Guilin University of Electronic Technology, China

Abstract—In this paper, a susceptible sensor is offered, consisting of a ring-rectangular composite resonator and a metal-insulation-metal (MIM) waveguide coupled with a tube wall on the side. The transmission and sensing properties of the structure are investigated numerically by the finite element method (FEM), and the Fano resonance is found in the transmission spectrum. The results reveal several Fano resonance peaks in the transmission spectrum, and there is a linear relationship between resonant wavelength and refractive index. The Fano resonance peaks are maybe adjusted by modifying the geometric parameters of the structure. The refractive index sensitivity (S) can reach 914 nm/RIU by optimizing the structural parameters. In addition, we can obtain the temperature sensor with high sensitivity by filling ethanol in the medium, and the maximum sensitivity is 0.35 nm/℃. The sensing properties of the structure can be applied to promote the research of nanoscale optical sensors in the integrated photonic devices.

Keywords-Finite Element Method (FEM); MIM waveguide structure; Fano resonance; Refractive index and temperature sensors.

V10: Technologies and Applications & Optical Fiber Upgrade

Zoom Meeting Room 2

ID: 930 3313 8929 | Time: 14:30~17:15

Session Chair: **Yunqi Liu**, Shanghai University, China

14:30~15:00 | Invited Speaker: Wei Yan

Dr. Wei Yan is a postdoc researcher with Prof. Yoel Fink (founder of Advanced Functional Fabric of America) at the Research Laboratory of Electronics, MIT, USA. He obtained his PhD from the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland in 2017. His research interests focus on fiber-shaped flexible and stretchable electronics and optoelectronics for applications in sensing, actuation, robotics, smart textiles and neuroscience as well as fundamental study of in-fiber functional materials. He has been published over 20 research articles in top journals including 2 papers in Nature Nanotechnology, 2 Nature Communications and 4 Advanced Materials. He has been authorized 4 patents in the USA and EU. His PhD thesis was awarded 2019 Professor René Wasserman Award, EPFL, Switzerland (the only winner at EPFL). He won the OSA Best Student Paper award in 2017. His research work lead to the first monocrystalline semiconducting nanowire-based optoelectronic fiber and ultralong, complex structured nanoscale metallic glass fibers. He also invented an aerospace-grade textile for the detection of micrometeoroids and space debris that has been sent to the International Space Station in 2020. He is serving as a member of Youth Editorial Board of Advanced Fiber Materials (Springer Nature), a member of the Editorial Advisory Panel for "Nanotechnology" (IOP Science), an international reviewer for the Swiss National Science Foundation (SNSF), and a reviewer for 26 international journals, such as Nature Communications, Advanced Materials, Nature – npj Flexible Electronics, and ACS Photonics.

----Invited Talk----

Advanced Optoelectronic and Electronic Multi-material Fiber Devices and Textiles

Abstract—Fibers, ancient yet largely underdeveloped forms, are the common building blocks of a broad spectrum of product forms from textiles to aircraft constructs. While ubiquitous, these fibers are produced at scale from essentially single materials. The integration of a variety of electronic and optoelectronic materials within thermally-drawn fibers has emerged as an unprecedentedly compelling platform for enabling fibers to evolve into functional devices and smart systems. This approach exploits the thermal drawing of a macroscopic preform, where functional materials or prefabricated devices are arranged at a prescribed position, yielding kilometers of functional fibers with a sophisticated architecture and complex functionalities in a very simple and scalable manner. A single strand of fiber that incorporates materials with disparate electronic, optoelectronics, thermomechanical, rheological and acoustic properties can see objects, hear sound, sense stimuli, communicate, store and convert energy, modulate temperature, monitor health and dissect brains. Integrating these fibers into fabrics, ancient yet largely

underdeveloped forms, is setting a stage for fabrics to be the next frontier in computation and Artificial Intelligence. In this presentation, I will show the fabrication of smart optoelectronic and electronic fiber devices, and elaborate their unique applications in the fields of sensing, healthcare, robotics, textiles and neuron science as well as their fundamental research in materials science and physics.

15:00~15:30 | Invited Speaker: Yu Cheng

Professor Yu Cheng received his PhD from Wuhan University of Technology.He is now a professor and master tutor of Guilin University of Electronic Science and Technology.Member of Chinese Optical Society, Member of Chinese Communication Society.He was a postdoctoral fellow at the University of Southampton and the University of Bath.At present, he has presided over one national scientific research project and participated in the national key research and development program projects.He has presided over 2 provincial projects, participated in 3 '863' projects, 1 national major project, 2 EPSRC projects, etc.He has published more than 18 papers in Optics Express, APL, JLT and other journals.We have applied and obtained more than 20 national patents.Research interests: communication fiber, special fiber, broadband fiber amplifier, fiber sensor, etc.

----Invited Talk----

Recent progress in optical fiber technology and applications

Abstract—Fiber optics, the 2009 Nobel Prize-winning technology, has been a hot topic of scientific research for years.In the field of communication, optical fiber connects nearly 6 billion people around the world, making the communication between people on a global scale at any time in any corner.However, the era of data explosion driven by mobile Internet calls for more transmission bandwidth. Therefore, the space division multiplexing technology arises at the right moment to increase the bandwidth of a single optical fiber to the Pbit/s level.In the sensing field, the Angle sensor represented by polarization maintaining fiber has been widely used.In the field of fiber amplifier and laser, rare earth doped fiber and specialty fiber for devices also attract many researchers and enterprises to struggle for them.In the aspect of scientific research, hollow core fiber, multi-core fiber, square core fiber, high nonlinear fiber is in full swing.All in all, although the research of optical fiber has passed 50 years, there are still many theoretical and application problems waiting for the majority of scientists to explore and solve.

15:30~16:00 | Yunqi Liu

Yunqi Liu received the Ph.D. degrees in Optics from Nankai University, China, in 2000. From 2000 to 2008, he worked as a Research Fellow in School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, in School of Engineering, City University London, U.K., and in Department of Electronic Engineering, City University of Hong Kong, Hong Kong, China, respectively. He joined the School of Communication and Information Engineering, Shanghai University, China, as a full professor in 2008. He was supported by the Program for Professor of Special Appointment (Eastern Scholar) at Shanghai Institutions of Higher Learning, China. He has published more than 200 papers on fiber gratings, fiber optic sensors and optical fiber communications.

----Invited Talk----

Helical Long-Period Fiber Grating Mode Converter

Abstract—We demonstrate the fabrication of helical long-period gratings (HLPGs) by using focused carbon dioxide laser. The mode coupling and characteristics of the HLPGs written in the specialty fibers were investigated experimentally. The generation and conversion of the orbital angular momentum (OAM) modes were achieved by the special designed gratings. The HLPGs could have promising application as all fiber mode converters for mode-division-multiplexing optical communications and high sensitivity optical sensors.

16:00~16:30 | Invited Speaker: Xinyong Dong

Xinyong Dong (SM'17) received the Ph.D. degree in optics from Nankai University, China, in 2002. He joined the Hong Kong Polytechnic University (HKPU) as a research assistant in 2001. Then, he became a research fellow at Nanyang Technological University, Singapore, in 2002, and came back HKPU as a post-doctoral fellow in 2006. From 2008 to 2018, he had been with China Jiliang University as a full professor and finally joined Guangdong University of Technology in 2019. He published three book chapters and over 400 technical papers with over 8000 citation times. His research interests include optical fiber sensors, amplifiers and lasers.

----Invited Talk----

FBG-Based Wind Speed Sensor with Enhanced Sensitivity

Abstract—A sensitivity-enhanced wind speed sensor based on a cladding-etched optical fiber Bragg grating (FBG) coated with a layer of silver film and optically pumped by using a 1480 nm laser diode is demonstrated. Wind speed measurement with sensitivity up to -1978 pm/(m/s) is achieved at wind speed of 0.1 m/s when the FBG cladding diameter is etched down to 71.6 μm. Sensitivity enhancement up to 61.2% in magnitude is realized if it is compared with the sensitivity of the reference sensor without cladding etching. The maximum wind speed, limited by the wind tunnel used in the testing, is 20 m/s.

16:30~16:45 | G2957

Mode Analysis and Characterization of Negative Curvature Hollow-core Fiber under Bending

Donglai An, Donglai An, Yingying Wang, Shoufei Gao and Xia Yu
Beihang University, China

Abstract—Negative curvature hollow-core fiber (NC-HCF) is a promising waveguide candidate for long haul transmission, high power laser delivery and macro-/micro-bend sensing. It is important to study in details of its bending characteristics, among which the critical bend radius is a crucial parameter. In this paper, a new semi-analytical model is reported to calculate the critical bend radius accurately. This model is then validated numerically and experimentally. Meanwhile, the influence of structural parameters and bend radius on the fundamental core mode effective index is discussed. The model can also be used to predict the peak values in loss spectrum under bending condition. Generally, it supports the design of NC-HCF and related devices to meet the requirements about broad bandwidth in telecommunication as well as high bending sensitivity in sensing application.

16:45~17:00 | G29123

Sensitivity-improved sensor for ultrasound detection and imaging of seismic physical model

Yin Huanhuan, Huanhuan Yin,Xi Yang, Zhihua Shao* and Xueguang Qiao*
Northwest University, China

Abstract—A sensitivity-improved fiber-optic ultrasonic sensor is proposed and employed for ultrasonic imaging of seismic physical models. The sensor consists of a single mode fiber (SMF) embedded into the hollow-core-fiber (HCF) bubble. Using gas pressure assisted arc discharge, the diameter of the bubble can be larger than 430 μm with a wall thickness of approximately 0.48 μm. Besides, by using the coating technique, the optical reflectivity and extinction ratio of the ultra-thin bubble are further improved. Fiber tails of SMF and the HCF are partly bonded to form an open-cavity sensor. When applied with ultrasonic waves, the compact bubble can balance the difference of air pressure between inside and outside. The fault topography is designed and the proposed sensor is used for ultrasonic detection and imaging.

17:00~17:15 | G2999

Fluorescence detection with a dual-core photonic crystal fiber

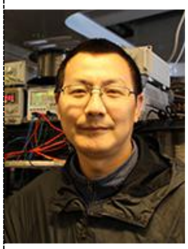
Wenlin Luan, Wenlin Luan, Jialin Chen, Zhouzhuo Tang, Wenzhuo Li, Hui Gao, Xia Yu
Beihang University, China

Abstract—In this work, an all-fiber fluorescence detection method was proposed based on wavelength division multiplexing (WDM) of dual-core photonic crystal fiber (DC-PCF). The air-hole region offers embodiment of fluorescence sample of 100 nL volume. On the other hand, the excitation light and fluorescence emission could be separated through the precise control of the dual-core fiber length. Finally, 11.23 dBextinction ratio between emission and excitation was achieved experimentally.

V11: Near-infrared, Mid-infrared and Far-infrared Technologies and Applications
Zoom Meeting Room 3
ID: 827 9043 9167 | Time: 14:30~16:45

Session Chair: **Jiagui Wu**, Southwest University, China

14:30~15:00 | Invited Speaker: Jiagui Wu



Jiagui Wu is a Professor with the College of Artificial Intelligence, Southwest University and a visiting scholar in the University of California, Los Angeles, USA. He has authored or co-authored over 70 publications including about 50 journal papers. His research interests include Near-infrared, Mid-infrared and Far-infrared Technologies and Applications,micro-nanophotonic,information security.

----Invited Talk----

Secure communication with quantum cascade laser chaos

Abstract—Mid-infrared free-space optical communication has a large potential for high speed communication. The synchronization of chaos inspires in sciences and promises a broad range of engineering. Here, we show our group that two coupled quantum cascade lasers (QCL) operating in the chaotic regime and the synchronization between them allow for the extraction of informationn. This could be a important tool to implement a high degree of privacy directly on the physical layer. We realize a proof-of concept communication at a wavelength of 5.7 μm with a message encryption. it may opens new platform for physical layer secure communication.

15:00~15:30 | Invited Speaker: Peng Wang

Peng Wang, associated professor at Shanghai Institute of Technical Physics, Chinese Academy of Sciences. His main research interest is focus on the infrared photodetector. He has published 26 first author and corresponding author SCI papers in Nature Communications, Science Advances, Advanced Materials, ACS Nano, etc. He has also coauthored in more than 60 SCI papers, which has more than 4,000 times citations with h index of 33. He was selected for “Youth Innovation Promotion Association CAS” at 2021, “Youth talent promotion project of CAST” at 2020, and “Shanghai Sailing Program” at 2019. He awarded the Young Scientist Award of IEEE ICOCN 2019, Best Oral Award of 2DMAT 2019, and Outstanding Graduate Student Award of

Synergetic Innovation Center of Quantum Information & Quantum Physics in 2016. He is appointed as a member of young scientist committee of Chinese Physics Letters, Chinese Physics B, Acta Physica Sinica and Physics.

----Invited Talk----

Recent progress of high-performance infrared photodetectors driven by local field

Abstract—In the past decades, infrared (IR) photodetectors have been widely applied in remote sensing, medicine, communication and many other important fields. The smaller size, lighter weight, lower power, higher performance and lower price are expected in the next generation IR detection system. In recent years, many new types of advanced IR photodetectors with extraordinary designs, operating modes and materials come to the fore quickly. Here, we will introduce the progress and challenges of IR technology and give a report on our progress in the development of IR photodetectors driven by local field.

15:30~16:00 | Invited Speaker: Xiaoqiong Qi

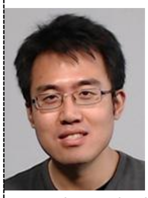
Xiaoqiong Qi received the B.E. degree and the Ph.D. degree in electrical engineering from Lanzhou University, China in 2003 and 2009, respectively. She conducted research at University of California at Los Angeles (UCLA) for two years during her Ph.D. studies. She joined the Institute of Semiconductors, Chinese Academy of Sciences (CAS) as a postdoctoral research fellow and in 2011 promoted as an Associate Professor. She visited Centre for Biophotonics and Laser Science at the University of Queensland (UQ) in 2013. She was awarded UQ Fellowship in 2015 and Advance Queensland Industry and Research Fellowship in 2020. She is currently a Research Fellow at UQ and her research interests are laser dynamics in semiconductor lasers, sensing and imaging by using terahertz quantum cascade lasers.

----Invited Talk----

Optical feedback dynamics in terahertz quantum cascade lasers and the applications

Abstract—The high ratio of photon-to-carrier lifetimes and small linewidth enhancement factor in terahertz (THz) quantum cascade lasers (QCLs) leads to absence of relaxation oscillations and negligible coupling from the amplitude to phase in this type of laser. It was widely accepted that THz QCLs are ultrastable against optical feedback. However, we experimentally observed and theoretically explanied the optical feedback dynamics in THz QCLs. We explored the periodic oscillations properties of the OF dynamics in THz QCLs and their applications as a novel THz sensing and imaging modality.

16:00~16:30 | Invited Speaker: Hairun Guo



Prof. Dr. Hairun Guo received his PhD at Technical University of Denmark (DTU) in 2014, and worked as a post-doc scientist in the laboratory of photonics and quantum measurements, led by Prof. Tobias J. Kippenberg at Swiss Federal Institute of Technology Lausanne (EPFL), where his research interests were centered on microresonator based optical frequency combs and cavity dissipative soliton physics, with a focus on mid-infrared frequency comb generations in nano-photonic chip-based devices. Since 2019, he joined the key laboratory of specialty fiber optics and optical access networks at Shanghai University, China. His group is now focusing on optical frequency comb techniques and ultra-fast nonlinear regimes in optical frequency metrology. Hairun has published more than 40 journal article, with an overall citation >2000.

----Invited Talk----

Frequency metrology via coherent vector supercontinuum process in photonic waveguides

Abstract—Supercontinuum generation has been well known for extending the bandwidth of mode locked lasers to perform *f-2f* self-referencing. Recently, this process in photonic integrated platforms has also been employed to access optical frequency combs in the mid-infrared as well as in the visible, with demonstrated no degradation in the coherence. Conventionally, the supercontinuum process is managed within one of the two fundamental *x*- and *y*-polarized modes in a photonic waveguide.

In this talk, we will review our recent advances in photonic supercontinuum serving for coherent and broadband mid-infrared optical frequency combs, including a proof-of-concept mid-infrared dual-comb spectrometer. More importantly, we will report a novel photonic supercontinuum dynamic that involves both of the two fundamental modes of the waveguide. We discover that in addition to simultaneous supercontinuum generations in both modes, light coupling is featured as a transfer function in the radio frequency (*rf*) domain, and a response spectrum in the optical domain can be retrieved. Physically, the retrieved response spectrum reveals a complete chart of wavelength-dependent coupling intensities in the photonic waveguide, and in practice, such an optical-to-microwave transfer can be employed to the implementation of optical frequency modulo operation, particularly that the frequency reminder can be with the light in the visible range where detectors are highly sensitive. This is highly desired in frequency metrology as well as in laser stability. Given the fact that two fundamental modes are orthogonal polarized, we term our observation as a vector supercontinuum process.

16:30~16:45 | G2951

A Fast Calculation Method of Gas Infrared Radiation Characteristics at High Temperature based on Radial Basis Function Neural Network

Xiaying Meng, Jun Du, Biao Wang, Yutao Zhang, Dandan Gu, Jian Qiu

Science and Technology on Electromagnetic Scattering Laboratory, China

Abstract—The radiation characteristics of high temperature gas are of great significance for infrared target detection. In this paper, a calculation method of high temperature gas radiation characteristics with high calculation efficiency is proposed. The

calculation model of CO2 absorption coefficient at 2001-2450 cm-1 band is established by using radial basis function neural network (RBFNN). In RBFNN model, the most accurate line by line (LBL) method is utilized to generate training samples. The input parameters are gas temperature, pressure and component concentration, and the output parameter is absorption coefficient. The results show that, compared with LBL method, RBFNN model has higher accuracy and is insensitive to input. After RBFNN training, RBFNN has higher computational efficiency while ensuring computational accuracy.

V12: Optical Communication and Networks

Zoom Meeting Room 4

ID: 816 7808 8000 | Time: 14:30~17:15

Session Chair: **Chen Chen**, Chongqing University, China

14:30~15:00 | Invited Speaker: Chen Chen

Chen Chen (Member, IEEE) received the B.S. and M.Eng. degrees from the University of Electronic Science and Technology of China, Chengdu, China, in 2010 and 2013, respectively, and the Ph.D. degree from Nanyang Technological University, Singapore, in 2017. He was a Post-Doctoral Researcher with the School of Electrical and Electronic Engineering, Nanyang Technological University, from 2017 to 2019. He is currently a Research Professor with the School of Microelectronics and Communication Engineering, Chongqing University, Chongqing, China. His research interests include optical wireless communication, optical access networks, Internet of Things, and machine learning.

----Invited Talk----

NOMA for LiFi-Enabled Bidirectional IoT Communication: An Energy Efficiency Perspective

Abstract—In this talk, we will introduce an energy-efficient non-orthogonal multiple access (NOMA) scheme for light fidelity (LiFi)-enabled bidirectional Internet of Things (IoT) communication. In order to efficiently improve the energy efficiency (EE) of the bidirectional LiFi-IoT system, NOMA with a quality-of-service (QoS)-guaranteed optimal power allocation (OPA) strategy is first proposed, and then an adaptive channel and QoS-based user pairing approach is further designed. Analytical and simulation results demonstrate the superiority of NOMA with OPA in comparison to orthogonal multiple access (OMA) and NOMA with typical channel-based power allocation strategies.

15:00~15:30 | Invited Speaker: Fangzheng Zhang

Prof. Fangzheng Zhang received the B.S. degree from Huazhong University of Science and Technology, Wuhan, China, in 2008, and the Ph.D. degree from Beijing University of Posts and Telecommunications, Beijing, China, in 2013. He is currently a professor with the College of Electronic and Information Engineering, Nanjing University of Aeronautics and Astronautics. His current research interest includes microwave photonics, radar imaging, and machine learning.

----Invited Talk----

Deep Learning based Signal Recovery for Broadband Radar over Fiber Transmission

Abstract—Radar over fiber networks, or fiber distributed radar networks, is a good solution to extend the radar detection area. In such networks, a group of distributed radar stations covering different detection areas are connected to the central radar station by optical fibers. To simplify the system and save the cost, it is preferred that the radar echoes received by each radar station are transmitted through fiber links to the central station, where analog-to-digital conversion and digital signal processing are conducted. In this process, the radar echoes would suffer from noises and nonlinear spurs because of unideal E/O and O/E conversions as well as fiber dispersion and nonlinearities. To deal with the signal distortions, specially designed electro-optical modulation formats or optical signal processing modules can be applied, but the system is heavily dependent on the electro-optical devices and usually only one aspect of the impairments can be compensated. Some of the system defects, such as the in-band harmonic spurs, cannot be compensated using the traditional optical signal processing methods. In this report, a deep learning assisted radar signal recovery method is presented, in which a convolutional neural network (CNN) is applied to deal with the system defects and recover the radar signals. Performance of this method is experimentally investigated. The results can soundly verify the feasibility and effectiveness of the proposed method, which is a promising solution for broadband radar signal recovery in radar over fiber networks.

15:30~16:00 | Invited Speaker: Biao Chen

Biao Chen received the Bachelor and Master degrees in Industrial Electronics from Zhejiang University, Hangzhou, China, in 1984 and 1987 respectively, and the Ph.D. degree in Information & Communication Engineering from Zhejiang University in 2004. In 1987, he joined Zhejiang Institute of Technology, Hangzhou, China, where he was engaged in research on optical transmission systems, Instrumentation & control systems. In 1993, he partly joined Shenzhen Sanxin Photoeletronics Technology Co. Ltd., serving as Chief Engineer and the president later on. In 1994, he designed and implemented the optical CATV transmitters/receivers, which were the first models in China and commercialized successfully. Since 2000, he joined Zhejiang University, Hangzhou, China, where he has been engaged in research on metropolitan- and access-area network technologies. Recently He has successfully developed an advanced on-line automatic instrumentation system for ferrule fabrication industry and combination of optical and radio network systems for remote driving and operation. Currently, he is executive director of Optical Engineering division, Ningbo Research Institute Zhejiang University, and header of the Ningbo Advanced Photoelectric Technology Innovation Platform. His current research interest is in optical and radio Industrial communication systems and networks.

----Invited Talk----

Hybrid FSO/RF for a mobile wireless link

Abstract—The performance of free space optical (FSO) links can seriously be affected by fog and pointing errors and less subject to rain, while radio frequency (RF) wireless systems that use frequencies above 10 GHz are adversely impacted by rain and less impacted by fog and pointing errors. This motivates the design of hybrid RF/FSO systems for reliable wireless connection applications. We present a design of hybrid RF/FSO systems for a mobile wireless link which could be used in broadband industrial applications. A key issue in this design is how to effectively use RF and FSO links in parallel. We try to fix it at data link level.

16:00~16:30 | Invited Speaker: Xian Zhou

Xian Zhou received the Ph.D. Degree in electromagnetic field and microwave techniques from Beijing University of Posts and Telecommunications, China in 2011. She was a Hong Kong Scholar at the Department of Electrical and Information Engineering at the Hong Kong Polytechnic University from Feb. 2014 to Feb. 2017. She is currently professor at School of Computer and Communication Engineering at University of Science and Technology Beijing. Her current research interests include high-speed optical fiber transmissions and fiber sensing technologies. She collaborates extensively with industry and is currently the principle investigator of various governmental- and industry-funded research projects in various aspects of optical communications and sensor systems.

----Invited Talk----

Coherent Detection for Data Center Interconnections

Abstract—After 400G, Ethernet speed is envisioned to be 800G and/or 1.6T, which is projected to be deployed within 5 years. However, the limited spectral efficiency of the PAM-like IM-DD systems cannot support to scale the transport data rate up to terabit. Some cost-efficient solutions of coherent detection have started to attract attention in short reach transmission scenarios. This talk will review the recent progress of these simplified coherent optical schemes and provide a discussion about problems faced them.

16:30~16:45 | G2978

Machine Learning Assisted Hardware Fingerprint Identification for TDM-PON from Eye Diagram

Huiyuan Gong, Huiyuan Gong, Mengfan Cheng, Weidong Shao, Lei Deng, Qi Yang, Xiaojing Gao, Deming Liu

Wuhan Research Institute of Posts and Telecommunications, China

Abstract—Identity authentication management is a challenge in network security solutions. Especially, this issue becomes more prominent in passive optical network (PON) due to its broadcasting nature and point to multipoint (P2MP) topological structure. Unauthorized access, injection attack and identity spoofing are not difficult to implement.

From the authentication perspective, several encryption strategies have been reported in order to improve the security of PONs. However, this type of methods excessively depends on the keys, which have the risk of being leaked and cloned by certain illegal means. On the other hand, hardware device fingerprints are natural features with uniqueness and non-clonability at the physical layer, and they are caused by the tolerances of electronic and optic components of device. More specifically, manufacturing variability among electro-optical transmitters generates unique signature in the transmitted analogue waveform, which could be used as the fingerprint for ONU identification to achieve intrusion detection and resist identity spoofing attacks.

An identity authentication scheme for TDM-PON at physical layer is proposed. The schematic is shown in Fig.1. We use the received eye diagram as the source of fingerprint. A trained convolutional neural network (CNN) is utilized to directly learn and classify the features in the eye diagrams. A commercial FPGA evaluation board with 10G SFP+ port is used as the ONU. 10 in total 10G SPF+ transceiver modules are under test using the transmit pattern of pseudo random bit sequence (PRBS-15). An oscilloscope is used to detect the signal at the OLT-side. Experimental results show that the recognition rate can reach 99%. The proposed method can be used to enhance the security performance of TDM-PON at the physical layer in a compact manner.

16:45~17:00 | G2933

Network Design Models with Partial Protection Schemes Against Multiple Failures under Optical-Channel Data Unit Constraints

Yiliu Tan, Qian Wu, Yoshiki Nakano, Jiading Wang, Maiko Shigeno

University of Tsukuba, Japan

Abstract—In recent years, dependency on computer networks has been increasing due to the increasing speed and capacity of data transmission. To guarantee the quality of service in networks, new technologies are being developed. The use of optical-channel data unit (ODU) technology in optical networks can segment and combine the required traffic demands and make effective use of network resources so that more traffic demands can be satisfied. An algorithm for addressing multiple ODU switch failures is described in this paper. This paper proposes three models to prevent multiple failures and formulates them as

integer linear programming problems. The computer experiments compare their efficiencies. As a result, each traffic demand on the network is divided into plural paths, and less calculation time is required when the capacity allocated to each path is fixed. When the same method is used but the capacity allocated to each path is unfixed, the resource cost is relatively small.

17:00~17:15 | G2917

A 15 Gbps 520-nm GaN Laser Diode based Visible Light Communication System utilizing Adaptive Bit Loading Scheme

Junhui Hu, Chao Shen, Fangchen Hu, Guoqiang Li, Sizhe Xing, Wangwei Shen, Junwen Zhang and Nan Chi
Fudan University, China

Abstract—In this paper, we demonstrate a high-speed visible light communication system employing a 520-nm green laser diode. A recorded data rate of 15.004 Gbps is reported by utilizing an adaptive bit-loading discrete multitone (DMT) modulation scheme with a measured bit error ratio (BER) of 3.724 × 10-3, which satisfies the forward-error-correction (FEC) criteria. The results suggest the system has a high spectral efficiency of 5.456 bit/s/Hz at 2.75 GHz bandwidth.

VIRTUAL SESSIONS / Sept. 18, 2021

V13: Translational Photomedicine and Biophotonics

Zoom Meeting Room 1

ID: 979 0046 1385 | Time: 10:00~12:00

Session Chair: **Wenbo Hu**, Northwestern Polytechnical University, China

10:00~10:30 | Invited Speaker: Huilin Shao

Dr. Huilin Shao is Presidential Young Professor, Department of Biomedical Engineering, and Principal Investigator, Institute for Health Innovation & Technology (iHealthtech), National University of Singapore. Dr. Shao received her BA from Cornell University, with a double major in Biological Sciences and in Physics. She completed her dual PhD (Biophysics) at Harvard University and PhD (Medical Engineering) from Harvard-MIT Health Sciences and Technology (HST). Her research focuses on developing integrated nanotechnology platforms for molecular analyses of novel biomarkers. She has pioneered multiple technologies to advance molecular diagnostics. Her work has been published in top journals such as Nature Biotechnology, Nature Nanotechnology, Nature Medicine, Nature Biomedical Engineering, Nature Communications and highlighted in major reviews and popular news media. In recognition of her achievement, Dr. Shao has received multiple awards, including James Mills Pierce Award, A*STAR Independent Fellowship, NUS Early Career Research Award, the L'Oreal For Women in Science National Fellowship, Springer-Nature MINE Young Scientist Award, and Singapore Presidential Young Scientist Award.

----Invited Talk----

Nanosensor technologies for molecular analyses of circulating biomarkers

Abstract—The growing emphasis on personalized medicine significantly increases the need to analyze key molecular markers. In comparison to tissue biopsies, circulating biomarkers (liquid biopsies) can be conveniently and repeatedly obtained from biofluids with minimal complications. In particular, exosomes have recently emerged as a promising circulating biomarker. Exosomes are nanometer-sized membrane vesicles actively shed off by cells and possess unique advantages: they abound in biofluids and harbor diverse molecular contents. In this talk, I will describe various nanosensor systems we have developed for quantitative analyses of diverse circulating biomarkers. These technologies integrate advances in device engineering, nanomaterial sciences and molecular biology. By enabling rapid, sensitive and cost-effective detection of circulating biomarkers, these platforms could significantly expand the reach of preclinical and clinical research, in informing therapy selection, rationally directing trials, and improving sequential monitoring to achieve better clinical outcomes.

10:30~11:00 | Invited Speaker: Wenbo Hu

Wenbo Hu received his Ph.D. degree from Nanjing University of Posts and Telecommunications in 2016. He carried out postdoctoral work at Nanjing Tech University (2017) and State University of New York at Buffalo (2018–2019). In 2020, he obtained full professorship at Northwestern Polytechnical University. His research focuses on the ultrafast excited-state dynamics in organic phototheranostic materials.

----Invited Talk----

Manipulating the Dynamics of Dark Excited States in Organic Materials for Phototheranostics

Abstract—Manipulating the dynamics of dark excited-states (DES) such as higher excited singlet or excited triplet states with no or small radiative decay, are of both fundamental as well as practical interests, an important application being photoactivated diagnosis and therapy (phototheranostic) which include photoacoustic (PA) imaging, photodynamic therapy (PDT), and photothermal therapy (PTT). However, the current understanding of DES in organic structures is rather limited, thus making any rational manipulation of DES in organic materials very challenging.

A DES decays primarily by radiationless transition through two pathways: (i) singlet-to-triplet intersystem crossing (ISC), and (ii) internal conversion (IC) relaxation. The deactivation of DES via ISC can generate cytotoxic reactive oxygen species (ROS) for PDT, while IC could convert photons into heat for PA imaging and PTT. Herein, we highlight our research on developing a fundamental understanding of structure-property relationship for manipulation of DES in organic materials in relation to phototheranostic. We describe the application of femtosecond transient absorption (fs-TA) spectroscopy for obtaining valuable insights into the DES dynamics. Afterwards, we present our work on DES in non-rigid molecules that revealed greatly enhanced ISC through geometry-twisting, which leads to an innovative pathway to develop organic materials exhibiting external stimuli-responsive reversible switching of ISC. This insightful understanding of ISC can lead to the development of more advanced photosensitizers for PDT. Two other emergent concepts from our work presented here are: 1) significantly enhanced IC producing strong local heating by combining two-photon absorption with excited state absorption for cumulative multiphoton absorption, thus greatly increasing the strength of the PA signal for nonlinear PA imaging; and 2) by an example of an organic molecule, BODIPY, we show nanoscale charge-transfer state mediated strong IC in aggregate nanoparticles resulting in exceptionally high photothermal conversion efficiency of 61% for both PA and PTT.

11:00~11:15 | G2931

Numerical Study on the Light Extraction Efficiency and Angular Energy Distribution of Micro-LEDs

Zhengcong Fan, Weihong Chen, Feifan Qiu, Canbin Fang , Bingxi Xiang , Dan Wu and Mingxia Qiu
Shenzhen Technology University, China

Abstract—Abstract—Micro light emitting diodes (Micro-LEDs) possess advantages of high optical efficiency, high resolution and long lifetime, leading to a very broad application prospect in the future. This study uses Monte Carlo ray tracing method to study the variation of the luminescence characteristics of light emitting diode (LED) chips including horizontal electrode chip, flip chip, and vertical electrode chip while the size of LED chip decreases from conventional high-power LED size to micro-meter size LED. As the size of LED chip gets smaller, the luminescence characteristics will be significantly affected. The changes of the chip's luminescence characteristics are simulated as a function of dam's angle or reflectivity. Through simulations, it is found that when the size decreases from 1000 to 20 μm, the light extraction efficiency (LEE) of the three structures has reached more than 200% of the conventional LED chips, while the side emission ratio (SER) has increased by more than 50%. The simulation also reveals that for Micro-LED with flip electrode structure, adding the dam brings the following changes: the LEE increases as the rise of reflectivity of the dam. The half-peak width of the angular energy distribution curve decreases firstly and then increases with the increase of the dam's angle. The dam's angle of 30 ° can not only optimize the angular energy distribution curve, but also have a higher LEE. The results of this numerical study have an important significance for optical design and future application of Micro-LEDs.

11:15~12:00 | G2932

Analysis of package factors affecting the light output efficiency of quantum dots-based micro-LEDs

Yuhao Wu, Hairui Xie, Yuxuan Zhang, Jianwen Li, Kai Wang, Zhili Zhao, Mingxia Qiu, Fan Yang, Dan Wu
Shenzhen Technology University, China

Abstract—As the demand for telecommuting, remote instruction, and non-contact testing increases, augmented reality (AR) and virtual reality (VR) are growing rapidly due to the ability to fulfill site constraints. The key component of AR/VR is the microsize light sources. Among various types of potential sources, light emitting diodes (micro-LEDs) are the one of the most promising candidates. Different packages have a significant impact on the light output characteristics of micro-LEDs, which in turn affects their application. In this work, Monte Carlo ray tracing method is used to study the luminous characteristics of quantum dots (QDs) based micro-LEDs in different package structures. The effects of various bank reflectance and tilt angle on the luminous characteristics are simulated to fit the different needs of practical applications. With the increase of reflectivity, the light efficiency is significantly improved, and the impact is the largest at the bank with the angle of 90 °, where the light efficiency increases from 11.73% to 100%. The effect of QDs with different thickness and concentration on light efficiency was analyzed. The effect of QDs on light efficiency is not significant. However, owing to the formation of total internal reflection inside the micro-LED and the scattering characteristics of QDs, the absorption characteristics, which make the loss severe, semi-spherical micro-lens were added to break the total internal reflection at the light emitting interface and the light efficiency was increased by about 30%. This study will provide guidance for micro-LED packaging of different applications.

V14: Quantum Optics and Information

Zoom Meeting Room 2

ID: 930 3313 8929 | Time: 10:00~12:00

Session Chair: **Xuejian Wu**, Rutgers University-Newark, USA

10:00~10:30 | Invited Speaker: Saijun Wu

I graduated from Peking University in 2001, with M.S. degree in Optics, from Harvard University in 2007 with Ph.D degree in Appiled Physics. From 2007-2011 I worked with Prof. J. V. Porto at NIST and Univeristy of Maryland. From 2011-2014 I was a (senior)lectuer at Swansea University, UK. Since 2014 I was a professor at Fudan University. My research area are primarily on atomic physics and quantum optics. I am interested in developing new methods for controlling of atoms with light and vice versa. Current research projects in my Fudan Physics lab primarily are focused on developing methods for coherent control of atomic states and interactions with wideband shapable laser pulses, and for atomic spectroscopic imaging with holographic microscopy.

----Invited Talk----

Geometric control of dipolar spin-waves unraveling microscopic interaction at a cold-atom photonic interface

Abstract—Interaction between light and macroscopic ensemble of motionless atoms is a complex phenomenon featuring many-body resonant dipole interactions. An essential step toward possibly exploring the quantum resources of the system is to suppress the macroscopic light propagation, to allow the microscopic correlations to build up and to be analyzed in a background-free fashion. In this talk I will discuss a few recently developed optical techniques to precisely control strong transitions with geometric phases and to reversibly suppress propagation of light in a cold atomic ensemble. By transiently

suppressing the macroscopic dynamics, we unravel and precisely characterize a microscopic dipolar dephasing effect that generally limits the lifetime of the optical spin-wave order in ensemble-based atom-light interfaces.

10:30~11:00 | Invited Speaker: Yogesh S. S. Patil

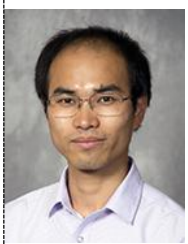
Bachelors in Engineering Physics at IIT, Bombay 2011;
PhD in Physics at Cornell University, 2018 working in AMO Physics studying open quantum systems with cold atoms and optomechanics;
Post-doc at Yale University working on quantum optomechanics since 2018

----Invited Talk----

Measurements of High-Order Phonon Correlations in an Optomechanical System via Single-Photon Detection

Abstract—We use single photon detectors to probe the motional state of a superfluid Helium resonator. The arrival times of Stokes and anti-Stokes photons (scattered by the resonator's acoustic mode) are used to measure the resonator's phonon coherences up to the fourth-order. These measurements are found to be consistent with predictions that assume the acoustic mode to be in thermal equilibrium with a bath through a Markovian coupling. By post-selecting on photon detection events, we also measure coherences (up to the third-order) of phonon-subtracted or -added thermal states of the resonator.

11:00~11:30 | Invited Speaker: Tongcang Li



Prof. Tongcang Li is an associate professor of physics and astronomy, and an associate professor of electrical and computer engineering at Purdue University. Before joining Purdue University in 2014, he did postdoctoral research at the University of California, Berkeley during 2011-2014. He obtained his Ph.D. degree from the University of Texas at Austin in 2011. Prof. Li is a pioneer in levitated optomechanics. He has won multiple awards including the NSF CAREER Award in 2016. Prof. Li has published one book and many high-impact papers in Science, Nature Physics, Nature Nanotechnology, Nature Communications, Physical Review Letters, and other leading journals. His recent work on GHz rotation of an optically levitated nanoparticle was selected as one of the "Highlights of the Year" of 2018 by the American Physical Society (APS) website Physics.

----Invited Talk----

Quantum sensing with levitated nanoparticles and spin defects in 2D materials

Abstract—Recently, we optically levitated nanoparticles in vacuum and driven them to rotate at a record-high speed of 300 billion rpm (5 GHz) [J. Ahn, et al. Nature Nanotechnology 15, 89 (2020)]. We demonstrated ultrasensitive torque detection with an optically levitated nanoparticle in vacuum. This system will be promising to study quantum surface interactions. We have also created shallow spin defects in hexagonal boron nitride (hBN), which is a van der Waals material. We observed a record-high optically detected magnetic resonance (ODMR) contrast of 46% at room temperature, and simultaneous enhancement of the photoluminescence of hBN spin defects by up to 17-fold by the surface plasmon of a gold-film microwave waveguide. Our results support the promising potential of hBN spin defects for nanoscale quantum sensing.

11:30~12:00 | Invited Speaker: Jiafeng Cui

Jiafeng is working as a Postdoctoral Researcher at Indiana University, Bloomington. His current research group is working on forming a radial 2D ion crystal in a linear Paul trap which is especially well-suited for studies of highly frustrated quantum spin models. Prior to Indiana, he has been working on using ion trap to probe quantum chemistry at Northwestern University for a short amount of time as a Postdoc.

----Invited Talk----

Radial two-dimensional ion crystals in a linear Paul trap

Abstract—We experimentally study two-dimensional (2D) Coulomb crystals in the "radial-2D" phase of a linear Paul trap. This phase is identified by a 2D ion lattice aligned entirely with the radial plane and is created by imposing a large ratio of axial to radial trapping potentials. Using arrays of up to 19 171Yb+ ions, we demonstrate that the structural phase boundaries and vibrational mode frequencies of such crystals are well-described by the pseudopotential approximation, despite the time-dependent ion positions driven by intrinsic micromotion. We further observe that micromotion-induced heating of the radial-2D crystal is confined to the radial plane. Finally, we verify that the transverse motional modes, which are used in most ion-trap quantum simulation schemes, remain decoupled and cold in this geometry. Our results establish radial-2D ion crystals as a robust experimental platform for realizing a variety of theoretical proposals in quantum simulation and computation.

V15: AI Photonics
Zoom Meeting Room 3
ID: 827 9043 9167 | Time: 10:00~12:00

Session Chair: **Jianqiang Li**, Kuaishou Technology, China

10:00~10:30 | Invited Speaker: Hsuan-Tung Peng

Hsuan-Tung Peng received the B.S. degree in physics from National Taiwan University, Taipei, Taiwan, in 2015 and the M.A. degree in electrical engineering in 2018 from Princeton University, Princeton, NJ, USA, where he is currently working toward the Ph.D. degree. His current research interests include neuromorphic photonics, photonic integrated circuits, and optical signal processing.

----Invited Talk----

A Photonic-Circuits-Inspired Compact Network: Toward Real-time RF fingerprinting

Abstract—Machine learning (ML) methods are ubiquitous in wireless communication sys- tems and have proven powerful for applications including radio-frequency (RF) fingerprinting, automatic modulation classification, and cognitive radio. However, the large size of ML models can make them difficult to implement on edge devices for latency-sensitive downstream tasks. In wireless communication systems, ML data processing at a sub-millisecond scale will enable real-time network monitoring to improve security and prevent infiltration. In addition, compact and integratable hardware platforms which can implement ML models at the chip scale will find much broader application to wireless communication networks. Toward real-time wireless signal classification at the edge, we propose a novel compact deep network that consists of a photonic-hardware-inspired recurrent neural network model in combination with a simplified convolutional classifier, and we demonstrate its application to the identification of RF emitters by their random transmissions. With the proposed model, we achieve 96.32% classification accuracy over a set of 30 identical ZigBee devices when using 50 times fewer training parameters than an existing state-of-the-art CNN classifier. Thanks to the large reduction in network size, we demonstrate real-time RF fingerprinting with 219 µs latency using a small-scale FPGA board, the PYNQ-Z1.

10:30~11:00 | Invited Speaker: Nan Hua

Dr. Nan Hua is an associate professor at Tsinghua University, Beijing, China. He received his B.S and Ph.D. degrees from Tsinghua University, in 2003 and 2009, respectively. In 2008, he went to the Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute (HHI) in Germany to conduct research studies. Since 2011, he joined the Department of Electronics Engineering, Tsinghua University and worked on optical switching networks. His areas of research include large-scale optical network control, all-optical switching technology, data center optical network, satellite optical network and high-precision network time synchronization. He has obtained more than 20 patents and published over 100 academic papers.

----Invited Talk----

The Impact of Data Acquisition Inconsistency and Time Sensitivity on Digital Twin for AI-Driven Optical Networks

Abstract—We focus on the causes and impact of noise and distortion in the digital twin for AI-driven optical networks, which is the cornerstone of convergence of resources for perception, transmission, storage and computing. Some possible solutions are put forward to reduce or eliminate the influence of the above two factors as well.

11:00~11:30 | Invited Speaker: Ching Eng PNG

Ching Eng (Jason) Png is Director of the Electronics and Photonics Department at Institute of High Performance Computing (IHPC), A*Star, Singapore. He received his PhD degree from the University of Surrey, UK (2004), MBA from INSEAD, France (2014) and Tsinghua University, China (2014). Dr. Png joined IHPC in 2005 with research interests spanning from quantum and high-speed photonics/plasmonics to electromagnetics.

He received numerous awards including the prestigious Royal Academy of Engineering Prize, Vebleo Fellow, Vebleo Scientist Award, IET Innovation Award - Software Design (highly commended), Skolkovo Prize at INSEAD Venture Competition, and Spring TECS Proof-of-Value grant. Dr. Png sits on SPIE Photonics West technical program and is Founding Chair for URSI Singapore Chapter.

----Invited Talk----

AI in Computational Photonics

Abstract—Photonic component modeling and design tasks mainly involves solving two challenges; firstly we address the forward problem where the goal is to seek optical response for a given photonic geometry. This is accomplished by hard computing methods in which Maxwell equations are numerically evaluated. In hard computing, it is extremely challenging to manage computational resources when evaluating large simulation domains and large simulation batches. This is a significant bottleneck in the forward modeling, limiting the full exploration of the parameter space. Secondly, we solve the inverse problem to derive appropriate photonic geometries for given optical responses. The solution to the inverse problem cannot be directly evaluated and is challenging to solve because the solution space is non-convex, meaning there exist many local optima. Although great efforts have been made in solving the inverse problem, identifying the best overall device given a desired objective and constraints remains challenging. Machine learning – a soft computing approach, has high potential to revolutionize photonic design and technologies. It is a proven method for the capture, interpolation, and ultrafast optimization of highly complex phenomena in many fields. Thus, the amalgamation of traditional photonic hard computing methods with machine learning algorithms ignites a new promising direction to accelerate the design cycle and generate innovative photonic geometries (with state-of-art performance excellence) that are beyond physical intuitions. In this invited talk, we demonstrate via modeling our recent works in this field. These includes optical mode solving using machine learning, group index predictions, and deep learning discovered power dividers. The use of the Bayesian inference methods to design photonics devices will also be demonstrated in this talk. We will also illustrate the use of the Bayesian inference method to estimate the waveguide geometry parameters of a fabricated optical filter device.

V16: THz Metamaterials and Device Applications

Zoom Meeting Room 4

ID: 816 7808 8000 | Time: 10:00~11:30

Session Chair: **Jingbo Wu**, Nanjing University, China

10:00~10:30 | Invited Speaker: Yihao Yang

Yihao Yang is a tenure-track professor at the College of Information Science & Electric Engineering, Zhejiang University. He received a PhD degree in Electronics Science and Technology from the Department of Information Science and Electronic Engineering, Zhejiang University, China, in 2017. He was a research fellow at the Centre for Disruptive Photonic Technologies (CDPT), Nanyang Technological University, Singapore, from 2017 to 2020. His main research interests include topological photonics/acoustics, invisibility cloaks, and metamaterials. He has published more than 50 peer-reviewed papers in leading scientific journals. He, as first or corresponding author, has published more than 30 articles in Nature, Nature Photonics, Nature Physics, Nature Communications, Physical Review Letters, Advanced Materials, and Light, Science & Applications. His works were highlighted by Physics, Physics World, Physorg, IEEE Spectrum, and many others, and selected as PRL Editors' Suggestion twice. His researches were selected as China's Top 10 Optical Breakthroughs (2019), Top 10 Breakthroughs at Zhejiang University (2019). He won the Excellent Doctoral Dissertation awarded by the Chinese Institute of Electronics (2019). He is one of the MIT Technology Review 'Innovators Under 35 China' (2020).

----Invited Talk----

Terahertz Topological Photonics for on-chip Communications

Abstract—The realization of integrated, low-cost and efficient solutions for high-speed, on-chip communication requires terahertz-frequency waveguides and has great potential for information and communication technologies, including sixth-generation (6G) wireless communication, terahertz integrated circuits, and interconnects for intrachip and interchip communication. However, conventional approaches to terahertz waveguiding suffer from sensitivity to defects and sharp bends. Here, building on the topological phase of light, we experimentally demonstrate robust terahertz topological valley transport through several sharp bends on the all-silicon chip. The valley kink states are excellent information carriers owing to their robustness, single-mode propagation and linear dispersion. By leveraging such states, we demonstrate error-free communication through a highly twisted domain wall at an unprecedented data transfer rate (exceeding ten gigabits per second) that enables real-time transmission of uncompressed 4K high-definition video. Terahertz communication with topological devices opens a route towards terabit-per-second datalinks.

10:30~11:00 | Invited Speaker: Jingbo Wu

Jingbo Wu received the B.S. degree in Electronic Information Science and Technology in 2005, the M.S. degree in Radio Physics in 2008, and the Ph.D. degree in Electromagnetic Field and Microwave Technology in 2012 from Nanjing University, China. He was a Radio Frequency Engineer in Huawei Company from 2008 to 2009. From 2012 to 2016, he was a Postdoctoral Researcher in University of Leeds and University of Cambridge, UK. From 2016, he joined School of Electronic Science and Engineering, Nanjing University and is an associate professor currently. His research interest includes terahertz metamaterials, superconductor electronics and terahertz spectroscopy.

----Invited Talk----

Terahertz Coding and Programmable Metasurface for Beam Steering

Abstract—Terahertz (THz) technology has shown prospects in wireless communication, radar, imaging, and other fields. The THz devices capable of controlling THz beam arbitrarily and dynamically are in great demand. However, the phased array widely used at microwave frequencies encounters technical challenges at THz frequencies. Here we report our recent progress on coding and programmable THz metasurface for THz beam control. We developed 1-bit coding metasurfaces on the flexible substrate. The THz beam deflection angle could be altered by controlling the coding sequences of “0” and “1” elements. The tunable materials of liquid crystal and vanadium dioxide (VO2) were adopted to realize the dynamic control of the spectral response. Utilizing the

tunable Brewster effect of VO2 film on the dielectric substrate, we realized the reconfigurable and broadband THz beam deflection control. Our work offers a new path of THz beamforming.

11:00~11:30 | Invited Speaker: Kaveh Delfanazari

James Watt School of Engineering, University of Glasgow, UK
Electrical Engineering Division & Cavendish Lab. University of Cambridge, UK

----Invited Talk----

Superconducting Quantum Terahertz Electronics: from superconducting coherent THz light sources to ultracompact waveguides and photonic integrated nano-circuitry

Abstract—Current compact emitter and receiver technologies are generally inefficient and impractical at terahertz (THz) frequencies between 0.1 and 10 THz. Hence, a gap exists between mature microwave and developed optical technologies. On-chip, integrated broadly tunable and
powerful quantum sources that coherently radiate THz waves between 0.1 and 11 THz (potentially extendable to 15 THz) can be achieved based on quantum tunneling of electron pairs across the stack of intrinsic Josephson junctions (IJJs) naturally present in a single crystal
of the layered high-temperature superconducting BSCCO. Such devices have been found to be especially promising solid-state THz sources capable of bridging the entire THz gap, as their wide-frequency tunability range is superior to that obtained from their semiconducting-based
rivals, either single resonant-tunneling diodes (RTDs) or THz-quantum cascade lasers (QCLs).
Due to the unique electrodynamics of BSCCO, they can also be operated as switching current THz detectors and quantum sensors.
We will propose that integrated IJJ THz devices with sub-centimeter-sized modules are easy to use in various applications, and they can be regarded as pocket quantum THz torches. We will conclude by demonstrating low-loss microwave-THz photonic integrated nanocircuitry to develop a fully integrated superconducting THz system.

V17: Perovskite Materials and Optoelectronic Applications

Zoom Meeting Room 1

ID: 979 0046 1385 | Time: 14:30~17:15

Session Chair: **Aung Ko Ko Kyaw**, Southern University of Science and Technology, China

14:30~15:00 | Invited Speaker: Wei Lin Leong

Dr. Wei Lin Leong received her Bachelor degree in Electrical and Electronic Engineering and Doctor of Philosophy in Materials Science and Engineering from Nanyang Technological University (NTU) in 2004 and 2009 respectively. She performed her postdoctoral fellowship under Nobel Laureate Professor Alan Heeger in University of California, Santa Barbara (UCSB), working on polymer and small molecule solar cells, where she was part of the team to achieve world record efficiency. In 2012, she joined Institute of Materials Research and Engineering (IMRE), Singapore, working in the area of photovoltaics and printed electronics. In July 2016, she joined the School of Electrical and Electronic Engineering (EEE) as an Assistant Professor. Currently, she is also the Deputy Director at the Centre for Micro- and Nano-Electronics at EEE NTU. Her research focuses primarily on developing nanomaterials (organic and hybrid) and implementing electrical device engineering for ubiquitous electronics and energy harvesting, such as flexible memory, solar cells and tactile sensors.

----Invited Talk----

High Efficiency Scalable Perovskite Solar Cells using Slot-Die Coating Process

Abstract—While impressive efficiency progress has been achieved for perovskite-based solar cells, process upscaling represents one of the main remaining hurdles to commercial applications. In this talk, we show that slot-die coating technique combined with synergistic gas quenching and substrate heating can produce compact, homogenous and reproducible perovskite films. The versatility of this crystallization strategy, which eliminates the need for complex solvents or additive engineering, was studied using planar SnO_2- and TiO_2-coated FTO substrates. Our study provides greater insights into achieving controlled coating and homogeneous crystallization of perovskite films over large-area substrates (~10 × 10 cm^2) necessary for the commercialization of this technology.

15:00~15:30 | Invited Speaker: Vincenzo Pecunia

Prof. Vincenzo Pecunia, PhD Cantab., is the founder and leader of the "Pecunia Research Group – Thin-Film Optoelectronics" (www.pecunialab.com). Pecunia's research covers environmentally-friendly, printable semiconductors (e.g., organic semiconductors, lead-free perovskite derivatives, amorphous metal-oxides, and carbon nanotubes), their optoelectronic properties, and their applications in printable optoelectronics and photovoltaics. Prior to establishing his group, Pecunia worked for over six years at the Cavendish Laboratory, University of Cambridge, UK. Whilst there, he earned his PhD in Physics and worked as a Postdoctoral Research Associate under the supervision of Professor H. Sirringhaus. Pecunia has published in highly reputable journals such as Nature, Advanced Materials, Advanced Energy Materials, Nano Energy, Advanced Functional Materials, and ACS Nano. Drawing from his research experience, he has also authored the books 'Organic Narrowband Photodetectors' (Institute of Physics Publishing) and 'Organic and Amorphous-Metal-Oxide Flexible Analogue Electronics' (Cambridge University Press).

----Invited Talk----

Tailoring Antimony-Based Perovskite Derivatives for High-Performance Indoor Photovoltaics and Self-Powered Photodetection

Abstract—Lead-free perovskite derivatives are capturing ever-growing attention in photovoltaics and optoelectronics research, driven by their promise to replicate the properties of the lead-based counterparts but without the same toxicity limitations.1,2 An attractive approach involves the replacement of lead with antimony.

To contribute to the realization of the potential of A3Sb2X9 absorbers (A+: monovalent cation; X-: halide anion), we focused on solution-deposited two-dimensional (2D) embodiments, given their attractive higher dimensionality compared to the mainstream zero-dimensional (0D) counterparts. We first developed deposition strategies that enhanced the microstructure and charge transport properties of Rb3Sb2I9, boosting its photoconversion to 65%.3 Further, we demonstrated a low-temperature synthetic route enabling the 0D-to-2D structural conversion of the Cs3Sb2X9 system, leading to superior charge transport properties and a peak photoconversion efficiency of 63%.4 Importantly, the photoconversion efficiencies attained in both cases are the highest to date for all A3Sb2X9 absorbers and bismuth-based analogues.

Capitalizing on these results, we investigated for the first time the capabilities and potential of antimony-based perovskite derivatives for indoor photovoltaics (IPV), an area of considerable commercial value in relation to the rapidly growing demand for energy-autonomous smart devices for the Internet of Things (IoT).1 We showed that the IPV efficiency of 2D Cs3Sb2I9-xClx is up to four times higher than its solar photovoltaic efficiency and is already within the range of mainstream commercial IPV.5 Additionally, optoelectronic characterization pointed to strategies for future performance improvements.5 Finally, we demonstrated that millimeter-scale 2D Cs3Sb2I9-xClx IPV devices are already capable of powering printed circuitry.5

Furthermore, we investigated, for the first time, the impact of the structural dimensionality of A3Sb2X9 absorbers on their performance as the active layers of self-powered photodetectors,6 which are in high demand for low-cost, ubiquitous light sensing for IoT applications. We revealed that 2D Cs3Sb2I9-xClx and Rb3Sb2I9 deliver cutting-edge self-powered photodetector performance, with a more-than-tenfold increase in external quantum efficiency (EQE), speed of response, and linear dynamic range compared to all prior self-powered implementations based on A3M2X9 absorbers (M3+: Sb3+ or Bi3+).6 Detailed characterization allowed us to reveal that such a performance boost originates from the superior carrier lifetimes and reduced exciton self-trapping enabled by the 2D structure.6

By illustrating the impact of microstructure, dimensionality, and optoelectronic properties on their photovoltaic and photodetection capabilities, our findings highlight the attractive opportunity that 2D A3Sb2X9 absorbers provide for lead-free perovskite-inspired photovoltaics and light sensing for the ongoing IoT revolution.

15:30~16:00 | Invited Speaker: Yuxi Tian

Yuxi Tian received his B.S. from Peking University in 2003 and his PhD in 2008 from Institue of Chemistry, Chinese Academy of Science. Then he continued postdoctoral research in Lund University, Sweden and Leiden University, Netherlands. In 2015, he joined Nanjing University as a professor in School of Chemistry and Chemical Engineering. He is main research interest is single molecule spectroscopy, including single molecule devices, photophysics in optoelectric materials and development of new technologies.

----Invited Talk----

Quenching Defects in Perovskite Materials Revealed by Microscopy

Abstract—Organometal halide perovskite materials have attracted broad interest during the last twelve years due to their special optoelectric properties including high charge separation efficiency, long carrier diffusion, tunable band gap energy and so on. However, the controllable fabrication of these materials is still challenging due to the fast crystallization process. Different defects are formed randomly during the crystallization determining the properties of the materials and the performance of the devices which are still far from understood. By using microscopy, we could investigate the dynamics of charge carries in these materials with high spatial resolution. We tried to reveal the chemical natures of the quenching defects in these materials by investigating the photoluminescence intensity, spectra, lifetime and variation dependence on electric field or atmospheres together with theoretical calculation.

16:00-16:30 | Invited Speaker: Bo Xu

Prof. Bo Xu is currently leading a research group working on Organic Electronics at the Department of Materials Science and Engineering, Nanjing University of Science and Technology, China. He obtained Ph.D. degree at the Department of Chemistry, KTH-Royal Institute of Technology, Stockholm, Sweden in 2015. Subsequently, he worked as a postdoctoral researcher (from 2015 to 2020) at the University of Washington, USA, Uppsala University and KTH, Sweden, respectively. He has been awarded the "King Carl XVI Gustaf Anniversary Award in 2019, Sweden" and selected for the "National High-level Young Talent Program in 2020, China". His research interests are mainly focusing on organic electronic materials with controlled chemical and physical properties for applications in optoelectronic devices, like photovoltaics and light-emitting diodes.

----Invited Talk----

Advanced p-Type Organic Semiconductors for Perovskite Optoelectronics

Abstract—Organic p-type semiconductors play an important role in device performance and stability of perovskite optoelectronics, typically, perovskite solar cells (PSCs) and perovskite light-emitting diodes (PeLEDs). The development of high-performance new generation p-type organic semiconductors is of great importance for perovskite optoelectronic devices for future industrial application. In this talk, Xu will introduce his work on the development of new p-type organic semiconductors for application in PSCs and PeLEDs.

16:30-17:00 | Invited Speaker: Zhanhua Wei

Zhanhua Wei is a full-time professor at the Institute of Luminescent Materials and Information Displays, College of Materials Science and Engineering, Huaqiao University, China. He received his B.S. degree in 2011 from the Department of Chemistry, Xiamen University, China, and his Ph.D. degree in 2015 from Prof. Shihe Yang's group, Department of Chemistry, Hong Kong University of Science and Technology, China. After postdoc research with Prof. Qihua Xiong at Nanyang Technological University, he joined Huaqiao University as a principal investigator in May 2016. His current research focuses on the synthesis of perovskite materials, perovskite light-emitting diodes, perovskite solar cells, and other optoelectronic devices. He has published ~50 peer-reviewed papers in scientific journals like Nature, J. Am. Chem. Soc. and Angew. Chem. Int. Ed.

----Invited Talk----

Fabrication of High-Performance Perovskite Optoelectronic Devices

Abstract—Metal halide perovskite materials are an emerging class of solution-processed semiconductors with considerable potential for use in optoelectronic devices. For example, light-emitting diodes (LEDs) based on these materials could see the application in flat-panel displays and solid-state lighting, owing to their potential to be made at low cost via facile solution processing, and could to provide tunable colors and narrow emission linewidths at high photoluminescence quantum yields. However, the highest reported external quantum efficiencies of green- and red-light-emitting perovskite LEDs are still well behind the performance of organic LEDs and inorganic quantum dot LEDs. Here we describe visible-light-emitting perovskite LEDs that surpass the quantum efficiency milestone of 20%. This achievement stems from a new strategy for managing the compositional distribution in the device—an approach that simultaneously provides high luminescence and balanced charge injection. Specifically, we mixed a pre-synthesized CsPbBr3 perovskite with a MABr additive (where MA is CH3NH3), the differing solubilities of which yield sequential crystallization into a CsPbBr3/MABr quasi-core/shell structure. The MABr shell passivates the nonradiative defects that would otherwise be present in CsPbBr3 crystals, boosting the photoluminescence quantum efficiency, while the MABr capping layer enables balanced charge injection. The resulting 20.3% external quantum efficiency represents a substantial step towards the practical application of perovskite LEDs in lighting and display.

17:00~17:15 | G29159

Efficient CsPbBr3 Nanoplatelets-based Blue Light-Emitting Diodes Enabled by an Intermediate Phase Strategy

Haoran Wang, Fanghao Ye, Jiayun Sun, Zhaojin Wang, Wei Chen, Pai Liu, Xiaowei Sun, Weiwei Zhao, Kai Wang
Southern University of Science and Technology & Harbin Institute of Technology, Shenzhen, China

Abstract—Quantum-confined CsPbBr3 nanoplatelets (NPLs) with very narrow emission linewidth are promising candidates for color-saturated blue emitters, but their electroluminescence performance is limited by inferior carrier transport. Here, we realize short-ligands capped-CsPbBr3 NPLs with improved photoluminescence quantum yield by introducing an intermediate phase to control the crystal growth. CsPbBr3 NPLs with short ligands exhibit enhanced charge transport ability and give rise to a remarkable electroluminescence efficiency of 2% (at 464 nm), a record for blue perovskite NPLs-based light-emitting diodes.

V18: Quantum Optics and Information

Zoom Meeting Room 2

ID: 930 3313 8929 | Time: 14:30~17:30

Session Chair: **Yong-Chun Liu**, Tsinghua University, China

14:30~15:00 | Invited Speaker: Shau-Yu Lan

Shau-Yu Lan received his PhD from Gaorgia Tech in 2009 and worked as a postdoc scholar at UC Berkeley from 2009 to 2013. He is now a Nanyang Assistant Professor at Nanyang Technological University. His research focuses on quantum sensing and engineering with cold atoms.

----Invited Talk----

Large array of Schrödinger cat states facilitated by an optical waveguide

Abstract—Quantum engineering using photonic structures offer new capabilities for atom-photon interactions for quantum optics and atomic physics, which could eventually lead to integrated quantum devices. Despite the rapid progress in the variety of structures, coherent excitation of the motional states of atoms in a photonic waveguide using guided modes has yet to be demonstrated. Here, we use the waveguide mode of a hollow-core photonic crystal fibre to manipulate the mechanical Fock states of single atoms in a harmonic potential inside the fibre. We create a large array of Schrödinger cat states, a quintessential feature of quantum physics and a key element in quantum information processing and metrology, of approximately 15000 atoms along the fibre by entangling the electronic state with the coherent harmonic oscillator state of each individual atom. Our results provide a useful step for quantum information and simulation with a wide range of photonic waveguide systems.

15:00~15:30 | Invited Speaker: Xuejian Wu

Dr. Xuejian Wu is an assistant professor in the department of physics at Rutgers University-Newark. His research aims to develop new atomic inertial sensors based on light-pulse atom interferometry. Before that, he did postdoctoral research at the University of California, Berkeley, and received his Ph.D. at Tsinghua University.

----Invited Talk----

Gravity surveys using a mobile atom interferometer

Abstract—Mobile gravimetry is important in metrology, navigation, geodesy, and geophysics. Atomic gravimeters could be among the most accurate mobile gravimeters but are currently constrained by being complex and fragile. Here, we demonstrate a mobile atomic gravimeter, measuring tidal gravity variations in the laboratory as well as surveying gravity in the field. The tidal gravity measurements achieve a sensitivity of 37 μGal/√Hz (1 μGal=10 nm/s2) and long-term stability of better than 2 μGal, revealing ocean tidal loading effects and recording several distant earthquakes. We survey gravity in the Berkeley Hills with an accuracy of around 0.04 mGal and determine the density of the subsurface rocks from the vertical gravity gradient. With simplicity and sensitivity, our instrument paves the way for bringing atomic gravimeters to field applications.

15:30~16:00 | Invited Speaker: Wei Zhang

Wei Zhang received his Bachelor's degree in 1998 and Ph. D in 2003, respectively, from Electronic Engineering Department, Tsinghua University, China. Then he joined Institute of Information Optoelectronic Technology, Electronic Engineering Department, Tsinghua University. At present, he is a tenured professor of Tsinghua University and the vice director of the Institute of Information Optoelectronic Technology. His research interests include Micro/nano-photonic devices, integrated photonic quantum devices, photonic quantum information technologies, especially quantum communications and quantum imaging.

----Invited Talk----

Fully Connected Quantum Networks based on Spontaneous Four-Wave-Mixing Quantum Light Sources

Abstract—Spontaneous four wave mixing (SFWM) is an important way to develop telecom band quantum light sources, which are crucial photonic quantum devices required for fiber-based quantum communications. This talk introduces our recent works on SFWM in silicon photonic quantum circuits, and its applications on quantum key distribution (QKD) networks.

16:00~16:30 | Invited Speaker: Chunlei Qu

Dr. Chunlei Qu is currently an assistant professor in the Department of Physics, Stevens Institute of Technology. He received his Ph.D. from the University of Texas at Dallas. Before joining Stevens, Dr. Qu was a postdoctoral researcher at the BEC Center, University of Trento in Italy, and a research associate at JILA, University of Colorado at Boulder. His research focuses on exploring novel quantum phases and dynamics that are useful for quantum information science in atomic, molecular, and optical systems.

----Invited Talk----

Spin Squeezing with Short-Range Spin-Exchange Interactions

Abstract—Spin squeezed states are known to be a useful resource for quantum metrology. Although there have been many proposals on how to generate spin squeezing, most of the dynamical generations involve collective Ising interactions via the so-called one-axis-twisting (OAT) model. In this talk, I will present our recent results on spin squeezing generation in the XXZ model with power-law interactions. Despite the inhomogeneous character of the spin couplings, we find this system can exhibit a level of spin-squeezing similar to that generated by the OAT model. I will report on our systematic investigation of this model and explain the mechanism responsible for the large spin squeezing generation. Our results are useful for state-of-the-art ultracold

polar molecular experiments where pinned molecules in an optical lattice can interact with each other by long-range dipolar interactions and for trapped ion crystals featuring long-range interactions mediated by the phonon modes of the crystal.

16:30~17:00 | Invited Speaker: Victoria Xu

Victoria Xu completed her PhD at UC Berkeley, where she studied fundamental physics using atom interferometry in the group of Professor Holger Müller. Her research focused on developing a trapped atom interferometer in an optical cavity with ultra-long coherence times, for applications in precise quantum metrology, gravitational physics, and searches for new physics. She is now a postdoctoral associate at the Massachusetts Institute of Technology, working with the MIT LIGO group on quantum measurement and gravitational wave detection.

----Invited Talk----

Lattice atom interferometry in an optical cavity

Abstract—Atom interferometers are powerful tools for both measurements in fundamental physics and inertial sensing applications. Their performance, however, has been limited by the available interrogation time of atoms freely falling in a gravitational field. I will present our realization of an intra-cavity trapped atom interferometer with 20 seconds of coherence, which extends the coherent interrogation time of spatially-separated quantum superpositions of massive objects by nearly an order of magnitude. I will also discuss how this trapped geometry differs from traditional free-fall atom interferometers by allowing potentials to be measured by holding, rather than dropping, atoms.

17:00~17:30 | Invited Speaker: Yong-Chun Liu

Yong-Chun Liu is an associate professor at Department of Physics, Tsinghua University. He received his PhD degree in physics from Peking University. His research interests include quantum optics and quantum precision measurement. He has published over 60 papers (including 7 in PRL), with a total citation of over 2000 and H index of 28.

----Invited Talk----

High-performance optical nonreciprocity using atomic ensembles

Abstract—Optical nonreciprocity is an essential property for a wide range of applications, such as building nonreciprocal optical devices that include isolators and circulators. The realization of optical nonreciprocity relies on breaking the symmetry associated with Lorentz reciprocity, which typically requires stringent conditions such as introducing a strong magnetic field or a high-finesse cavity with nonreciprocal coupling geometry. Here we discover that the collision effect of thermal atoms, which is undesirable for most studies, can induce broadband optical nonreciprocity. By exploiting the thermal atomic collision, we experimentally observe magnet-free and cavity-free optical nonreciprocity, which possesses a high isolation ratio, ultrabroad bandwidth, and low insertion loss simultaneously. The maximum isolation ratio is close to 40 dB, while the insertion loss is less than 1 dB. The bandwidth for an isolation ratio exceeding 20 dB is over 1.2 GHz, which is 2 orders of magnitude broader than typical resonance-enhanced optical isolators. Our work paves the way for the realization of high-performance optical nonreciprocal devices and provides opportunities for applications in integrated optics and quantum networks.

V19: Fiber-Based Technologies and Applications

Zoom Meeting Room 3

ID: 827 9043 9167 | Time: 14:30~16:30

Session Chair: **Xia Yu**, Beihang University, China

14:30~15:00 | Invited Speaker: Wonkeun Chang

Dr Wonkeun Chang received the BTech in Optoelectronics and MSc in Physics from the University of Auckland, and subsequently his PhD in Physics from the Australian National University. He then joined the Max Planck Institute for the Science of Light, where he developed expertise in ultrafast light-matter interactions in hollow waveguides. In 2013, Dr Chang was granted a Discovery Early Career Researcher Award from the Australian Research Council, and led a project on complex pulse dynamics and extreme events in ultrafast laser systems at the Australian National University. He is currently a Nanyang Assistant Professor at the School of Electrical and Electronic Engineering in Nanyang Technological University. His research interests are in specialty optical fibres, novel light source development and femtosecond laser systems.

----Invited Talk----

A fiber-based platform for ultraviolet frequency combs

Abstract—Frequency comb refers to an optical spectrum which consists of a series of discrete frequecy lines that are spaced equally across its bandwidth, offering an unprecedented level of accuracy in frequency metrology. We introduce a fiber-based approach to generate ultraviolet frequency combs by exploiting the phase-matched nonlinear frequency conversion in a gas-

filled small-mode-area hollow-core fiber.

15:00~15:30 | Shifeng Zhou

Shifeng Zhou received his PhD degree (2008) in Materials Science and Engineering from Zhejiang University. He spent one year at the Hong Kong Polytechnic University as a research assistant (2007). Subsequently, he joined Hokkaido University as a postdoctoral researcher (2008-2009), and then moved to Kyoto University as a JSPS postdoctoral fellow (2009-2011). He was an associate professor in Zhejiang University (2011-2013). Since 2013, he is a full professor in South China University of Technology. He is the recipient of the Motoharu Kurata Award of the Ceramic Society of Japan and Gottardi Award of International Commission on Glass. His primary research area is glass fibers and devices.

----Invited Talk----

Multicomponent Photonic Glasses and Fibers

Abstract—Multicomponent glasses and fibers are considered to be the fundamental building blocks of the next-generation fiber photonics. In this talk, the recent progress in designs, fabrications and applications of selected materials for multicomponent optical glasses and fibers is introduced. In the first part of the talk, the typical microstructures in multicomponent glass system represented by topological features, heterogeneities and locally crystallized domains are discussed. The preliminary results about the relation between the glass microstructure and its optical properties are introduced. In the second part, glasses and glass-ceramics with various optical functions, including photon generation, amplification, modulation and detection are highlighted. Especially, multicomponent glasses and fibers with attractive properties such as tunable, broadband and flat emission are introduced. Their potential applications as gain matrix of broadband fiber amplifier are discussed. In addition, the glasses and fibers with strong radiation blocking ability and intense radiation induced luminescence are introduced. The fiber derived device for radiation detection is highlighted.

15:30~15:45 | G2961

Optical Manipulation through Tapered Optical Fiber in Microfluidic System

Wu Zhang, Weiqian Chen, Jiahan Lin, Yusong Gao and Yanxiao Lin
Guangzhou University, China

Abstract—Optical force is effectively used to manipulate microparticles, usually realized in a bulk optical system with a high numerical aperture objective lens and complex optical control modules. Here we will report our working progress on the optical manipulation in a miniaturized, low cost and integrated microfluidic chip based on tapered optical fiber trapping. In the integrated system, we aim to measure the optical force amplitude, fulfill of optical trapping function and control the movement of microparticles. Optical fibers with different tapered structures were designed to trap microparticles in different distances. A tunable trapping distance was also realized in real time by changing the environment liquid in the microfluid chip. In addition, The trapping force was characterized in the microfluidic system with a controlled microflow rate.

15:45~16:00 | G2940

Instantaneous Frequency Measurement Using Optical Power Monitoring Based on a DP-DPMZM

Yulin Zhu, Beilei Wu, Jing Li, Muguang Wang, Zixiao Wang, Shiying Xiao, Fengping Yan
Beijing Jiaotong University, China

Abstract—We demonstrate an instantaneous frequency measurement (IFM) scheme using optical power monitoring based on a dual-parallel dual-polarization Mach-Zehnder modulator (DP-DPMZM). The amplitude comparison function is related to the input microwave frequency and electrical time delay, which is achieved by monitoring the optical power of orthogonal polarization signals. The principle of the scheme is theoretical analyzed, and the simulation of the IFM system is performed to verify the mechanism.

16:00~16:15 | G2948

OAM Modes Amplifier based on Erbium-doped Ring-core Fiber

Shuaishuai Liu, Liang Zhang, Jianxiang Wen, Wei Li, Cheng Du, Huanhuan Liu and Fufei Pang
Shanghai University, China

Abstract—We experimentally demonstrated orbital angular momentum (OAM) mode fiber amplifiers by the utilization of erbium-doped ring-core fiber. For the power amplification of OAM modes with topological charge $|l| = 1$, the maximum output power of up to 16.1 dBm is achieved. Furthermore, the signal gain is about 26.5 dB at the communication spectral window.

16:15~16:30 | G2928

Generation of Controllable High-Order Modes in Mode Selective Coupler

Yan Wu, Jianxiang Wen, Fufei Pang, Xianglong Zeng, Tingyun Wang
Shanghai University, China

Abstract—We fabricated a kind of mode selective coupler with a homemade ring-core fiber, which can generate different high-order modes by controlling the pre-stretched length of the single-mode fiber. This coupler can be used as a mode converter and is of potential interest for increasing channel capacity in optical telecommunications.

V20: AI Photonics

Zoom Meeting Room 4

ID: 816 7808 8000 | Time: 14:30~17:00

Session Chair: **Chaoran Huang**, Chinese University of Hong Kong, China

14:30~15:00 | Invited Speaker: Xin Yuan

Dr. Xin Yuan (Senior Member, IEEE, xinyuan@ieee.org) is currently a video analysis and coding lead researcher at Bell Labs, Murray Hill, NJ, USA. Prior to this, he had been a Post-Doctoral Associate with the Department of Electrical and Computer Engineering, Duke University from 2012 to 2015, where he was working on compressive sensing and machine learning. He develops compressive sensing techniques for high-dimensional imaging with applications to videos, hyperspectral, microscopy and x-ray imaging. Before joining Duke, Dr. Yuan obtained his Ph.D. from the Hong Kong Polytechnic University in 2012. He has published more than 140 journal and conference papers and holding dozens of international patents. In 2020, one paper he coauthored has won the best paper runner up award in IEEE International Conference on Multimedia and Expo (ICME).

----Invited Talk----

Deep Learning for Snapshot Compressive Imaging

Abstract—We consider deep learning methods for snapshot compressive imaging (SCI), where a single 2D detector is used to capture the high-dimensional data-cube. This work reviews the recent advances of deep learning based inversion algorithms for SCI.

15:00~15:30 | Invited Speaker: Jianning Lu

Jianing Lu was born in Zhejiang Province, China, in 1993. He received the B.Eng. and the M. Eng. degrees in optical and electrical information engineering, in 2015 and 2018, from Huazhong University of Science and Technology, Wuhan, China. From June 2017 to January 2018, he was a Research Associate with the Department of Information Engineering, Chinese University of Hong Kong. He is currently working toward the Ph.D. degree in Photonics Research Centre, Department of Electronic and Information Engineering, The Hong Kong Polytechnic University, Hong Kong. His research is focused on digital coherent optical communication, optical performance monitoring and digital signal processing algorithms.

----Invited Talk----

Completely automatic generation and collection of ultra-large scale experimental training dataset for machine-learning-based quality of transmission estimation

Abstract—Applications of machine learning (ML) models in optical communications and networks have been extensively investigated. For an optical wavelength-division-multiplexing (WDM) system, the quality of transmission estimation (QoT) generally depends on many parameters including the number and arrangement of WDM channels, the launch power (LP) of each channel, the number and distribution of fiber spans, the attenuation, dispersion, and nonlinearity parameters and length of each fiber span, the noise figure (NF), gain and the gain tilt of EDFA, transceiver noise, digital signal processing (DSP) performance, and so on. In recent years, ML-based QoT estimation schemes have gained significant attentions. However, nearly all relevant works are conducted through simulations because it is difficult to obtain sufficient and high-quality dataset for training ML models. In this talk, we demonstrate a completely automated generation and collection of ultra-large scale experimental training dataset for ML model-based QoT estimation by automating of transceivers and optical link parameters, as well as data transfer and DSP. Implementation details and key codes of automation are presented. Artificial neural network (ANN) models with 1 and 2 hidden layers are trained by the collected dataset and brief QoT estimation results are evaluated and discussed to verify the performance and stability of the established automated system.

15:30~16:00 | Invited Speaker: Chaoran Huang

Chaoran Huang is an assistant professor at the Chinese University of Hong Kong (CUHK). Before joining CUHK in 2021, she was a postdoctoral research associate at Princeton University. Her ongoing work is dedicated to developing integrated photonic hardware for artificial intelligence (AI) computing and related applications. She was the recipient of the 2019 Rising Stars Women in Engineering Asia. She has published more than 50 peer-reviewed research papers. Her research work has been presented as a postdeadline paper at 2020 OFC, was featured in the special issue of Optical Neural Networks by OSA Optics and Photonic News, and was selected as Spotlight articles by several journals.

----Invited Talk----

Neuromorphic photonics and its applications in optical communications

Abstract—Neuromorphic photonics creates processors 1000× faster than electronics while consuming less energy. We will discuss the role of neuromorphic photonics in optical communications, review existing approaches, and outline the required

technologies to evolve this field.

16:00~16:30 | Yan Shi

Yan Shi, PhD, Senior Engineer of China Unicom Research Institute, studies on the SDN and intelligence research of optical network.

----Invited Talk----

Research and Applications of Optical Transport Network Intelligence

Abstract—A healthy and high-performance optical and packet network serves as the foundation for all application scenarios of 5G. Traditional approaches are facing great difficulties to automatically and efficiently analyze network data, solve network faults, as well as optimize network performance. Therefore, it is concerned to utilizize machine learning to construct an intelligent, healthy and high-performance optical network, or to enhance the operator experience through the use of machine learning. In this report, the requirements and applications of intelligent network management for telecom operators will be introduced.

16:30~17:00 | Yubin Zang

Yubin Zang was born in Nanjing, Jiangsu Province, China, on May 17, 1995.

He received the B.E degree in information engineering from the College of Electronic and Information Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing, China, in 2017. He is now a PhD candidate of the Department of Electronic Engineering, Tsinghua University, Beijing, China. His current research interests include optical systems for AI and AI-assisted optical system modeling.

----Invited Talk----

AI based Fiber Transmission Models

Abstract—Fiber optical communications has been widely researched and utilized in today's society. In predicting signal transmission so as to better design the communication systems, traditional models based on split-step Fourier method (SSFM) are adopted which can numerically solve the nonlinear Schrödinger equation (NLSE). Though this kind of models can obtain results with acceptable precision, relatively large requirements for storage must be catered. Besides, calculation complexity may increase intensely as the distance increases. With the help of artificial intelligence (AI), these costs can be alleviated or even eliminated. In this report, developments of AI based optical fiber communication optimization in optical performance monitoring, fault detection will be firstly illustrated. Then, AI based fiber transmission models will be focused and their prediction performances will be shown. More discussions on probable future research trends will be developed at the end.

V21: Liquid Crystal Photonics

Zoom Meeting Room 5

ID: 896 3784 6459 | Time: 14:30~16:30

Session Chair: **Jiangang Lu**, Shanghai JiaoTong University, China

14:30~15:00 | Invited Speaker: Jiangang Lu

Dr. JianGang Lu, professor of department of electronic engineering, Shanghai JiaoTong University, chair of LCT committee of SID China, and Committee Member of SID, received his B.S. of electrical engineering in 1995 and a Ph.D. degree of electronic engineering in 2003 from Zhejiang University, Hangzhou, China. He was a senior researcher at Liquid Crystal research Lab, Next generation LCD Research Center, Samsung Electronics in Korea. Dr. Lu worked as the project leader for 3-D display, blue phase liquid crystal, Charge Share SPVA LC mode, and OCB mode Field Sequential LC Display, et, al. After He joined Shanghai JiaoTong University, Dr. Lu focused his research on liquid crystal material and photonic device, flexible integrated sensor, three-dimensional display system, and Micro & Nano Structure integrated optoelectronics. Dr. Lu has published more than 100 papers and has more than 60 licensing patents. And he has charged for the projects of NSFC, 863, 973, and National Key R&D Program.

----Invited Talk----

Photonic Devices of Templated Twist Structure Liquid Crystals

Abstract—Twist structure liquid crystals (LCs) consist of cholesteric liquid crystal (CLC) with one dimensional twist structures, blue phase liquid crystal (BPLC) consisted of double twist cylinders (DTCs) and the disclination lines, and sphere phase liquid crystal (SPLC) composed of three-dimensional twist structures (3-DTSs) and disclination lines among them. The template effects on stability of twist structure LCs were investigated. A multi-wavelength filter with Templated-BPLCs was demonstrated that it may get much narrower reflection bandwidth, more stable wavelength and bandwidth with the temperature shift compared with the CLC filters. Furthermore, the central wavelength and bandwidth can be easily controlled by the fabrication process and the optimization of the material concentration. A bandwidth tunable CLC filter were fabricated with the multi-templating technology

which shows simple fabrication process, good stability and extensibility. By template processing, a wavelength tunable random lasing was demonstrated with dye doped SPLC. With different polymer concentrations, the reconstructed sphere phase random lasing may achieve more than 40nm wavelength continuous shifting by electrical field modulation. The templated twist structure LCs show great potential applications in optical communication, display, and lasing.

15:00~15:30 | Invited Speaker: Lishuang Yao

In order to break the situation that the processing of the key liquid crystal correction devices of liquid crystal adaptive optics relies on foreign countries, the design and processing technology of the driver chip is studied, and the only domestic development platform of silicon-based liquid crystal devices is built. Aiming at the problem of uniform response for high-precision liquid crystal devices, new technologies such as super thin alignment film optimization and over-driving are proposed. Otherwise the research on liquid crystal control technology with pure optical driving and without any electronic control components we carried out. This technology will further expand the direction and road of the application field of liquid crystal optical control. The representative papers published were about 40 SCI, including more than 13 patents.

----Invited Talk----

Systematic development of fast and high accuracy liquid crystal light modulator

Abstract—Our research mainly focused on systematic development of fast and high accuracy liquid crystal light modulator. In order to break the situation that the processing of the key liquid crystal corrector of liquid crystal adaptive optics relying on foreign countries, the design and processing technology of the silicon chip is studied, and the only domestic development platform for silicon-based liquid crystal devices is built. Aiming at the problem of uniform response of high-precision liquid crystal devices, new technologies such as cell thickness optimization and over- driving technique are proposed. A high-precision liquid crystal spatial light modulation device with liquid crystal layer thickness of only 1.8μm, thickness accuracy of better than 0.1 μm and spatial non-uniformity of PV better than 80 nm is developed. In detail,in order to solve the problem of dielectric voltage drop caused by the traditional rubbing orientation layer in LCoS devices, photo-sensitive alignment film based on self-assembled multi-layer technology is proposed. The thickness of the orientation layer is reduced from 100 nm to less than 10 nm. The voltage drop of the orientation layer is eliminated and the response speed of the device is further improved. Aiming at the application potential of optical driving liquid crystal modulator in high energy field in the future, we carried out the research on liquid crystal device with pure optical driving and without any electronic components.

15:30~16:00 | Invited Speaker: Yong Xie

Dr. Yong XIE (谢勇) is an Associate Professor & Doctoral Supervisor at the School of Physics, Beihang University. He is heading a research group of liquid crystalline nanomaterials and soft condensed matter with 7 group members and with a broad spectrum of research interests, ranging from nanoparticles self-assembly to photoelectronic device applications, from magnetic soft matter to smart actuators, and from synthesis of porous materials to water treatment. He published over 30 papers in journals such as Nat. Comm., ACS Nano, ACS Appl. Mater. & Interfaces, etc.

----Invited Talk----

Morphological and Orientational Controls of Gold Nanorods Self-Assembly Directed by Evaporative Microflows

Abstract—Evaporative self-assembly of noble metal nanoparticles into ordered structures holds great promise for fabricating optical and plasmonic devices by virtues of low cost, high efficiency, and ease of operation. However, only few kinds of well-defined assembly structures have been realized so far. Poor control of Marangoni flows during the droplet evaporation is one of the challenges accounting for the limited assemblies. Herein, based on the Bernoulli principle we design simple but reliable flow-field-confinement platforms to control the evaporative microflows and to work concur-rently with the depletion forces to enable the ordered self-assembly of gold nanorods. On this basis, we realized orientationally-ordered assemblies by designed strong unidirectional microflow in a capillary, and device-scale assembly monolayer membranes by created weak convection in home-made glass cells. Morphologically diversified assembly superstructures, such as spherulite-like, boundary-twisted, chiral spiral assemblies and merging membranes with a π-twisted domain wall, were obtained due to spontaneous symmetry breaking or in the presence of defects, such as surface steps and screw dislocations. Optical anisotropy and polarization-dependent behaviors of these assemblies were further revealed. Understanding of these entropy-driven assembly behaviors and control of the evaporative microflows to guide the self-assembly of gold nanorods provide insights into the general bottom-up approach that would be helpful for constructing complex, yet robust nanostructural units.

16:00~16:30 | Invited Speaker: Jingxia Wang

Jingxia Wang received her PhD degree in Materials Science from Tsinghua University in 2004. She worked as a postdoctoral fellow in Prof. Lei Jiang's group at the Institute of Chemistry, Chinese Academy of Sciences (CAS), between 2004 and 2006. Acting as an associate professor, she then joined Prof. Yanlin Song's group at the Institute of Chemistry, CAS, between 2006 and 2014. In 2014, being a full professor, she moved to the Technical Institute of Physics and Chemistry, CAS. Her research interest is focused on the fabrication and applications of colloidal PCs with superwettability, phase change characterization of blue phase liquid crystal, soft actuator and etc. She has published more than 100 SCI Journal papers in the field.

----Invited Talk----

Comprehensive Characterization of the Diffusionless Transformation of Blue Phase liquid Crystals

Abstract—Blue phase liquid crystals (BPLCs) are typical soft cubic phases that combine the order of solid molecular crystals and the fluidity of the liquids, exhibiting potential applications in adjustable lasers, displays, and nonlinear optical devices. Typically, BPLCs are obtained by slow cooling from the isotropic state, and a phase transformation occurs from blue phase III (BPIII) to blue phase II (BPII, simple cubic lattice) or blue phase I (BPI, body-centered cubic lattice), in which BPIII is thought to consist of a spaghetti-like tangle of DTCs. The DTCs, which are analogous to the atoms of the atomic crystals, whose microstructures have been observed using confocal laser scanning microscopy, transmission electron microscopy (TEM), and corresponding simulations. However, the phase transition process has yet to be observed at the submicrometer scale owing to the poor stability of the transition states, and thus the transition mechanism remains unclear. A full understanding of the phase transition processes of the soft cubic superstructure is expected because it is highly important not only for fundamental science but also for practical applications, and will provide important insights into the design and fabrication of functional materials and devices.

In this work, the intermediate stages with core-shell configurations are fast polymer-stabilized to achieve ultra-high thermal stability from -190 to 340 °C for further characterization. TEM, synchrotron small-angle X-ray diffraction (syn-SAXS), and angle-resolved microspectroscopy (ARM) were used to dynamically track the phase transformation process of BPLCs: including diffusionless phase transformations (DLPTs) of BPIII → BPII, BPIII → BPI, and reversible thermoelastic martensitic of BPII → BPI. Here the DTCs are considered as structural units that do not diffuse during the DLPTs. In particular, DTCs in BPII→BPI show a diffusionless, collective, and highly coordinated motion, which is a hallmark of a reversible thermoelastic martensitic transformation. Besides, diffusionless behaviors of DTCs are also proven in BPIII→BPI, BPIII→BPII. In addition, three types of core-shell configurations are formed: BPIII/BPI, BPIII/BPII, and BPIII/BPII/BPI. In light of our findings, several applications based on the core-shell configurations have been achieved, such as temperature-switchable binary and ternary QR codes, micro-area lasing, and fabrication of blue phase liquid crystals with large domain sizes.

Keywords: Blue phase liquid crystals; Diffusionless phase transformations; martensitic transformation; Micro-area lasing.

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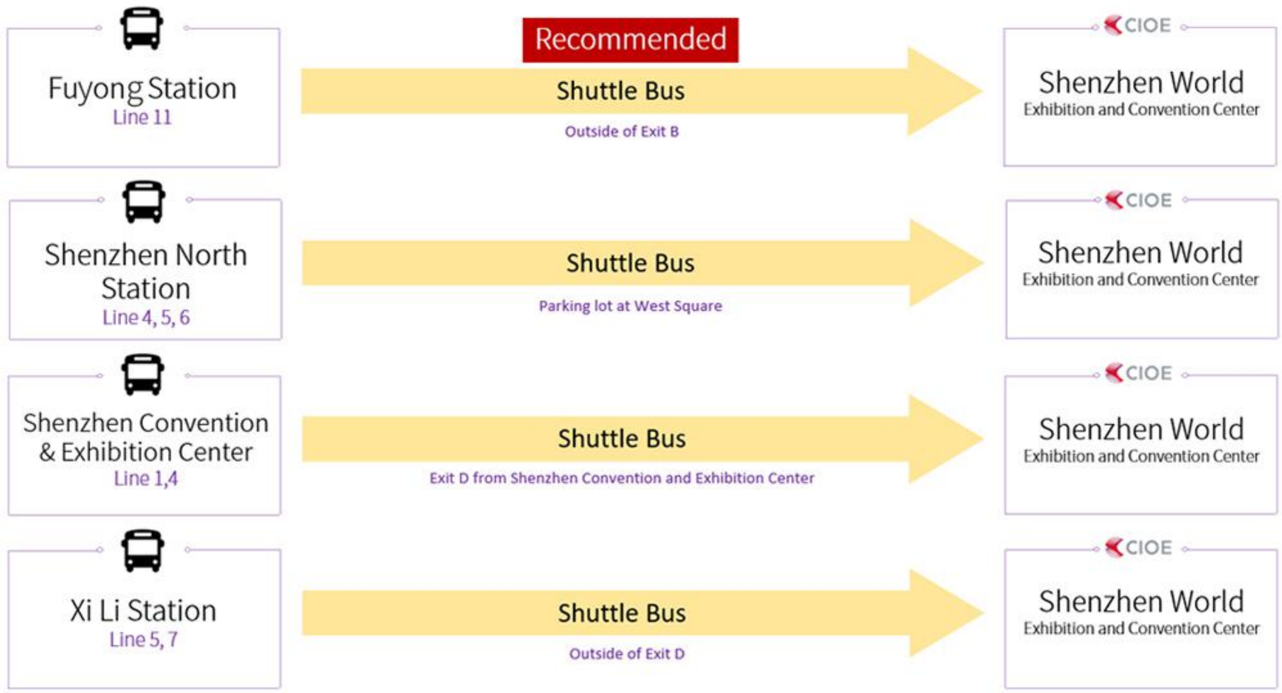

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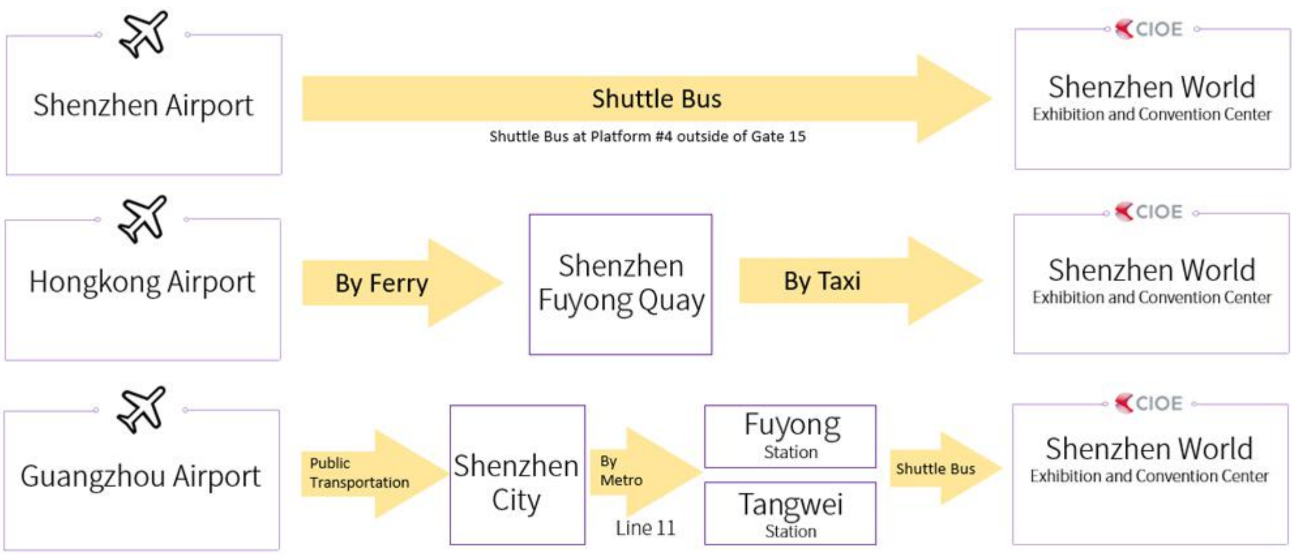

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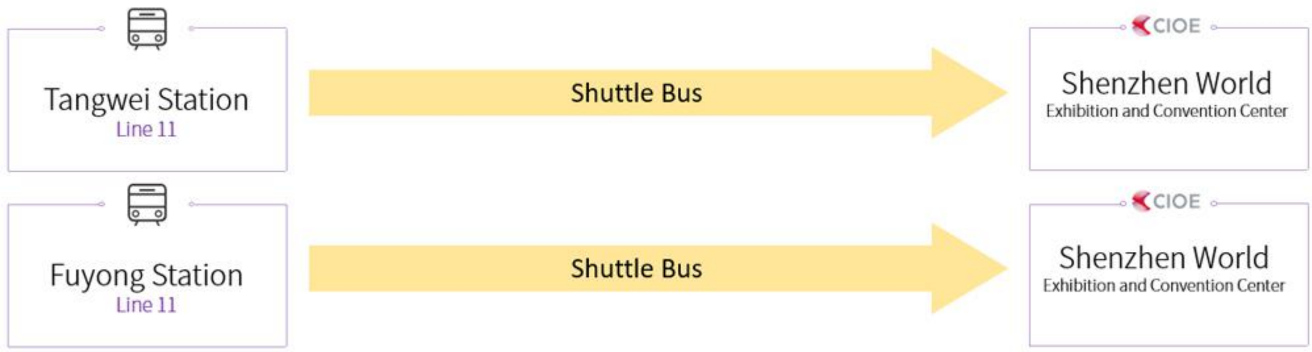

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