OGC 2020
Optoelectronics Global Conference

2020 Optoelectronics Global Conference

Shenzhen, China

7-11 September, 2020

ORGANIZERS

IEEE Photonics Society

IEEE Photonics Society Guangdong Chapter

Department of Electrical and Electronic Engineering 电子与电气工程系

LOCAL HOST

CIOE China International Optoelectronic Expo

CIOEC 中国国际光电高峰论坛 China International Optoelectronic Conference

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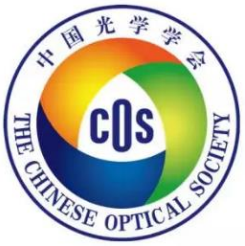
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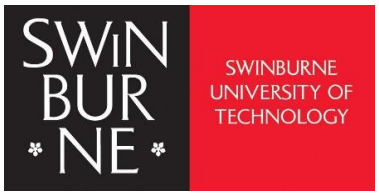
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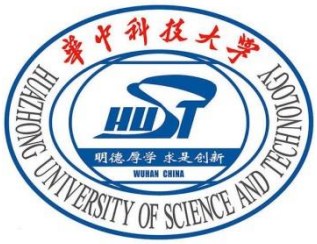
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1896
SHANGHAI JIAO TONG UNIVERSITY


UNIVERSITY OF POSTS AND TELECOMMUNICATIONS
北京邮电大学 BEIJING


中国科学院
SIAT
CHINESE
ACADEMY OF
SCIENCES
深圳先进技术研究院


華南理工大学
1934
SOUTH CHINA UNIVERSITY OF TECHNOLOGY


1920
HIT


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


1933
華南師範大學
SOUTH CHINA NORMAL UNIVERSITY


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1907
FUJIAN NORMAL UNIVERSITY


中国地质大学
1952
CHINA UNIVERSITY OF GEOSCIENCES


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四川大学
1896
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長理工大学
1958
CHANGCHUN UNIVERSITY OF SCIENCE AND TECHNOLOGY


SPIE.


SHENZHEN UNIVERSITY
1983


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CONTENTS

ABOUT OGC 2020

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

OGC 2020 will be held concurrently with the 22nd China International Optoelectronic Exposition (CIOE) in Shenzhen. The conference aims to promote interaction and exchange of various disciplines among professionals in academia and industry at home and abroad. In addition, it also serves to turn technologies into industrial applications. 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 optoelectronics industry. It will be a perfect gathering to learn about new perspectives, technologies and trends which might pushes the boundaries of the technology and eventually creates a broader future for optoelectronics applications.

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

Symposia

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

Special Events

- <Workshop>. Photonics Global Student Conference (PGSC)
- <Workshop>. Emerging Techniques for Detection/Control of Infectious Diseases
- <Workshop>. Optoelectronics Innovation Challenge
- <Workshop>. Progress in Laser Cleaning Technique and Applications

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PUBLISH WITH OGC 2020

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

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S6. OPTOELECTRONIC DEVICES AND APPLICATIONS

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Workshops Committee

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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 25 minutes for the presentation plus ab. 5 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 12 minutes for the presentation plus ab. 3 minutes for questions from the audience.
A projector & computer will be available in every session room for regular presentations.
We suggest you bring a backup PDF-version of your presentation.

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For Poster Presentation

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

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。
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- 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

Sign-in Site	**SIGN-IN desk outside LM105**
Main Conference Room	**LM103A&B @ 1F**
Breakout Rooms	**LM104A @ 1F; LM104B @ 1F; LM104C @ 1F**
Lunch Restaurant	**LM105&LM106 @ 1F**

AGENDA OVERVIEW

Sept. 07, 2020 | SIGN-IN

@ Sign-in desk outside Room LM105 (1F) | 一楼会议室 LM105 外签到台

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

Sept. 08, 2020 | Technical Meeting

@ Room LM103 (1F) | 一楼会议室 LM103

09:00-09:20	**Opening Ceremony** *chaired by Perry Shum, Southern University of Science and Technology*	
	Welcome Remarks *given by Xiancheng Yang, China International Optoelectronic Exposition (CIOE)*	**Opening Remarks** *given by Hai Yuan, Guangzhou Institute of Advanced Technology, Chinese Academy of Science (GIAT)*

09:20-10:00	**Plenary Speech I** Title: VCSELs and Green Data Com **Dieter Bimberg**, Executive Director, "Bimberg Chinese-German Center for Green Photonics" of CAS at CIOMP, Changchun, China; Founding Director, Center of NanoPhotonics, TU Berlin, Germany

10:00-10:20 | Coffee Break

10:20-11:00	**Plenary Speech II** Title: Optical Interconnect Technologies for Hyperscale Cloud Infrastructure **Chongjin Xie,** Senior Director in Alibaba Cloud, Alibaba Group

11:00-11:40	**Plenary Speech III** Title: Meta-lens: An Eye to the Future **Din-Ping Tsai,** The Hong Kong Polytechnic University, Hong Kong, China; Fellow of AAAS, APS, EMA, IEEE, JSAP, OSA and SPIE

12:00-13:30 | LUNCH @ LM105/LM106(1F)

AGENDA OVERVIEW

Sept. 08, 2020 | Technical Sessions

13:30-15:00	**13:30-15:00**	**13:30-15:15**
Room LM104-A (1F) 一楼会议室 LM104-A	Room LM104-B (1F) 一楼会议室 LM104-B	Room LM104-C (1F) 一楼会议室 LM104-C
Session T01 **Topic** | Laser Technology-A	**Session T02** **Topic** | Fiber-Based Technologies and Applications-A	**Session T03** **Topic** | Optoelectronic Devices and Applications-A
Invited Speeches | Luming Zhao; Qian Li; Xiaosheng Xiao	**Invited Speeches** | Fei Xu; Bo Lin **Oral Presentations** | #2866, #2870	**Invited Speeches** | Zhaoyu Zhang; Pan Wang; Kan Wu **Oral Presentations** | #39
15:15-15:30 | Coffee Break		
15:30-17:45	**15:30-18:00**	**15:30-18:00**
Room LM104-A (1F) 一楼会议室 LM104-A	Room LM104-B (1F) 一楼会议室 LM104-B	Room LM104-C (1F) 一楼会议室 LM104-C
Session T04 **Topic** | Optoelectronic Devices and Applications-B	**Session T05** **Topic** | Biophotonics and Biomedical Optics-A	**Session T06** **Topic** | Optical Communication and Networks-A
Invited Speeches | Connie Chang-Hasnain; Jianwen Dong; Xinlun Cai; **Oral Presentations** | #2845, #2848, #2862	**Invited Speeches** | Tianxun Gong; Chao Tian **Oral Presentations** | #22, #23, #24, #26, #2874, #2886	**Invited Speeches** | Biao Chen; Guijun Hu; Hongyan Fu; Changyuan Yu **Oral Presentations** | #2884, #2883

16:00-17:30 Lounge (1F) | 一楼长廊	**Posters** #1, #6, #8, #11, #13, #14, #28, #31, #34, #2844, #2847, #2860, #2869, #2872, #2880, #2882, #2885, #2890, #2892

Sept. 09, 2020 | Special Events

09:00-12:00	The 22nd China International Optoelectronic Exposition Opening Ceremony & CIOEC 2020 Keynote Speech	South Ballroom (2F) 二楼宴会厅 A
14:00-17:30	**Workshop** | Emerging Techniques for Detection/Control of Infectious Diseases	Room LM104-C (1F) 一楼会议室 LM104-C
14:00-17:15	**Workshop** | Progress in Laser Cleaning Technique and Applications	Room LM104-B (1F) 一楼会议室 LM104-B
14:00-17:00	**Workshop** | Optoelectronics Innovation Challenge	Virtual Meeting 线上会议

12:00-13:30 | LUNCH @ LM105/LM106(1F)

AGENDA OVERVIEW

Sept. 10, 2020 | Technical Sessions

09:00-10:15	**09:00-10:45**
Room LM104-B (1F)	一楼会议室 LM104-B	Room LM104-C (1F)	一楼会议室 LM104-C
Session T07 **Topic**	Optoelectronic Devices and Applications-C	**Session T08** **Topic**	Precision Optics-A
Invited Speeches	Chunmei Ouyang; Lixia Zhao **Oral Presentations**	#9	**Invited Speeches**	Nankuang Chen; Sen Han; Xueke Xu **Oral Presentations**	#5
10:15-10:45 | Coffee Break	**10:45-11:00 | Coffee Break**
10:45-12:00	**11:00-12:00**
Room LM104-B (1F)	一楼会议室 LM104-B	Room LM104-C (1F)	一楼会议室 LM104-C
Session T09 **Topic**	Fiber-Based Technologies and Applications-B	**Session T10** **Topic**	Optoelectronic Devices and Applications-D
Invited Speeches	Zhenggang Lian; Yunhe Zhao **Oral Presentations**	#7	**Invited Speeches**	Zhenzhou Cheng **Oral Presentations**	#2867, #38

12:00-13:00 | LUNCH @ LM105/LM106(1F)

13:00-14:45	**13:00-14:00**
Room LM104-B (1F)	一楼会议室 LM104-B	Room LM104-C (1F)	一楼会议室 LM104-C
Session T11 **Topic**	Biophotonics and Biomedical Optics-B	**Session T12** **Topic**	Optical Communication and Networks-B
Invited Speeches	Guanghui Wang **Oral Presentations**	#27, #2856, #2865, #2868, #2873	**Invited Speeches**	Zixiong Wang **Oral Presentations**	#2852, #2876
14:45-15:00 | Coffee Break	**14:00-14:15 | Coffee Break**
15:00-16:45	**14:15-17:15**
Room LM104-B (1F)	一楼会议室 LM104-B	Room LM104-C (1F)	一楼会议室 LM104-C
Session T13 **Topic**	Laser Technology-B	**Session T14** **Topic**	Infrared Technologies and Applications-A
Invited Speeches	Chongxi Zhou **Oral Presentations**	#2877, #2879, #15, #2836, #2850	**Invited Speeches**	Fang Wang; Yi Gu; Zhipeng Wei; Peng Wang; You Wang **Oral Presentations**	#32, #2871

AGENDA OVERVIEW

Sept. 10, 2020 | Special Event

10:00-17:00	**Workshop** | Photonics Global Student Conference (PGSC) Video view link: https://pgsc2020.weebly.com/presentations.html	Virtual Meeting 线上会议

19:00-20:30 | 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 2020 年 10 月 10 日晚 17:45 前于注册台集合，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

AGENDA OVERVIEW

Sept. 11, 2020 | Virtual Sessions

08:30-9:30	**08:30-10:15**
Virtual meeting on Zoom	Virtual meeting on Zoom
Session T15 **Topic** | Laser Technology-C	**Session T16** **Topic** | Optoelectronic Devices and Applications-E
Invited Speeches | Carel Martijn de Sterke **Oral Presentation** | #2887, #43	**Invited Speeches** | Yikai Su; Andrew Wing On Poon; Ching Eng (Jason) PNG **Oral Presentations** | #2851
09:30-09:45 | Short Break	**10:15-10:30 | Short Break**
09:45-12:00	**10:30-12:15**
Virtual meeting on Zoom	Virtual meeting on Zoom
Session T17 **Topic** | Precision Optics-B & Biophotonics and Biomedical Optics	**Session T18** **Topic** | Optoelectronic Devices and Applications-F
Invited Speeches | Yaocheng Shi; Ximeng Zheng; Quan Liu; Jun Qian **Oral Presentation** | #21	**Invited Speeches** | Shangjian Zhang; Yu Luo; Changzheng Sun **Oral Presentation** | #20

12:15-13:00 | LUNCH BREAK

13:00-15:00	**13:00-15:30**
Virtual meeting on Zoom	Virtual meeting on Zoom
Session T19 **Topic** | Fiber-Based Technologies and Applications-C	**Session T20** **Topic** | Optical Communication and Networks-C
Invited Speeches | Kin Yip WONG; Simon Fleming; Ya-nan Zhang **Oral Presentations** |#2888, #2889	**Invited Speeches** | Boon S. Ooi; Yong Liu; Daoxin Dai; Yan Li **Oral Presentations** | #16, #2
15:00-15:15 | Short Break	**15:30-15:45 | Short Break**
15:15-16:45	**15:45-18:30**
Virtual meeting on Zoom	Virtual meeting on Zoom
Session T21 **Topic** | Fiber-Based Technologies and Applications-D	**Session T22** **Topic** | Infrared Technologies and Applications-E
Invited Speeches | Baishi Wang; Xinyu Fan **Oral Presentations** | #25, #2891	**Invited Speeches** | E Wu; Chuantao Zheng; Yiding Wang; Baile Chen **Oral Presentations** |#2878, #12, #2854

PLENARY SPEAKER / 09:20-10:00, Sept. 8, 2020

Dieter Bimberg
Executive Director
"Bimberg Chinese-German Center for Green Photonics" of CAS at CIOMP, Changchun, China
Founding Director, Center of NanoPhotonics, TU Berlin, Germany

Dieter H. Bimberg is the Founding Director of the Center of Nanophotonics at TU Berlin. He was chairman of the department of solid state physics at TUB from 1991 to 2012 and was holding the chair of Applied Physics until 2015. Until 2018 he was holding a Distinguished Professorship at KAU, Jeddah. Since 2018 he is the director of the "Bimberg Chinese-German Center for Green Photonics" of the Chinese Academy of Sciences at CIOMP Changchun. His research interests include the growth and physics of nanostructures and nanophotonic devices, ultrahigh speed and energy efficient photonic devices for information systems, single/entangled photon emitters for quantum cryptography and ultimate nanoflash memories based on quantum dots. He has authored more than 1500 papers, 61 patents, and 7 books resulting in more than 60,000 citations worldwide and a Hirsch factor of 110 (@ google scholar). His honors include the Russian State Prize in Science and Technology 2001, his election to the German Academy of Sciences Leopoldina in 2004, to the Russian Academy of Sciences in 2011, to the American Academy of Engineering in 2014, to the American Academy of Inventors 2016, as Fellow of the American Physical Society and IEEE in 2004 and 2010, respectively, the Max-Born-Award and Medal 2006, awarded jointly by IoP and DPG, the William Streifer Award of the Photonics Society of IEEE in 2010, the UNESCO Nanoscience Award and Medal 2012, Heinrich-Welker-Award 2015, the Nick Holonyak jr. Award of OSA in 2018 and the Stern-Gerlach- Prize of DPG in 2020..

TALK ON

VCSELs and Green Data Com

Abstract: The energy required to transmit information as encoded optical and electrical data bits within and between electronic and photonic integrated circuits, within and between computer servers, within and between data centers, and ultimately nearly instantly across the earth from any one point to another clearly must be minimized. This energy spans between typically tens of picojoules-per-bit to well over tens of millijoules-per-bit for the intercontinental distances. We seek to meet the exploding demand for information within the terrestrial resources available but more importantly as a common sense measure to reduce costs and to become stewards of a perpetual Green Internet. The concept of a Green Internet implies a collection of highly energy-efficient, independent, and ubiquitous information systems operating with minimal impact on the environment via sustainable energy sources [1]. A key enabling optical component for the Green Internet is the vertical-cavity surface-emitting laser (VCSEL). Our research on energy-efficient VCSELs for applications as light-sources for optical interconnects and for optical fiber data communication between 850 and 980 nm is reviewed. We present VCSEL designs, design principles, and operating methods that enable data communication systems capable of error-free operation at bit rates exceeding 50 gigabits-per-second with energy consumption approaching 50 femtojoules-per-bit @ 25 Gb/s. Yet unpublished results for 200+ Gbit/s optical interconnects based on wavlength multiplexing are presented. Novel photon lifetime engineering [2] for reducing the energy consumption and increasing the possible bit rate is presented. Optimum photon lifetimes and gain-to etalon wavelength offsets are shown to depend on the target bit rate.In order to minimize energy consumption trade-offs between number of wavelength channels, operating bit rates and modulation formats for given aggregated data rates have to be found.The importance of Si photonics: integration with dedicated drivers based either on SiGe, CMOS or SOI technologies and novel fibers is high-lighted.

PLENARY SPEAKER / 10:20-11:00, Sept. 8, 2020

Chongjin Xie
Senior Director in Alibaba Cloud,
Alibaba Group

Chongjin Xie is a senior director and Chief Communication Scientist in Alibaba Cloud, Alibaba Group, leading an optical network R&D, architecture, design and testing team to develop datacenter optical interconnects and networking technologies to support Alibaba online platform and cloud services. Prior to joining Alibaba Group in 2014, Dr. Xie was a Distinguished Member of Technical Staff at Bell Labs, Alcatel-Lucent, doing research on optical communication systems and networks. He did his postdoctoral research at Chalmers University of Technology in Sweden from 1999 to 2001, and received his M.Sc. and Ph.D. degrees from Beijing University of Posts & Telecommunications in 1996 and 1999, respectively. Dr. Xie has published one book, 5 book chapters and over 200 journal and conference papers. He was an associate editor of Journal of Lightwave Technology and a program chair of OFC'2019, is an associate technical editor of the IEEE Communications Magazine and a general chair of OFC'2021. He served as chairs, TPC chairs or TPC members in many conferences. Dr. Xie is a Fellow of OSA and a senior member of IEEE.

TALK ON

Optical Interconnect Technologies for Hyperscale Cloud Infrastructure

Abstract: Ubiquitous cloud computing and internet services rely on the ability of hyperscale infrastructure to scale in computing, storage and networking in response to increasing demand. Optical interconnects, which provide a high-speed communication platform among computing, storage and network equipment, is the foundation of the large distributed system. In this talk, we discuss the development and challenges of optical interconnect technologies that enable the hyperscale cloud infrastructure.

PLENARY SPEAKER / 11:00-11:40, Sept. 8, 2020

Din-Ping Tsai
Department of Electronic and Information Engineering
The Hong Kong Polytechnic University, Hong Kong, China
Fellow of AAAS, APS, EMA, IEEE, JSAP, OSA and SPIE

Professor Din-Ping Tsai is currently Chair Professor and Head of the Department of Electronic and Information Engineering, The Hong Kong Polytechnic University. He is an elected Member of International Academy of Engineering (IAE), and Academician of Asia-Pacific Academy of Materials (APAM). He is an elected Fellow of American Association for the Advancement of Science (AAAS), American Physical Society (APS), Electro Magnetics Academy (EMA), Institute of Electrical and Electronics Engineers (IEEE), The Japan Society of Applied Physics (JSAP), Optical Society of America (OSA), and International Society of Optical Engineering (SPIE), respectively. He is author and coauthor of 313 SCI papers (more than 11,959 SCI cited times, SCI H-index 55), 65 book chapters and conference papers, and 38 technical reports and articles. He was granted 67 patents in USA (19), Japan (3), Canada (3), Germany (2), China (1), etc. for 44 innovations. Twenty of his patents were licensed to industrial companies. He was invited as an invited speaker for international conference or symposium more than 275 times (12 Plenary Talks, 48 Keynote Talks). He received many prestigious recognitions and awards including "2019 Global Highly Cited Researchers," Web of Science Group (Clarivate Analytics); China's Top 10 Optical Breakthroughs in 2018," Chinese Laser Press (2019); "Mozi Award" from International Society of Optical Engineering (SPIE) (2018), etc. He currently serves as an Editor of Progress in Quantum Electronics (Elsevier), and Associate Editor of Journal of Lightwave Technology (IEEE & OSA).

TALK ON

Meta-lens: An Eye to the Future

Abstract: Optical meta-devices using meta-surfaces which composed of artificial nanostructures are able to manipulate the electromagnetic phase and amplitude at will. The design, fabrication and application of the novel optical meta-devices are reported in this talk. As an eye to the future, meta-lens is considered as the top 10 emerging technologies in World Economic Forum 2019. Design principles and application prospects of meta-lens will be addressed in this talk.

T01 Laser Technology-A

Room: LM104-A | 13:30-15:00

Symposia Chair: Qian Li

Peking University Shenzhen Graduate School, China

13:30-14:00 | Luming Zhao

Huazhong University of Science and Technology, China

Luming Zhao received the B.S. and the M.S. degrees from Tsinghua University, China. He acquired his Ph.D. degree from Nanyang Technological University, Singapore. Currently, Zhao serves as a professor at the School of Optical and Electronic Information, Huazhong University of Science and Technology, China. His current research interests include laser physics and engineering, soliton dynamics, ultrafast optics and optical telecommunications. Dr. Zhao is an IEEE/OSA/SPIE Senior member.

----Invited Talk----

Soliton separation from resonant background CW from a fiber laser

Abstract—Pulses generated in a fiber laser can be considered as solitons. However, solitons exist in conservative systems only. Pulses generated in a fiber laser actually are a mixture of pure soliton and continuous wave (CW). Kelly sidebands are a resonant CW with solitons. Therefore, it is difficult to separate CW especially Kelly sidebands from a soliton. In another word, pure solitons so far are not obtained from a fiber laser. We propose an approach of soliton separation, by making nonlinear Fourier transform (NFT) on a steady pulse generated from a fiber laser, then filtering out the eigenvalues of the resonant CW background in the nonlinear frequency domain, and finally recovering the soliton by inverse NFT (INFT). Simulation results verify that the soliton can be separated from the resonant CW background in the nonlinear frequency domain and pure solitons can be obtained by INFT. Soliton separation pave a way for exploring soliton dynamics without CW background.

14:00-14:30 | Qian Li

Peking University Shenzhen Graduate School, China

Qian Li received the Bachelor of Science degree from Zhejiang University, Hangzhou, China, in 2003, the Master of Science degree from the Royal Institute of Technology (KTH), Stockholm, Sweden, in 2005, and the Ph.D. degree from The Hong Kong Polytechnic

University, Hong Kong, in 2009. After graduation, she was a Visiting Scholar with the University of Washington, Seattle and a Postdoctoral Fellow with the Hong Kong Polytechnic University. In 2012, she joined the School of Electronic and Computer Engineering (ECE), Peking University, Beijing, China, as an Assistant Professor. Since 2013, she has been an Associate Professor with ECE.

Her research interests include nonlinear optics, ultrafast optics, and integrated optics. She is a Senior Member of the Optical Society of America (OSA). From March 2017 to April 2019, she was the Vice Chair of IEEE ED/SSC Beijing Section (Shenzhen) Chapter and a Chair for EDS. From 2015, she has been an Advisor of OSA Student Chapter with Peking University Shenzhen Graduate School. From 2019, she has been an Advisor of Peking University Shenzhen Graduate School Photonic Society Student Branch Chapter.

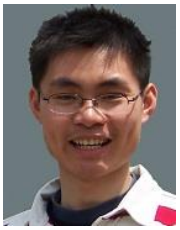
----Invited Talk----

Supercontinuum Generation in Fibers and Silicon Waveguides

Abstract—I will present our recent simulation results and experiment findings about supercontinuum generation in fibers and silicon waveguides.

14:30-15:00 | Xiaosheng Xiao

Beijing University of Posts and Telecommunications, China



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

----Invited Talk----

Recent progress of spatiotemporal mode-locked fiber lasers

Abstract—Spatiotemporal mode-locking, i.e., simultaneously locking of multiple transverse and longitudinal modes, is a general form of mode-locking. Spatiotemporal mode-locked (STML) multimode fiber lasers are ideal platforms for investigating spatiotemporal nonlinear dynamics, in addition to their potential applications benefiting from the high pulse energy. In this Presentation, recent progress of STML fiber lasers is reviewed. Our numerical and experimental observations of nonlinear spatiotemporal dynamics in the STML fiber lasers will be given.

T02 Fiber-Based Technologies and Applications-A

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

Symposia Chair: Fei Xu

Nanjing University, China

13:30-14:00 | Fei Xu

Nanjing University, China

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

----Invited Talk----

Optical fiber micro resonators for laser and sensing applications

Abstract—Highly sensitive and wearable sensors are novel building blocks in the development of human-interactive system. These attachable and flexible smart devices are commonly considered as the essential components in the next generation of human-portable devices for remote diagnosis and treatment. Here, we report a simple architecture of ultrasensitive and wearable photonic sensor which covers the detection of strain and pressure. The proposed sensor consists of a hybrid plasmonic microfiber knot resonator (HPMKR) embedded in polydimethylsiloxane (PDMS), resulting in a PDMS-HPMKR-PDMS sandwich structure. A gauge factor as large as 13,700 has been demonstrated in one direction and 794 in the other perpendicular direction of the device, which is more than one order magnitude larger than traditional electronic devices. The experiments for sensing humans'wrist pulse, respiration, and finger pulse are demonstrated. Finally, we will demonstrate its application in mode-lock lasers.

14:00-14:30 | Bo Lin

China Academy of Electronics and Information Technology, China

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

----Invited Talk----

Airport perimeter intrusion detection systems based on fiber optics sensors

A commonly used fiber optics sensor-fiber Bragg grating of different structures will be illustrated, and a perimeter intrusion detection system at airport using specially designed fiber grating sensors will be introduced.

14:30-14:45 | #2866

The Theoretical Research and Experimental Fabrication of the Dispersion Turning Point Sensors Realized in Tapered-microfibers

Yan Meng, Yunxu Sun, Xiaomin Zhan, Fucheng Xiao, Jianyu Zhang

Harbin Institute of Technology, Shenzhen

Abstract—A tapered-microfiber sensor near the dispersion turning point (DTP) is theoretically researched and experimentally fabricated by carefully tapering a standard single mode fiber (SMF). With respect to other tapered fiber sensors, the microfiber sensor near DTP has quite high sensitivity, which is verified by the theoretical analysis in this work. The influences of two critical structural parameters, the tapering length and the waist diameter, on the occurrence of DTP are also studied. Furthermore, the preparation technology of this sensor is experimentally explored. As last, the transmission spectrum of the fabricated microfiber DTP sensor is highly consistent with that in theoretical calculation. These results show its potential for humidity sensing and other environmental trace detection.

14:45-15:00 | #2870

Characterization of Multimode Optical Fiber Transmission Matrix with Different Neural Networks

Fucheng Xiao, Yunxu Sun, Yan Meng and Xiaomin Zhan

Harbin Institute of Technology, Shenzhen

Abstract—Multimode optical fiber (MMF) is a typical multi-scattering medium, through which light will produce speckles that completely annihilate the original signal. But in fact, this distortion is only seemingly random, and the input and output of the optical fiber have a deterministic relationship. Therefore, if a MMF is used as transmission medium, the response characteristics of the input and output of the MMF must be known. It is proposed here to use different neural network to characterize the transmission characteristics of MMF, which is also called the transmission matrix (TM). Different network fitting effects are expressed by the reconstruction quality of the image.

T03 Optoelectronic Devices and Applications-A

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

Symposia Chair: Jianwen Dong

Sun Yat-sen University, China

13:30-14:00 | Zhaoyu Zhang

Chinese University of Hong Kong, China

Prof. Zhaoyu Zhang received his B.S. and M.S. degree in Applied Mechanics from University of Science and Technology of China, Hefei, China, in 1998 and 2001 respectively. He received Ph.D. degree from California Institute of Technology, Pasadena USA in 2007 in Electrical Engineering. From 2008 to 2011, he worked in University of California, Berkeley as a postdoctoral fellow in College of Chemistry, with a joint appointment with Lawrence Berkeley National Laboratory. From 2011 to 2015, he worked in Peking University and led a team of "Nano OptoElectronics Lab (NOEL)". In 2015, he and his team moved to Chinese University of Hong Kong, Shenzhen. In 2016, he was approved to set up Key Labortary of Semicoductor laser, Shenzhen and be the director. His main achievements including the first demonstration of red-emission photonic crystal lasers, wavelength-scale micro-lasers with physical size smaller than 1 micron, microfluidic microlasers based on dye materials, as well as the first demonstration of photonic crystal lasers directly grown on silicon substrates. He has published more than 20 referred papers on renowned journals including Nature Communications, Advanced Materials, Physics Review Letters, Optica, Photonics research, Optics Letters, Applied Physics Letters, etc.

----Invited Talk----

Quantum dot photonic crystal and microdisk lasers monolithically integrated on silicon substrate

Abstract—Monolithic integration of efficient III-V light sources has been recognized as a promising technology for realizing Si-based photonic integrated circuits (PICs). Here, we present our latest progress about quantum dots microlasers monolithically int egrated on Si substrate with ultra-low power consumption and small footprint, which represent a major advance towards large-scale, low-cost integration of laser sources on the Si platform.

14:00-14:30 | Pan Wang

Zhejiang University, China

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.

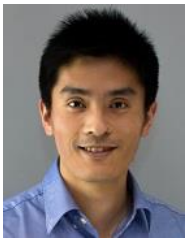
----Invited Talk----

Nanophotonic devices based electron tunneling effect

Abstract—Electron tunneling is a quantum-mechanical effect which allows the transport of electrons across a nanoscale junction between two conducting electrodes. Here, 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. Electrically-driven plasmonic nanorod metamaterial provides a fertile platform merging photonics and electronics at the nanoscale, opening up opportunities for developing electron tunnelling-based devices, such as light sources, sensors, optoelectronic memristors, and photodetectors.

14:30-15:00 | Kan Wu

Shanghai Jiao Tong University, China



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

----Invited Talk----

Recent progress in integrated beam steering and lidar

Abstract—Integrated beam steering and lidar has attracted wide interest for its advantages on compact size, high speed and high reliability. We briefly introduce our recent works on lens assisted integrated beam steering technology and lidar applications.

15:00-15:15 | #39

Optimal control for stabilizing fringe phase in interference lithography

Sen Lu, Kaiming Yang, Yu Zhu, Leijie Wang, Ming Zhang

Tsinghua University

In interference lithography, the environmental disturbances will lead to a phase drift of the interference fringes during the exposure process, resulting in a decrease of exposure contrast. Feedback control is usually used to stabilize the phase, and the choice of control algorithm will affect the exposure effect. In this paper, a linear-quadratic-Gaussian (LQG) controller combined with a Kalman filter is applied to provide an optimal feedback control by solving the problem of minimizing the variance of the residual phase errors. The phase control method is described using a state-space approach. The simulation results show that the proposed control method can effectively suppress the low-frequency phase drift, as well as the phase perturbation caused by mechanical vibrations.

T04 Optoelectronic Devices and Applications-B

Room: LM104-A | 15:30-17:45

Symposia Chair: Kan Wu

Shanghai Jiao Tong University, China

15:30-16:00 | Connie Chang-Hasnain

University of California, Berkeley, USA

Connie Chang-Hasnain is Associate Dean for Strategic Alliances, College of Engineering, and John R. Whinnery Distinguished Chair Professor of Electrical Engineering and Computer Sciences. She is also Chair of Nanoscale Science and Engineering Graduate Group, University of California, Berkeley. She received her Ph.D. from the same university in 1987. Prior to joining the Berkeley faculty, Dr. Chang-Hasnain was a member of the technical staff at Bellcore (1987–1992), and Assistant and Associate Professor of Electrical Engineering at Stanford University (1992–1996). She is an Honorary Member of A.F. Ioffe Institute, Chang Jiang Scholar Endowed Chair Professor at Tsinghua University, Visiting Professor of Peking University and National Chiao Tung University. She is Founding Co-Director of Tsinghua Berkeley Shenzhen Institute since 2015.

Professor Chang-Hasnain's research interests range from semiconductor optoelectronic devices to materials and physics, with current foci on nano-photonic materials and devices for chip-scale integrated optics. She has been honored with the Quantum Device Award (2014), IEEE David Sarnoff Award (2011), the OSA Nick Holonyak Jr. Award (2007), the IEEE LEOS William Streifer Award for Scientific Achievement (2003), and the Microoptics Award from Japan Society of Applied Physics (2009). Additionally, she has been awarded with a National Security Science and Engineering Faculty Fellowship by the Department of Defense (2008), a Humboldt Research Award (2009), and a Guggenheim Fellowship (2009).

She is an elected member of National Academy of Engineering, a member of the US Advisory Committee to the International Commission on Optics, National Academy of Sciences and Skolkovo Foundation Scientific Advisory Council. She served on the National Research Council Committee on "Optics and Photonics: Essential Technologies for Our Nation"; US Air Force Scientific Advisory Board; Board on Assessment of NIST Programs, National Research Council; IEEE LEOS Board of Governors, and OSA Board of Directors. She was the Editor-in-Chief Journal of Lightwave Technology 2007-2012 and is Associate Editor of the OSA Optica, since 2013.

----Invited Talk----

VCSELs for 3D Sensing

Abstract—Vertical cavity surface emitting lasers (VCSELs) have long been predicted as low-cost enabling laser sources for many applications including optical communications, sensing and imaging. The mirrors are typically distributed Bragg reflectors (DBRs) with many tens layers of epitaxy layers with alternating refractive indecies. Since 2004, we invented a single layer high index contrast near-wavelength gratings (HCG) to replace the hundred-layered DBR in a VCSEL structure. Snice then, we develeoped a new class of planar optics has emerged using near- wavelength dielectric structures, known as high contrast metastructures (HCM). Many extraordinary properties can be designed top-down based for integrated optics on a silicon or GaAs substrate. In this talk, I will review recent results using HCG as mirror for VCSEL. I will discuss inventions and advances in VCSELs that have led to recent global deployment of commercial applications including 3D sensing, LIDAR and optical coherent tomography applications. I will also discuss future prospects for advanced applications.

16:00-16:30 | Jianwen Dong

Sun Yat-sen University, China

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

----Invited Talk----

Silicon nitride metasurfaces and their visible applications

Abstract—Optical metasurface is one kind of artificial planar structures. By designing the geometric configuration and specific arrangement of subwavelength structures, metasurface can break through the performance limitation of natural materials, enrich the physical optical behaviors, and can be used to the applications of portable planar photonics devices. As an emerging CMOS-compatible material, silicon nitride has low absorption in optical band, which provides new impetus for the development of high-efficiency large-aperture visible light metasurface. Here will give a brief introduction to the existing silicon nitride metasurfaces, and show their visible applications of large-area high-resolution imaging, 3D integrated imaging, microscope meta-objective and multifunctional metasurface. We hope that the audience will have a new understanding of silicon nitride metasurfaces, and inspire some new ideas combining traditional optics and silicon nitride metasurface technology.

16:30-17:00 | Xinlun Cai

Sun Yat-sen University, China

Xinlun Cai received the Ph.D. degree in electrical and electronics engineering from the University of Bristol, Bristol, U.K., in 2012. He is currently a Professor with the School of Electronics and Information Technology, Sun Yat-sen University, Guangzhou, China. His research is mainly focused on optical communication and photonic integrated devices.

----Invited Talk----

Hybrid silicon and lithium niobate modulator

Abstract—Hybrid silicon and Lithium Niobate (LN) photonic integration platform has emerged as a promising candidate to combine the scalability of silicon photonic with the excellent modulation performance of LN. Mach-Zehnder modulators (MZM) based on this platform exhibit outstanding performance with low insertion loss, low drive voltage, and large bandwidth. In this paper, we discuss the technologies for realizing hybrid Silicon and LN platform. The configuration and key metrics of MZM are analyzed in detail. Moreover, various functional devices derived from the Mach-Zehnder interferometer configuration are reviewed.

17:00-17:15 | #2845

Mode-locked pulse generation based on black arsenic phosphorus in erbium-doped fiber lasers

Yiqing Shu, **Jianqing Li**, Leiming Wu, Zhitao Lin, Dingtao Ma

Macau University of Science and Technology

Abstract—Black arsenic phosphorus (b-AsP) is a novel two-dimensional (2D) material. It has aroused extensive interest in many fields thanks to its excellent performance of broad tunability band gap and high carrier mobility. In this paper, 2D b-AsP ultra-thin nanosheets were successfully prepared and systemically characterized. Under the influence of evanescent field effect, 2D b-AsP nanosheets is successfully prepared as a fiber-based saturable absorber (SA). Mode-locked pulses based on 2D b-AsP SA are generated in an Er-doped fiber laser, corresponding to the maximum repetition rate of 11.5 MHz and pulse duration of 807 fs. These results show that 2D b-AsP has excellent application potential in ultrafast photonics and photodetectors, etc.

17:15-17:30 | #2848

Electro-optical modulators based on silicon nanostructures with Mie resonances

Jiahao Yan

Institute of Nanophotonics, Jinan University

Abstract—The ability to dynamically modulate plasmon resonances or Mie resonances brings some advantages such as adjusting the operating wavelength and modulating the optical signals. Electrically tuning as one of the most effective active tuning methods can realize high switching speed and large tuning ranges. Also, the electrically driven optical devices can generate intriguing phenomena in both the linear and the nonlinear regimes. Recently, electrically tuning plasmonic metamaterials have been widely investigated where the modulation is realized through semiconductor layers, graphene, or electromechanical deformation. Noted that, there are much few works about the electrically tuning on single nanoparticle level up to now, which is important for building nanoscale functional devices. Conventional plasmonic materials have several disadvantages restricting their applications in singleelement nanoantenna or metamaterial devices. First, plasmonic materials like gold and silver suffer from high optical loss at visible range. Second, it is hard for plasmonic nanostructures to generate magnetic mode and tailor the optical field as we want. Fortunately, dielectric nanoantennas can hold both electric and magnetic responses simultaneously and naturally. Therefore, this has driven the intense search for high-index dielectric materials beyond noble metals. Silicon as a kind of high-index dielectric

materials has shown promising applications in metasurfaces, optical nonlinearity, and sensors. The magnetic resonant modes in silicon nanocavities can be modulated through changing the sizes or crystallographic phases. However, how to realize active control of the magnetic responses in silicon nanocavities has not been studied yet. On the other hand, silicon, as the premier material in the CMOS technology, has been vastly adopted for the implementation of photonic systems to enable various on-chip optical functionalities through the integration of optics and electronics. However, for the nonlinear optical devices, crystal inversion symmetry prohibits the second-order nonlinear processes in silicon nanostructures. To circumvent this challenge, one promising technique has been proposed through applying static electric fields, called electric field induced second harmonic generation (EFISH). Although this phenomenon has been studied on microscale silicon waveguides, how to electrically control the nonlinear signals of silicon nanocavities still remains unsolved. In this work, we realize the electrically controlled Mie resonance-based linear and nonlinear optical responses of individual silicon nanostructures in the visible range through changing the applied voltage. For linear scattering signals, we observed that the plasmon-dielectric hybrid resonant peaks experience blue shift and obvious intensity attenuation with increasing the bias voltages from 0 to 1.5 V. A physical model has been established to explain how the applied voltage influences the carrier concentration and how carrier concentration modifies the permittivity of silicon and then the final scattering spectra. For nonlinear signals, our experiments reveal that the application of a static electric field transduces the large third-order susceptibility of silicon into an effective second order process that facilitates the generation of frequency-doubled signals via the EFISH process. Our findings bring a new approach to build excellent tunable nanoantennas or other nanophotonics devices where the optical responses can be purposely controlled by electrical signals. Keywords:

17:30-17:45 | #2862

Optical humidity sensor based on ZnO nanomaterials

Haolin Li, Bingheng Meng, Huimin Jia, Dengkui Wang, Zhipeng Wei, Ruxue Li, Rui Chen

Changchun University of Science and Technology

Abstract—Humidity sensors are important devices that have been used extensively in our daily life. ZnO material exhibits excellent performance in the field of humidity sensing, most of which are based on changes in resistance under different environments. In this work, we report an optical-based ZnO nanomaterial humidity sensor. Humidity sensing is achieved by passivating oxygen vacancies on the surface of ZnO nanomaterials with water molecules. Through the irradiation of the 980 nm laser, the light scattering due to water droplets under high humidity has been solved. The optical-based ZnO nanomaterial humidity sensor provides new possibilities for humidity sensing, and this solution can also be applied to other material systems.

T05 Biophotonics and Biomedical Optics-A

Room: LM104-B | 15:30-18:00

Symposia Chair: Changfeng Wu

Southern University of Science and Technology, China

15:30-16:00 | Tianxun Gong

University of Electronic Science and Technology of China

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

----Invited Talk----

Surface Enhanced Raman Scattering Sensors for Diseases Detection

Abstract—Surface Enhanced Raman Spectroscopy (SERS) is able to provide "finger prints" information of the molecules in bio-samples, even in ultra-low concentration. Due to the different characteristic of the samples, various SERS platforms need to be developed. In my talk, I will introduce design and fabrication of LSPR and Fano based SERS sensors. Moreover, I will introduce their applications on disease detections, such as vascular disease and colorectal cancer.

16:00-16:30 | Chao Tian

University of Science and Technology of China, China

Dr. Chao Tian received the B.S. degree in Electrical Engineering and the Ph.D. degree in Optical Engineering from Zhejiang University, Hangzhou, China. He then worked as a Post-Doctoral Research Fellow in biomedical photoacoustic imaging with the Department of Biomedical Engineering at the University of Michigan, Ann Arbor. He has authored over 30 peer-reviewed journal articles and six inventions, and is the awardees of the Chinese Academy of Science (CAS) and Anhui Province, China. Dr. Tian is currently a research professor at the School of Engineering Science, University of Science and Technology of China (USTC). His research interests focus on photoacoustic imaging and its biomedical applications.

----Invited Talk----

Biomedical imaging leveraging light and sound

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

16:30-16:45 | #22

In vivo hybrid-contrast tomographic imaging by Magnetic Resonance Imaging and Photoacoustic Tomography

Shuangyang Zhang, Xipan Li, Zhichao Liang, Jian Wu, Shixian Huang,
Zhijian Zhuang, Yanqiu Feng, Qianjin Feng, Li Qi, Wufan Chen
Southern Medical University

Abstract—Photoacoustic tomography (PAT), as an emerging biomedical imaging technology, is capable of obtaining the distribution map of deeply seated optical absorbers with high spatial resolution and temporal resolution. This functional imaging method has been successfully used in pre-clinical and human studies, including tumor screening and response to treatment. Magnetic resonance imaging (MRI), with a multi-parameter contrast mechanism, can provide excellent anatomical soft tissue contrast with similar spatial resolution as PAT. The image contrast of PAT and T2 MRI is derived from the absorber concentration and proton relaxation velocity respectively, one carries functional information and the other provides structural information. Combining the strengths of these two complementary imaging modalities will provide reliable anatomical background information for better visualization of absorber distribution.

Here, we present a method for the acquisition and co-registration of PAT and MRI data in in vivo animal studies. Our method includes a novel dual-modality animal imaging bed and a robust dual-modality spatial co-registration algorithm. The dual-modality animal imaging bed consists of a gas tube, a breathing mask and a solid animal support that can be separated into two parts, one for PAT, and the other for MRI. This ensures that the animal maintains at the same posture while switching between the two imaging modalities. The spatial co-registration of the PAT and MRI images is divided into 2 steps. Step 1: Axial co-registration: before imaging, the surface of the mouse is marked with black Chinese ink, which can be visualized on both PAT and MRI. The corresponding position of the cross-sectional image can be located by analyzing the images with peak intensity on the tissue surface. Step 2: Transverse co-registration: rigid co-registration algorithm based on mutual information is used to precisely align the dual-modality images after the background is removed. This method can be applied to the entire body of the animal, including the head, lung, and abdomen.

In this work, we have demonstrated the feasibility of an image acquisition and co-registration method for PAT and MRI. The design of the dual-modality animal imaging bed ensures that the deformation of the animal is within acceptable range when switching imaging modalities, thereby simplifying image co-registration. The dual-modality hybrid-contrast image obtained with our method simultaneously provides functional and structural information. This simple and reliable method can be widely applied to *in vivo* animal pre-clinical studies that used PAT and MRI.

16:45-17:00 | #23

Multispectral Photoacoustic Tomography with a New Sparse Sampling Scheme

Xipan Li, Shuangyang Zhang, Jian Wu, Shixian Huang, Qianjin Feng, Li Qi and Wufan Chen

Southern Medical University

Abstract—Multispectral photoacoustic tomography (PAT) is capable of resolving tissue chromophore distribution based on spectral un-mixing. To cut down the data volume for multispectral acquisition, sparse sampling methods that reduce the number of detectors have been developed, but their image reconstruction is challenging because of insufficient angular coverage. During spectral un-mixing, these inaccurate reconstructions will further amplify imaging artefacts and contaminate the results. In this work, we present a new sparse sampling method, which we termed interlaced sparse sampling (ISS) PAT, to solve the above problem.

The proposed ISS-PAT method is based on a rotation-scanning imaging mechanism, which requires only a few transducers. Assisted with a specially designed image reconstruction algorithm, ISS-PAT achieves comparable performance to that using large number of transducers while keeping the total image acquisition time unchanged.

17:00-17:15 | #24

Measuring the space-variant point spread function for photoacoustic image deblurring

Jian Wu, Xipan Li, Shuangyang Zhang, Shixian Huang, Qianjin Feng, Li Qi, Wufan Chen

School of Biomedical Engineering, Guangdong Provincial Key Laboratory of Medical Image Processing, Southern Medical University, Guangzhou, Guangdong, China

Abstract—The spatial resolution of photoacoustic tomography (PAT) can be characterized by the point spread function (PSF) of the imaging system. Deconvolution of the images with the PSF has been shown to be able to restore image resolution and recover object details. However, due to its tomographic detection geometry, the PAT image degradation model should be described by using space-variant PSFs. Previous PAT approaches missed this inherent imaging characteristics and resolution restoration remains challenging. To solve this, we propose a PAT image restoration method to improve image quality and resolution based on experimentally measured space-variant PSFs.

In this work, we have designed a rigorous measurement procedure of the space-variant PSF for PAT and proposed an iterative deconvolution algorithm to correct for the resolution degradation. Phantom experiments were performed and the results showed significant image quality improvement.

17:15-17:30 | #26

Automatic initial rotation angle error correction for endoscopic airway OCT improves 3D structural reconstruction

Zhijian Zhuang, Shuangyang Zhang, Xipan Li, Jian Wu, Shixian Huang, Qianjin Feng, Li Qi and Wufan Chen

Southern Medical University

Abstract—Endoscopic airway optical coherence tomography (OCT) is a cross-sectional imaging modality that can detect the airway contours for high-resolution 3D reconstruction. During imaging, the endoscopic probe mechanically scans the airway, thus the acquired images inevitably suffered from the initial rotation angle error (IRAE). IRAE is one of the results of nonuniform rotational speed: when the probe scans the airway to form each frame, the initial rotation angle is slightly different. This leads to structural distortion when performing 3D reconstruction and visualization of the airway.

17:30-17:45 | #2874

Point-of-care Chemiluminescence Immunoassay Centrifugal Microfluidics for Gastric-17 Detection

Yang Minghao, Liu Kangkang, Yang Jiachen, Wang Guanghui

Nanjing University

Abstract—Gastric cancer is the one of the most common malignant disease worldwide that causes death. Serum gastric-17 (G-17) is considered to be a serological marker of gastric cancer. The difficulty of treatment is strongly depended on discover time. It is very important to develop a fast, accurate, low-cost and portable early diagnosis method. The lab-on-a-disc (LOAD) or centrifugal microfluidics platform introduces the centrifugal force generated by chip rotation under the driving of micromotor. LOAD is pump-free, providing the best way for multiple parallel operations, which is a good choice for early screening of gastric cancer. In this paper, we present a fully automated lab-on-a-disc for simultaneous detection of G-17 from whole blood based on magnetic enzyme chemiluminescence immunoassay. Serum extraction, metering different concentration ratio and fitting of standard curve can be realized on disc. There is a good linear correlation between chemiluminescence signal intensity and G-17 concentration over the entire measurement range (0-256pmol/L), and the detection limit is 2.11 pmol/L, which has great potential for point-of-care (POC) with high sensitivity and good repeatability.

17:45-18:00 | #2886

Research on the measurement of heart rate based on LD laser and multimode fiber

Xiaomin Zhan, Yunxu Sun*, Fucheng Xiao, Yan Meng, Jianyu Zhang

Harbin Institute of Technology, Shenzhen

Abstract—A micro-vibration fiber sensor for the measurement of human heart rate is proposed and experimentally demonstrated. The specklegram generated at the end of the multimode fiber depends on the applied disturbance along the fiber and thus can be used to detect the heartbeat signals. The sensitivity of vibration sensor based on fiber specklegram is highly sensitive to the multi-mode fiber diameters, which has been experimentally explored in this work. A multimode fiber with an appropriate diameter is selected to achieve a relative high sensitivity in vibration sensing. At last, the selected multimode fiber is utilized to measure the heart rate of the human body. By processing the detected specklegrams, a clear heartbeat signal curve is obtained, which shows potential application value in health monitoring.

T06 Optical Communication and Networks-A

Room: LM104-C | 15:30-18:00

Symposia Chair: Zixiong Wang

Tianjin University, China

15:30-16:00 | Biao Chen

Ningbo Research Institute Zhejiang University and College of Optical Science and Engineering, Zhejiang University, Hangzhou, China

Prof. 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 Systems 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 were 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 operating. His current research interest is in Optical and Radio Access Networks.

----Invited Talk----

New ATP Approach for optical wireless communications

Abstract—Acquisition, tracking, and pointing (ATP) mechanisms are generally adopted for optical wireless communications (OWCs) to maintain a strict alignment state for reliable communication. ATP mechanisms conventionally employ beacon lights to

determine the orientation of the remote optical terminal. we consider a visual tracking approach where metrics based on target imaging rather than the received beacon signal are used for steering the gimbals and/or mirrors to aim at the target. A traditional beacon uses a directional light source, which can only be detected at an extremely limited angle. The proposed method adopts a new shape beacon, which can be captured at a wide angle, and hence is much more suitable for mobile applications, such as vehicle-to-infrastructure, vehicle-to-vehicle, station-to-plane, and plane-to-plane communications.

16:00-16:30 | Guijun Hu

Jilin University, China

Hu Guijun, male, born in 1970. He is a Professor as well as a doctoral supervisor of 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 Institute 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, including more than 40 SCI searches, more than 40 EI searches, 8 authorized patents and 1 second prize for scientific and technological progress of Jilin Province.

----Invited Talk----

A few-mode fiber based Beamforming System

Abstract—In this paper, a novel beamforming system based on few-mode fiber is proposed. The beamforming architecture is consisted of single wavelength laser, photonic lanterns (PLs) and planar array antennas composed of cascading few-mode fiber loop TTD units and single-mode fiber loop TTD units, both of which are controlled respectively by 2 × 2 optical switches. Beam steering in the azimuthal dimension is provided via TTD lines with the identical mode. The mode diversity is brought to act as multiplying channel. Beam steering in the elevational dimension is provided via TTD lines between different modes. This novel beamforming system can realize 2D beam steering d under a single wavelength, which overcomes the high cost of tunable lasers in traditional beamforming system integrated with wavelength division multiplexing (WDM) technology. Moreover, the system structure is greatly simplified by adopting the mode dimension of few-mode fiber. We have made a proof-of-the-principle demonstration of 3 × 3 delay line matrix with a unit time delay of 6 ps in the elevational dimension and a unit time delay of 12.4 ps in the azimuthal dimension for two-dimensional steering. The experiment results demonstrate the feasibility of the proposed scheme.

16:30-17:00 | Hongyan Fu

Tsinghua-Berkeley Shenzhen Institute (TBSI), Tsinghua University

Hongyan Fu is currently an associate professor at Data Science and Information Technology Research Center, Tsinghua-Berkeley Shenzhen Institute (TBSI), Tsinghua University. He received the B.S. degree in electronic and information engineering from Zhejiang University and the M.S. degree in electrical engineering with specialty in photonics from Royal Institute of Technology, Sweden, and the Ph.D. degree from the Department of Electrical Engineering from Hong Kong Polytechnic University. His research focuses on integrated photonics and its related applications in communications and sensing including silicon photonics, optical wireless communications, and 3D sensing.

From 2005 to 2010, he was a research assistant and then research associate with Photonic Research Center, the Hong Kong Polytechnic University. From 2010 to April 2017, Dr. Fu was a founding member and leading the advanced optic communications research at Central Research Institute, Huawei. He was the project manager of All-Optical Networks (AON), which was evolved to a company-wide flagship research project that covers whole aspects of next generation optical communication technologies to guarantee Huawei's leading position. He was also a representative for Huawei at several industry/academic standards/forums. He was an active contributor at IEEE 802.3 Ethernet and Optical Internetworking Forum (OIF) where he was an OIF Speaker from 2012 to 2013. Dr. Fu is member of IEEE and life member of OSA, SPIE. Since 2017, he is the advisor of OSA Student Chapter at TBSI, Tsinghua University. Since 2020, he is the advisor of IEEE Photonics Society Student Branch Chapter and SPIE Student Chapter at

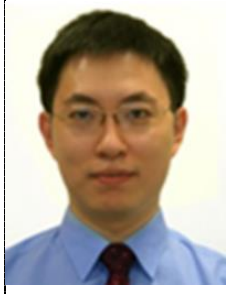
TBSI, Tsinghua University. Dr. Fu has authored/co-authored more than 150 journal or conference papers, 1 book chapter, over 50 granted/pending China /Europe/Japan/ US patents.

----Invited Talk----

Recent Advances on Optical Wireless Communication Technologies for 6G

Abstract—We will review our latest progress on the micro/nano devices-based optical wireless communication (OWC) development that is aiming for 6G. The light sources are critical for OWC and we will focus on presenting our new results on system applications based on micro-light emitting diodes (micro-LEDs) and vertical cavity surface emitting lasers (VCSELs). In addition, high-speed, multi-user and diffuse communications have become distinctive features of next generation 6G OWC systems. Different high-performance OWC systems in various application scenarios based on micro/nano devices will be discussed. For micro-LED, we firstly propose a high-speed and multi-user OWC system using OFDMA in the typically indoor environment which can support maximum 6 users for communication, simultaneously. Then we will present an underwater OWC system which has the highest system bandwidth distance product among current existing single-pixel LED-based underwater OWC systems. For VCSEL, our research shows that a diffuse OWC system which can provide high-speed access while maintaining a large coverage area. In addition, we demonstrate various high-speed and multi-user VCSEL-based OWC system using Code-OFDM, OFDMA and NOMA. Furthermore, we further design a novel modulation format, and implement machine learning and deep learning technologies for upcoming OWC systems. Finally, we will also discuss some future technologies and perspectives on the OWC for future 6G applications.

17:00-17:30 | Changyuan Yu



Dr. Changyuan YU received his B.S. in Applied Physics and B. Economics in Management from Tsinghua University, China in 1997, M.S. in Electrical and Computer Engineering from University of Miami, USA in 1999, and Ph.D. in Electrical Engineering from Optical Communications Lab at University of Southern California, USA in 2005. And he was a visiting researcher at NEC Labs America in Princeton, USA in 2005. He then joined the faculty of Dept. of Electrical and Computer Engineering, National University of Singapore (NUS) in 12/2005 and served as the founding leader of Photonic System Research Group in NUS till 12/2015. He was also a joint senior scientist with A*STAR Institute for Infocomm Research in Singapore. In 12/2015, he joined Department of Electronic and Information Engineering, The Hong Kong Polytechnic University as a tenured associate professor. And he also continues as an adjunct associate professor of NUS. His research focuses on photonic devices, subsystems, optical fiber communication and sensor systems, and biomedical instruments. As the PI/co-PI, he secured over 5 million US dollars grants, and supervised 10+ postdocs and 20+ PhD students. He has authored/co-authored 1 US patent, 6 book chapters, 400+ journal and conference papers (75 invited, including OFC2012 in USA). His group won 6 best paper awards in conferences and the championship in biomedical area in the 3rd China Innovation and Entrepreneurship Competition in 2014.

----Invited Talk----

Bionic palpation based on optical fiber sensor

Abstract—Vital signs, such as respiration and heartbeat, act as main health indicators for current clinical and household usage. The monitoring of vital signs can help to assess human health condition or even diagnosis specific diseases. Among vital signs, respiration and heartbeat play important roles since their monitoring can directly reflect the function of lung and heart, which are key organs inside human body. Up to now, to achieve stable and accurate respiration and heartbeat monitoring, many schemes have been proposed and even widely used. For example, the ECG device is used to record the electrical activity with heart pumping blood. However, these wearable devices always require body contact, which may discomfort the users, especially in long-term monitoring. To achieve contactless vital signs monitoring, Wi-Fi or radar sensor have been applied, but these systems are bulky and expensive.

In this paper, we review our research on contactless, low-cost, and compact vital signs monitoring based on optical fiber sensor. Optical fiber Mach-Zehnder Interferometers (MZIs), packaged as smart cushion or mattress, are firstly proposed for respiration and heartbeat monitoring due to their intrinsic advantages of high-sensitivity and low-cost. To realize stable and accurate heartbeat monitoring, the MZI-based system is further optimized with a phase shifter specifically designed and machine learning signal processing method adopted. As a result, BCG waveform can be obtained with stable performance and IJK complex in BCG can be successfully segmented. In addition, passive homodyne demodulation methods based on MZI are proposed and optimized for

vital signs monitoring. On the other hand, to make the optical fiber vital signs monitors more compact, in-line interferometers are utilized and specialty optical fibers are proposed. Twin-core fiber is designed, and it based in-line interferometers are fabricated for vital signs monitoring. Both respiration and heartbeat ratio are obtained, and post-exercise physiological activities are also characterized. Other than twin-core fiber, seven-core fiber and few-mode fiber are also demonstrated for vital signs monitoring. Two kinds of few-mode fiber are utilized, including two-mode fiber and four-mode fiber, and their based optical fiber interferometers are fabricated with single-mode fiber splicing on both ends with offset distance. Both respiration and heartbeat are obtained successfully.

Other than vital signs monitoring, out first attempt on bionic palpation based on optical fiber sensor is presented. Pulse-taking is a primary method to diagnosis diseases in Chinese traditional medicine. Various phase of pulse can reflect the working condition of organs. In recent years, the investigation on using modern technology or sensors to improve the pulse-taking performance becomes popular and many schemes were proposed. In our work, we proposed a bionic palpation of traditional Chinese medicine using intelligent robotics integrated with optical fiber sensors, aiming to enhance the accuracy and obtain accurate pulse waves.

In summary, we propose optical fiber sensors for healthcare and medical usage. Different structures and optical fibers are demonstrated to monitor respiration and heartbeat. In addition, bio palpation based on optical fiber sensor is proposed and accurate pulse-taking will be achieved.

The authors thank to the fund supports of National Natural Science Foundation of China 61971372 and HK RGC GRF 15211317.

17:30-17:45 | #2884

Predicting PON networking traffic flow based on LSTM neural network with periodic characteristic data

Ziyao Yang, Jian Tang, Dezhi Zhang

China Telecom Research Institute

Abstract—PON (Passive Optical Network) traffic prediction can provide data base for port expansion and bandwidth dynamic adjustment, so as to simplify PON traffic operation and improve bandwidth utilization. In this paper, based on the LSTM (Long Short-Term Memory) neural network, the characteristic data is redesigned based on the periodic characteristics of the PON port traffic. Compared with ARIMA (Autoregressive Integrated Moving Average model) and the basic LSTM neural network, the prediction accuracy is significantly improved and the calculation time is reduced.

17:45-18:00 | #2883

Intelligent OAM of new generation access network based on SDN

Jian Tang, Dezhi Zhang, ZiYao Yang

China Telecom Research Institute

Abstract—With the rapid development of the optical access network and the trend of full service access bearer, the operation, administration, and maintenance (OAM) of the optical access network also face more and more challenges. This paper analyzes the limitations of the traditional access network OAM interface, introduces the key enable technologies in access network to implement agile, automated and intelligent OAM. It provides application scenario for intelligent OAM and supports passive OAM. The evolution from OAM to active OAM effectively improves the intelligent OAM capabilities of the optical access network, thereby helping network operators to cope with various challenges in OAM of new services, enhancing service operation capabilities, and improving the end user's business experience.

Poster Session | 16:00-17:30

Poster | #1

Design of near infrared continuous zoom optical system

MA Zi-xuan, LI Xu-yang, REN Zhi-guang, CHU Nan-qing

XIOPM

Abstract—In order to achieve continuous fine recognition of targets with limited distance, a large zoom ratio near infrared continuous zoom optical system has been designed. Based on the zoom system and its automatic design principle of aberrations, reasonable technical indicators were formulated, the initial structure of the system was determined, and the optical design software CodeV was used to optimize it to achieve a continuous zoom optical system with good imaging quality. The system uses a detector of 4.5-micron × 4.5-micron pixels, and the field of view is 2.7-degree×2.7-degree ~ 12.7-degree×12.7-degree, F number is 4.8, using mechanical positive group compensation method, composed of front group, zoom group, compensation group and rear group, including 14 spherical lenses. The design results were evaluated for image quality and the cam curve was solved. The design and analysis results show that the system achieves a continuous zoom of 70-mm ~ 350-mm in the 750-nano ~ 900-nano band. The optical modulation transfer function of the system is better than 0.3 at 111-lp/mm, the maximum distortion is less than 2%, the image quality is good, and the processing cost is low. The system has the characteristics of large zoom ratio, high resolution, compact structure and smooth zoom curve, and can be used for fine recognition of limited distance targets.

Poster | #6

Chemical analysis of lipid and protein by Spectrum-Focusing Coherent anti-Stokes Raman Scattering Microscopy

Shaowei Li, Hangshi Xu, Zilin Li, Yanping Li, Binglin Shen, Liwei Liu, Junle Qu*

Shenzhen University

Abstract—Coherent anti-Stokes Raman scattering (CARS) microscopy permits vibrational imaging with high-sensitivity, high speed, and three-dimensional spatial resolution. SF-CARS is a kind of spectral-scanning single-frequency CARS imaging system with versatile spectroscopic capabilities, especially when coupled with broadband laser sources. Here, we implement spectral-focusing-CARS hyperspectroscopy to characterize lipid and protein in pork samples. For hyperspectral CARS imaging, the femtosecond pump and Stokes laser beams are chirped by using SF-57 glass rods with the lengths of 40.5 and 54 cm to generate the 2 ps pump beam and 1.8 ps Stokes beam, respectively, before they are combined onto a dichroic mirror. The results show that the CARS spectrum is consistent with the spontaneous Raman spectrum, and the ratio between CH2(2850cm-1)/CH3(2930cm-1) functional groups is high in lipids, on average >10, consistent with the literature, the peak ratio is on average <1 for proteins.

Poster | #8

Plasmonic Resonant Mental Array Enable in Observation of Exosomes Intrude into Cellular Structural Dynamics

Sheng Ren, Yihua Zhao, Binglin Shen, Rui Hu, Junle Qu and Liwei Liu

Shenzhen University

Abstract—Exosomes, as vesicles secreted specifically by cells, participate in inter-cell signal transduction and thus regulate the biological activity of receptor cells. The function of exosomes depends on the type of the source cell. Exosomes may play a role in the transmission of genetic information of tumor during the growth of tumor cells.Therefore, it is of great significance to study the effect of exosomes on tumor cells on the cognition of tumor cell transmission. According to the infrared spectrum of exosome surface, we designed a biosensor device which combines the metal nanoarray and the microchannel to produce the surface equiexcimer resonance for the specific band. Through the resonance mode of the amino or amide groups and the resonance coupling of the surface isoexciton, the signal is enhanced and amplified, so as to realize real-time monitoring of the conformational changes of the surface proteins before and after the exosomes enter the cell.

Poster | #11

Comparative Research of numerical calculating and simulating the performance of a fiber optic vector hydrophone

Hu Jiang-fei, Li Duan-ming, Gu Min-xue, Qu Rui-xuan

Shanghai Marine Electronic Equipment Research Institute

Abstract—To content acceleration sensitivity Ma and frequency response f need of an one-dimensional fiber optic inertial vector hydrophone, numerical calculating and finite element simulating approaches are proposed to research on. Respectively through the two measures, it is showed that there are some relationship curves among the two performances and the hydrophone structure

parameters as Young's modulus E、block quality M and radius R. Compared with numerical calculating and finite element simulating, the obtained relation curves are very similar for one structure parameter. In finally, the structure parameters is optimized, and it gets an excellent performance that diameter is less than 90mm, working frequency 0Hz-1000Hz, and acceleration sensitivity about 30dB. Meanwhile, a three-dimensional fiber optic inertial vector hydrophone is analyzed by the two approaches to get Ma 30dB and f higher than 4 kHz. It is of great significance for studying the sensing mechanism and designing the structure of a fiber optic vector hydrophone.

Poster | #13

Finite element simulation of fiber optic hydrophone with protecting jacket

Minxue Gu, Duanming Li, Jiangfei Hu, Ruixuan Qu

Shanghai Marine Electronic Equipment Research Institute

Abstract—Fiber optic hydrophone is essential for military applications and availability is a key parameter of the hydrophone being applied in underwater cases. In this paper, a protecting jacket to protect hydrophone optical devices was designed based on finite element simulation. Fiber optic hydrophone with a protecting jacket maintains stable sound-pressure sensitivity of -140dB and relatively low acceleration sensitivity in its working frequency range between 0.1 and 6 kHz.

Poster | #14

Ellipse Fitting Demodulation System of Fiber Optical Hydrophones SystemBased on 3×3 Coupler

Ruixuan Qu; Duanming Li; Jiangfei Hu; Minxue Gu

Shanghai Marine Electronic Equipment Research Institution

Abstract—3×3 coupling demodulation has the advantages of no carrier modulation, simple structure and capacity of realizing all-optical fiber hydrophone system. However, the asymmetry of 3×3 coupler will introduce demodulation errors to the usual 3×3 demodulation scheme, and the demodulation scheme using three channels of the 3×3 coupler is not conducive to the formation of large-scaled time division multiplexing system. In view of the above defects, this paper uses the ellipse parameter fitting combined with the digital arctangent algorithm to demodulate signals of two channels of the 3×3 coupler. The principle of this demodulation method is demonstrated in this paper, and simulations to verify the feasibility of the algorithm is carried out. Based on the simulation, the demodulation system in the laboratory was built. The sinusoidal analog signal with amplitude of 4.25v at 1000Hz was demodulated. The demodulation amplitude was 4.2024rad, and the harmonic suppression ratio THD of the demodulated signal frequency spectrum was 39.2014dB. The linear correlation coefficient of demodulated signals with different amplitude at 1000Hz was 0.98. The average demodulation phase difference of 3×3 coupler was 118.8877 °, and the standard deviation was 1.4616 °. Experiments showed that the demodulation system had good consistency and accuracy.

Poster | #28

Refractive Index Laser Sensor based on Seven Core Fiber at 2 μm

Ying Wang, Yajie Chen, Weujuan Chen, Zhihao Chen,Yishen Qiu, Xianzeng Zhang

Quanzhou Normal University

Abstract—This paper proposed a weakly-coupled taper-based seven core fiber (TSCF) structure for the refractive index (RI) measurement with fiber laser at 2 μm. Compared with conventional broadband sensing systems, the laser sensing system we proposed has higher optical intensity, optical signal to noise ratio (OSNR) and sensitivity. The performance of this new sensor for the refractive index measurement was investigated both theoretically and experimentally. The TSCF sensor was very sensitive to RI at 2 μm. A sensitivity of ~ 667 nm/RIU was obtained with the RI of NaCl solution changing from 1.3325 to 1.3793.

Poster | #31

Study on the propagation characteristics of partially coherent Bessel beams in slant turbulent link

Yalin Zhang, Zeyu Zhou, Xiaoyu Wen

Zhengzhou University of Light Industry

Abstract—The turbulence has a harmful effect on the beam propagating through the atmosphere. Turbulence will cause the wavefront aberration, resulting in spot drift, irradiance fluctuations and other forms of degradations. The propagation characteristics of partially coherent Bessel beams (PCBBs) in the vertical link are studied by means of wave optics simulation. The aperture averaged scintillation of PCBBs in the vertical link increases with beam order, and the mean signal-to-noise ratio (SNR) of beams used as communication link decreases with beam order. The capability of the PCBBs to resist the influence of the

turbulence is compared with that of the partially coherent Gaussian beam (PCGB). The results show that, the PCBBs are more resilient to the perturbations of the turbulence.

Poster | #34

LiDAR System Using MEMS Scanner-Based Coaxial Optical Transceiver

Yingyu Wang, Peijun Tang, Linjie Shen, Shiliang Pu

Hikvision Research Institute, Hangzhou Hikvision Digital Technology Company Ltd

Abstract—In this paper, we present a time-of-flight LiDAR (Light Detection and Ranging) system built with MEMS (Micro Electro Mechanical System) scanner-based coaxial optical transceiver. The optical transceiver combined with coaxial optical system and an electromagnetic MEMS scanner operated at 1.2 kHz was developed to transmit, receive and steer beam. Based on this all-in-one optical transceiver, a compact time-of-flight LiDAR system with FOV (Field of View) of 20°and resolution of 0.2°was demonstrated. The accuracy of LiDAR system is about 5cm in 50m without averaging.

Poster | #2844

Generation of oribital angular momentum beams using all-dielectric metasurfaces

Duofu Song and Yi Wang

Huazhong University of Science and Technology

Abstract—The orbital angular momentum (OAM) beams generation using all-dielectric metasurfaces are proposed and simulated. The optical performances of the transmitted light are analyzed. Finally, the topological charges of OAM beams are characterized by interferences.

Poster | #2847

Influence of Optical Cavity on Surface Plasmon Resonant Characteristic of Au Nanohole Array Device

Yuchen Zhao, Jiahuan Zheng, Boyang Zhao, Xiaoli Xi

Xi'an University of Technology

Abstract—In this paper, we investigate the influence of optical cavity on the surface plasmon resonant characteristic of Au nanohole array device. First, the finite-difference time-domain (FDTD) method is applied to simulate the surface plasmon resonance of Au nanohole arrays with different radii. It is obvious that the larger the radius is, the longer the resonant wavelength will be. Then, a 52nm thick optical cavity, originally designed for surface plasmon resonance in 672nm, is loaded to these arrays. And detailed simulations show that the optical cavity is not only an effective structure to improve the light absorption of the device, but also has certain robustness to the error of the array structure parameters. Meanwhile, the change of cavity thickness has a significant effect on the resonant characteristics of the device. Therefore, it is suggested that more attention should be paid to the fabricating precision of optical cavity in the manufacturing process of device.

Poster | #2860

Thin core fiber and thin fiber based inline Mach-Zehnder interferometer for temperature measurement

Wujun Zhang, Xuqiang Wu, Gang Zhang, Jinhui Shi, Cheng Zuo, Shasha Fang, Lei Gui, Benli Yu

Anhui university

Abstract—In this paper, a thin core fiber (TCF) and thin fiber (TF) based inline Mach-Zehnder interferometer is proposed and demonstrated experimentally. The proposed sensor is fabricated based on SMF-TCF-TF-SMF structure and the TF is core offset spliced with the TCF. Three sensors have been designed and the transmission spectral responses versus temperatures have been investigated. The experimental results show that the temperature sensitivity can reach up to 60.71 pm/℃ and the temperature response linearity is as high as 99.63 %. The proposed sensor is expected to have good application prospects in biological and chemical fields due to simple fabrication, compactness and low cost.

Poster | #2869

Observation of Various Bound States of Solitons in a Fiber Laser Based on GIMF-SIMF-GIMF Saturable Absorber

Yaping Gan, Qianchao Wu, Yong Yao, Chuyan Liu and Yanping Fu

Harbin Institute of Technology (Shenzhen)

Abstract—We report on the experimental observation of various bound states of solitons in an erbium-doped fiber laser mode-locked by a graded index multimode fiber-step index multimode fiber-graded index multimode fiber (GIMF-SIMF-GIMF) saturable absorber (SA). Based on the nonlinear multimode interference (NL-MMI) effect of the GIMF-SIMF-GIMF SA, not only

various bound single-pulse solitons (BSSs) can be obtained, but various bound twin-pulse solitons (BTSs) can also be achieved by adjusting the pump power and PC. The BSSs are formed by single soliton bound together, the BTSs are formed by multiple second-order tightly bound state of solitons.

Poster | #2872

L-band Passively Mode-locked Fiber Laser Using Carbon Nanotube in Sigma Configuration

Zekun Cui, Yuanjun Zhu, Lei Jin, Sze Yun Set and Shinji Yamashita

Tokyo Univ. RCAST

Abstract—Since carbon nanotube (CNT) was firstly proved effective and used as saturable absorber in passively mode-locked fiber laser, it has attracted considerable attention due to its advantages, such as broad operation band, subpicosecond recovery time, polarization insensitive and convenient fabrication. Different from other type laser cavities, sigma configuration mainly uses the non-polarization maintaing (non-PM) components but gets PM output, so that it is a convenient method to reduce the cost and get stable output. In this paper, a sigma configuration is designed to realize L-band mode-locked laser. The laser experimental setup is presented in Fig. 1. It consists of 5 m Erbium doped fiber (LIEKKI Er30-4/125), a 980/1550 single mode WDM coupler, a faraday mirror, a 3 ports polarization beam splitter, an isolator, a 10% output coupler, and the CNT saturable absorber placed between two SC/APC connectors. The double pass linear route is non-polarization maintaining with 5 m EDF and 5.5 m single mode fiber. The ring part is all polarization maintaining with about 7 m fiber length. The laser is pumped by a 980 nm laser diode with maximum pump power of 160 mW. The used CNT absorption maximum is at 1560 nm. After pumping at 70.7 mW threshold level, soliton mode-locking starts to operate. Figure 2 (a) shows the optical spectrum. The central wavelength is 1597.7 nm with 4.2 nm full-width at half maximum (FWHM). Several pairs of Kelly sideband appeared because of the long cavity length. Figure 2 (b) illustrates the oscilloscope temporal pulse train. The pulse interval is 139.4 ns, which corresponding to 7.17 MHz repetition frequency.

Poster | #2880

Improved SWCNT-silica Mode-locker for Generation of Stretched Pulse in Fiber Lasers

Ruimin Jie, Xueming Liu

Zhejiang University

Abstract—We have successfully obtained the stretched pulse using the improved SWCNT-incorporated silica films as the saturable absorber by sol-gel method in the passively mode-locked fiber laser for the first time. The generated pulses have a central lasing wavelength of 1555.2 nm, a spectral width of 14.4 nm, signal-to-noise ratio of about 55 dB and pulse duration of 2.43 ps.

Poster | #2882

A brief review of 2 μm laser scalpel

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

Southwest Institute of Technical Physics

Abstract—The 2 μm laser gains advantages in aspects of simple optical system, accessible fiber path, compact structure, and accurate positioning over far-infrared CO2 laser, as well as high absorption efficient for water and high safety to human eyes over visible and near-infrared lasers. The laser scalpel based on 2 μm laser thus has been widely investigated because of its safe, effective, accurate, and versatile application. In this paper, the development of 2 μm laser scalpel is briefly reviewed, in which the research progress of the interactions of 2 μm laser on biological tissues is particularly involved.

Poster | #2885

Terahertz Wavefront Manipulation in Graphene Metasurfaces for dual polarization incidences

Yuhui Zhang, Yiting Li, Bowei Yang, and Yuegang Fu

Changchun University of science and technology

Abstract—We proposed two metasurfaces structures based on graphene in the Terahertz (THz) regime by using the finite-difference time-domain method. One metasurfaces structure consists of one layer of graphene arrays, polymer dielectric spacer, and a gold mirror film, and the other metasurfaces structure consists of two layers of graphene arrays, polymer dielectric spacer and a gold mirror film. The proposed metasurfaces can focus the x- and y-polarized incident THz wave separately by reconfiguring the Fermi energy distribution of the graphene ribbons. We compared the focusing effects of the two metasurfaces structures, and

the results show that the focusing effects of the two structures are very well. According to the results, we can control the focus as our requirements by using the metasurfaces.

Poster | #2890

Long-Period Fiber Grating Wide-Range pH sensor based on polyvinyl alcohol/polyacrylic acid hydrogel coating

Yi Xu, Chi Chiu Chan and Xinyong Dong

China Jiliang University

Abstract—A wide-range pH sensor based on a coated long-period fiber grating is proposed. The pH responsive PVA/PAA hydrogel coating on the surface of the long period grating (LPG) swells/ deswells in response to change the local pH. The experimental results demonstrate a wide range for the PVA/PAA coated sensor in acid solution (from pH range 1.916 to 7.252). Moreover, the sensor also shows a high repeatability and stability.

Poster | #2892

Optical Fiber Copper (II) ion Sensor Based on Long Period Fiber Grating

Yanmei Tang and Chi Chiu Chan

China Jiliang University

Abstract—A fiber optic sensor based on long-period fiber grating by coating the chitosan/polyacrylic acid to detect the concentration of copper (II) ion is proposed. The measurement sensitivity can be reached of 26.1265nm/mMol.

T07 Optoelectronic Devices and Applications-C

Room: LM104-B | 09:00-10:15

Symposia Chair: Zhenzhou Cheng

Tianjin University, China

09:00-09:30 | Chunmei Ouyang

Tianjin University, China

Associate Prof. Chunmei Ouyang received the B.S. degree in Electronic Science and Technology and the M.S. degree in Optical Engineering from Harbin Engineering University, in 2003 and 2005, respectively, and Ph.D. degree in Optoelectronics Technology from Tianjin University, in 2009. From 2009 to 2012, she was a Postdoctoral Research Fellow in School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore. In 2013, she joined the Faculty of College of Precision Instrument and Optoelectronics Engineering, Tianjin University. Her research interests include terahertz generation and detection, metamaterials, plasmonic devices, and ultrafast lasers.

Associate Prof. Chunmei Ouyang has published over 80 contributed articles in peer-reviewed journals, including Advanced Materials, Light: Science & Applications, Science Advances, Laser & Photonics Reviews, Advanced Optical Materials, Optica, Scientific Reports, APL Materials, Applied Physics Letters, Optics Letters, Optics Express, and IEEE Photonics Journal, etc.

----Invited Talk----

Flexible Manipulation of Terahertz Waves in Metasurfaces

Abstract—Metasurfaces, being planarized ultrathin meta-arrays, have resolved many difficulties metamaterials have encountered, e.g., extreme propagation losses, and allow development of integrated photonic circuits. Metasurfaces are generally composed of subwavelength metallic or dielectric building blocks featuring electromagnetic phenomena not present in nature. Dimensions of their unit cells are always much smaller than the wavelength. As a result, metasurfaces have the ability to manipulate wavefronts into arbitrary shapes with subwavelength resolution. For example, it has been demonstrated that metasurfaces can be used to achieve anomalous reflection and refraction in the infrared regime. Optical devices with metasurfaces, such as vortex plates, wave plates and ultra-thin focusing lenses, have also been demonstrated for different types of incident light, i.e., linearly polarized light, circularly polarized light, or vertex beams. Metasurfaces can be used to not only steer far-field propagating waves, but also control the propagation of surface plasmon polaritons (SPPs) in the near-field regime efficiently and effectively. Recently, surface wave propagation and topological transitions in metasurfaces have been demonstrated. These works have proposed that unusual responses of topological transition materials may be translated into metasurfaces. Additionally, the coupling between the structural units of metasurfaces play a key role in determining their properties and performance. One example is electromagnetically induced transparency (EIT), realized by the coupling between the bright mode and the dark mode in metasurfaces. Moreover, mode coupling between metasurfaces and natural materials is possible and metasurfaces usually are sensitive to their surroundings. This opens a way to design active metasurfaces, advantageous for many practical applications. Metasurfaces integrated with semiconductor, superconductor and phase changing materials have been demonstrated to have a good tunability. In this conference, we will present our recent works on the anomalous wave propagation in a topological transition metasurface and a THz electric field dependent nonlinear metasurface consisting of an array of three adjoined orthogonally oriented split resonant rings (SRRs) coated with monolayer graphene. The unit cell of the topological transition metasurface consists of a complementary H-shape resonator, whose equal-frequency contours of the eigenmode experience a topological transition. Combining two different plasmonic modes, we observed anomalous SPP propagations at the interface where SPPs experience different mode changes, i.e., flat to elliptical, elliptical to hyperbolic, elliptical to flat, and one ellipse to another whose curvature is different from the former. As a result, when the mode changes from flat to elliptical, SPPs propagate along the y axis firstly, and then propagate mainly along two straight lines which are symmetric with respect to the y axis. When the mode changes from elliptical to hyperbolic, flat and another elliptical, SPPs propagate mainly along two straight lines firstly, and then propagate along two lines as if they will converge at one place, along two parallel lines both are parallel to the y axis, and along two different straight lines whose slope is different from the former, respectively. These anomalous wave propagations at the interface occur abruptly. Here, we successfully achieve redirecting SPPs in the terahertz regime. For the nonlinear metasurface, a maximum modulation depth of 23% in transmission has been experimentally achieved with up to 305 kV/cm THz peak field. Simulations and model calculations have been

performed and it is found that the mechanism behind the modulation is the graphene tuned coupling and damping of the modes in the metasurface under different THz electric field strength. Our study can be useful for future designs of graphene hybrid metasurfaces working under high THz electric field.

09:30-10:00 | Lixia Zhao

Institute of Semiconductors, Chinese Academy of Sciences, China

Professor in Institute of Semiconductors in Chinese Academy of Sciences. She got her Ph. D degree in physics from University of Nottingham, UK, in 2005. Afterwards, she worked at the GaN research Center of University of Cambridge. From 2007 to 2009, she worked in the Forge Europa, UK. In 2009, she joined the Institute of semiconductor, CAS with the "Import Outstanding Technical Talent Program" from CAS and was elected as youth innovation member of CAS in 2011. She has authored or co-authored over 100 papers with more than 2200 citations, and issued over 30 patents. Currently her research interests are mainly focused on the physical properties of III-Nitride semiconductor optoelectronic devices.

----Invited Talk----

GaN-based Photodiodes for Light Communication

Abstract—Following the rapid development of GaN-based light emitting diodes (LEDs), visible light communication (VLC) has attracted considerable attention. It has also been considered as a potential access option for future 6G wireless communications. However, the optical modulation bandwidth of commercial light emitting diodes (LEDs) is only several tens of MHz. To achieve data transmission rates in the order of Gbps, complex modulation schemes, and/or equalization have to be used. Therefore, it is necessary to enhance the modulation bandwidth of LEDs significantly for VLC applications. In addition, Si-based photodetectors are used currently as the optical receiver by implementing a blue-filtering technology for the VLC system. The broadband response of Si-based photodetectors causes undesirable interference effects between the detected and background signals. GaN-based photodetectors could offer an alternative solution as they have a high band edge extinction ratio. However, the performance is still not competitive with that of traditional Si-based detectors. Here, the progresses of the GaN-based photodiodes for light communication will be introduced. The work will lay a foundation to further develop light communication.

10:00-10:15 | #9

Remote Sensing Image Color Correction method based on Automatic piecewise polynomial method

Nan-qing CHU, LI Xu-yang, Yi Hong-wei, REN Zhi-guang, MA Zi-xuan

Xi'an Institute of Optics and Precision Mechanics, CAS

Abstract—In the process of remote sensing image restoration, color correction is very important. The polynomial algorithmcolor correction method based on standard color card is the most commonly used method. However, the traditional polynomial fitting method needs to determine the most appropriate combination of polynomials, and only one polynomial function fitting method is used. So it is difficult to guarantee high accuracy and good generalization performance at the same time. In order to solve the above problems effectively, this paper proposes an automatic piecewise polynomial fitting method. This study established the mapping between collected RGB value and standard RGB value through the calibration of the X-rite Color Checker, and represented the color difference by computing ΔE in CIELab color space. This improved algorithm adopts the idea of segmentation to select the most suitable function in different intervals, and the interval of segmentation is automatically determined by the chromatic aberration standard. The experimental results show that this algorithm has high correction accuracy and this algorithm is more adaptable to photos under different lighting conditions.

T08 Precision Optics-A

Room: LM104-C | 09:00-10:45

Symposia Chair: Chao Tian

University of Science and Technology of China, China

09:00-09:30 | Nan-kuang Chen

Liaocheng University, China

Nan-Kuang Chen received the B. Sc. and M. Eng. degrees from the National Tsing Hua University, Taiwan, the Ph. D. degree from National Chiao Tung University, Taiwan. Starting from Jan 2018, he joined Liaocheng University, China. He has also been invited to be a Ph. D. Student co-supervisor for IIT, Dhanbad in India since 2016, an SPIE (the international society for optics and photonics) Travelling Lecturer in 2015 and 2017. He has authored and co-authored more than 220 international SCI journal and conference articles. He has delivered 35 invited talks and 1 keynote talk in international conferences. He holds 14 Taiwan patents, 12 US patents, 1 Korea patent, and 4 PRC patents.

----Invited Talk----

Discovering the Van der Waals force in optical fibers

Abstract—It is well known that optical fiber is made of fused silica, SiO2, which is a dielectric material and does not produce electric charges by itself. The fused silica is different from glass and crystalline silica in the periodicity length scale of [SiO4]4- tetrahedron and the ordering is in the preference of glassy network to form rings of 6 tetrahedra. It is important to note that silica molecule has a tetrahedron unit with four oxygen atoms at the corners to surround the central silicon atom in a cubic symmetry. The angle of O-Si-O bond is about 109.5° and thus the Si-O bond is highly polar due to large electronegativity difference and the electrons are more strongly attracted by oxygen to result in uneven charge distribution. The central part and the four corners of tetrahedron is more positively and negatively charged, respectively, to generate electric dipole along each Si-O bond. However, for tetrahedron, the four dipoles point at different directions to cancel each other and thus no net dipole is created in this structure. Macroscopically, silica fiber is amorphous and electrically neutralized. To make standard silica fiber with a 125-mm-diameter cladding polarized is difficult due to the thick thickness. However, when fiber is thinned down to a wavelength scale by flame tapering or chemical-etching, microscopically, the local surface electric dipoles are automatically created to enhance the Van der Waals force for the applications in periodic nanoparticles clustering and kV high voltage sensing.

09:30-10:00 | Sen Han

University of Shanghai for Science and Technology

Sen Han: Sen Han obtained his Ph.D.in Optical Engineering from University of Stuttgart, Germany. Dr. Han is a Professor of University of Shanghai for Science and Technology, China. He is both a SPIE Fellow and an Adjunct Professor of University of Arizona, USA. Dr. Han won R&D 100 Award twice in USA.

----Invited Talk----

Applications of Laser Interferometer in Flatness Metrology and Industrial Inspection

Abstract—Laser interferometers are widely used for evaluating optical surfaces due to its outstanding sub-nanometer accuracy and precision. In this talk, we will summarize their advantages and then describe their applications in optical metrology and industrial inspection.

Transmission flat has normally /20 PV. However, when a flat surface under test is better or much better than the transmission flat, we need the absolute flat measurement. We developed a new method to be easily able to achieve the accuracy of /100 PV. We have dedicated our efforts to do so. The theoretical analysis, computer simulations, and experimental validation are presented in the paper.

10:00-10:30 | Xueke Xu

Shanghai Institute of Optics and Fine Mechanics, Chinese Academic Sciences

Xueke Xu, Optical engineering Dr., Professor. Mainly engaged in ultra-precision manufacturing and testing technology of otical element. As project director, presided over more than 10 sets of projects.

----Invited Talk----

Study on Key Process Techniques in Atmospheric Pressure Plasma Processing (APPP) for Silicon Carbide Mirrors(SCM)

Abstract—Silicon Carbide has been widely used in the mirrors of high-precision space optical systems and ground-based optical systems because of its excellent chemical stability, thermal properties, polishability and low expansion coefficient. These applications require high surface accuracy and quality, In the processing technology of SiC mirrors, Ultra-precision machining is the key to ensure that SiC surface is high precision, super smooth and defect-free. However, traditional mechanical contact polishing methods have the defects of high cost and low efficiency due to it's hardness and poor machinability. So that the existing optical processing technologies are difficult to process SiC in large quantities and efficiently. atmospheric

pressure plasma processing, which is a non-contact optical manufacturing technique with highly efficient, precision and low cost, has huge application potential in the field of optical manufacturing. Hence. based on the current research on SiC manufacture and APPP polishing, in this dissertation, theoretical and experimental research on APPP polishing. The main contents and results are as follows:

(1) APPP plasma discharge processing is analyzed theoretically. Based on gas discharge theory and tip electric field distortion effect, analyzing the effect of APPP electrode structure on the plasma discharge stability, And through experiments to verify the above conclusions. The results show that the SiC removal functions of APPP processing are stable, the volume removal rate does not change with the scanning speed, and the APPP is excellent stability.

(2) Study on the APPP Gaussian removal functions under different processing parameters. chemical etching is affected by plasma discharge, reactive particle concentration, the experiments use a single factor method to analyze the influence of reactive gas flow rate, power on the removal functions. The influence of different processing parameters on the removal functions have been obtain, which lay the technological foundation for the processing of SiC

（3）The effects of APPP on the surface quality of SiC are analyzed. There are some deposits on the surface of the workpiece after APPP, which deteriorate the surface quality of SiC. The paper focuses on the analysis of sedimentation polymerization and decomposition process, looking for theoretical guidance to reduce sediments.

（4）Based on the electrode structure optimization and the optimization of the processing parameters, the experiment verified the high-precision surface shape convergence processing of the ⌀ 0mmm SiC mirror, combined with the small tools polishing, the rapid removal of deposits was achieved.

10:30-10:45 | #5

Research progress of an ultra-stable laser system stabilized to a 30-cm-long cavity at NTSC

Chenhui Jiang, Linbo Zhang, Long Chen, Guanjun Xu, Tao Liu and Shougang Zhang

National Time Service Center (NTSC), Chinese Academy of Sciences

Abstract—The ultra-stable laser is significant in optical atom clock. The frequency stability of the laser is limited by the thermal noise of the cavity, which can be reduced by using the long cavity. In this paper, we demonstrate an ultra-stable laser system at NTSC that stabilized to a 30-cm-long optical reference cavity at 698nm, the calculated thermal-noise-limited of frequency stability is around 1×10-16. We evaluated the influence of major noises and the results show the Allan variance corresponding to all these noises can be reduced to the fractional frequency stability of less than 6×10-16 at one second.

T09 Fiber-Based Technologies and Applications-B

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

Symposia Chair: Xinyong Dong,

Guangdong University of Technology; China Jiliang University

10:45-11:15 | Zhenggang Lian

Yangtze Optical Electronics Co., China

Zhenggang Lian, obtained a bachelor's degree and Ph.D. degree in Electronic Engineering from the University of Nottingham, in 2006 and 2010 respectively. He then worked in the Optoelectronics Research Centre at the University of Southampton. From the year of 2014, he has been working in Wuhan Yangtze Optical and Electronics Co.; managing the R&D department. In 2016, he joint Huazhong University of Science and Technology as a part-time professor. He is an associate editor of <Optical and Quantum Electronics> and the director of Wuhan Optics Valley Metrology Centre. He has generated more than 60 publications, his research interests are designed/optimizing passive specialty optical fibers, has vast collaborations, and successfully applied the specialty fibers in sensing, lasers, IR transmission, and medicine, etc.

----Invited Talk----

High reliability of thin PANDA fiber and its application in miniaturized fiber gyroscope

Abstract—As a potential application in auto-mobile, the fast development of fiber gyroscope keeps perusing miniaturization in size; thus, thin diameter polarisation maintaining fibers that can be bent into small diameter fiber coils is urgently demanded. This report introduces the fabrication of short beat-length PANDA fiber with good mechanical properties. Both the glass and coating

materials are carefully chosen to prove good reliability performance. A diameter of 40 mm fiber coil is demonstrated; following a fiber gyroscope was assembled with an acceptable precision level (0.3°/hour). The optoelectronic sensing capabilities were demonstrated that combine multi-devices into a two-wheel mini balance vehicle, include angle sensing, single line LiDar, and even a visual function.

11:15-11:45 | Yunhe Zhao

Shanghai Maritime University, China

Yunhe Zhao received the Ph.D degree in communication and information system from Shanghai University, Shanghai, China, in 2018. Between 2016 and 2017, she was with the Aston Institute of Photonics Technology, as a visiting student. She is currently an Associate Professor with the Institute of Logistics Science and Engineering, Shanghai Maritime University, Shanghai, China. Her research interests include optical fiber devices, optical fiber sensors, optical vortices generation techniques and fiber lasers.

----Invited Talk----

Mode Coupling in tilted few-mode fiber gratings

Abstract—The characteristics of mode coupling in few-mode fiber with reflective tilted fiber gratings are demonstrated, including the core-to-core mode coupling and core-to-cladding mode coupling, as are the orbital angular momentum modes generation and the sensing properties.

11:45-12:00 | #7

Temperature fluctuation assisted fiber Fabry-Perot refractive index sensor

Ying Wu, Li Xia

Huazhong University of Science and Technology

Abstract—A refractive index sensor based on an in-line Fabry–Perot interferometer is proposed and experimentally demonstrated. The power responses of the two lasers are measured simultaneously. The two reflected power signals distribute along an ellipse. Since the refractive index of the liquid is calculated from the half-length of the main axes of the fitted ellipse. And the temperature fluctuation range only influences the power distribution position along the ellipse. The measuring result of the refractive index is insensitive to the temperature fluctuation. The experimental results matched well with the refractive index measured by the Abbe refractometer, and the refractive index demodulation error was less than 0.001. Furthermore, the temperature fluctuation range can be measured simultaneously, which will be of importance in biological detection and water pollution monitoring.

T10 Optoelectronic Devices and Applications-D

Room: LM104-C | 11:00-12:00

Symposia Chair: Chunmei Ouyang

Tianjin University, China

11:00-11:30 | Zhenzhou Cheng

Tianjin University, China

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

----Invited Talk----

Mid-IR Group-IV Photonics

Abstract—Mid-infrared integrated photonic devices developed by using group-IV materials (e.g. silicon, germanium, and graphene) have tremendous applications in sensing and spectroscopy. In this talk, I review our research progress in mid-infrared

group photonics. Specifically, I report our previous studies in developing novel suspended membrane photonic integrated circuits and subwavelength devices for sensing and nonlinear optics. Our study opens a new avenue for exploring novel on-chip applications in lasing, free-space communication, and biochemical molecular sensing.

11:30-11:45 | #2867

Notch filter based on photonic crystal self-collimation effect

Zhixi Zhu, Shulin Xie, Junzhen Jiang, Guimin Lin, Hui Li, Xiyao Chen

Fujian Normal University

Abstract—In this paper, a notch filter (NF) based on silicon photonic crystals (PCs) was proposed and the performance was numerically demonstrated. The structure of NF consists of a beam splitter and two mirrors. Light propagates in NF based on self-collimation (SC) effect. The theoretical transmission spectrum at the output port is simulated using the finite-difference time-domain method (FDTD). The simulation results indicate that changing the radius of the beam splitter or the distance between the mirrors affects the beam transmission effect. This NF is simple in structure, small in size, and based on silicon material, has potential application value in photonic integrated circuits.

11:45-12:00 | #38

Recent Progress of Lead Halide Perovskite Sensitized Solar Cells

Mingbo Pan, **Haocheng Sun**, Wenliang Hu, Zhiqiang Qi

Huazhong Institute of Electro-Optics

Abstract—Lead halide perovskite solar cells has the advantages of the efficiency of the commercial potential because of its low cost, simple preparation process, in the past two years into a high-profile star for solar fields. Lead halide perovskite solar cell structure, material synthesis and production of industrial occurred several revolutionary changes in a short period. The lead halide can perovskite type sensitized solar cell research progress are reviewed in this paper.

T11 Biophotonics and Biomedical Optics-B

Room: LM104-B | 13:00-14:45

Symposia Chair: Liwei Liu

Shenzhen University, China

13:00-13:30 | Guanghui Wang

Nanjing University, China

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

----Invited Talk----

Active centrifugal microfluidics and its application for point-of-care testing (POCT)

Abstract—Centrifugal microfluidics or lab-on-a-disc (LOAD) is a promising branch of lab-on-a-chip or microfluidics. Besides effective fluid transportation and inherently available density-based sample separation in centrifugal microfluidics, uniform actuation of flow on the disc makes the platform compact and scalable. However, the natural radially outward centrifugal force in LOAD system limits its capacity to perform complex fluid manipulation steps.

In order to increase the fluid manipulation freedom and integration capacity of LOAD system, we propose an active integrated centrifugal microfluidic chip and a binary centrifugal microfluidics chip. Many complex functional units including liquid sequential loading and switching of liquid flow are demonstrated. As an application, we also present a multi-layer complex chip for plasmid DNA extraction based on both platforms. In a word, our active centrifugal microfluidics platform provides a solution for the integration of complex bioassay on rotating disc, which has great potential in the applications of point of care diagnostics (POC).

13:30-13:45 | #27

Super-resolution Imaging Test of Novel Mitochondrial Probe

Jia Zhang, Jialin Wang, Wei Yan, Junle Qu

Shenzhen University

Abstract—Fluorescence microscope (FM) can selectively and specifically detect fluorescence molecules with high signal-to-noise

ratio, but unfortunately its resolution cannot exceed half wavelength due to the limitation of optical diffraction. Stimulated emission depletion (STED) microscopy provides sub-diffraction resolution and super-resolution nano-microstructures while preserving useful aspects of fluorescence microscopy, similar fluorescence microscopy can selectively and specifically detect molecules with high signal-to-noise ratio. However, the widespread use of STED microscopes especially in living cell bioimaging due to high illumination intensity limits. In this paper, a new type of fluorescent dye that is resistant to high-intensity illumination, which provides accurate targeting and is well positioned on the mitochondria of cells is designed. The imaging result shows the mitochondrial dye Super resolution imaging can be achieved to obtain a clear super resolution picture, beyond it has high signal-to-noise ratio.

13:45-14:00 | #2856

Optical manipulation and detection beyond the diffraction limit

Yuchao Li, Baojun Li

Institute of Nanophotonics, Jinan University

Abstract—With observation of small objects, a precisely manipulation is also highly desirable, especially for a three-dimensional manipulation of nanoparticles or biomolecules with a size of less than 100 nm. Although optical tweezers have become powerful tools to manipulate microparticles and cells, they have limits when extended to the nanoscale because of the fundamental diffraction limit of light. The emergence of near-field methods, such as plasmonic tweezers and photonic crystal resonators, have enabled surpassing of the diffraction limit. However, these methods are usually used for two-dimensional manipulation and may lead to local heating effects that will damage the biological specimens. Therefore, we propose a near-field technique that uses a photonic nanojet to perform the three-dimensional optical manipulation of sub-100-nm nanoparticles. With the photonic nanojet generated by a dielectric microlens bound to an optical fiber probe, three-dimensional manipulations were achieved for nanoparticles as well as for plasmid DNA molecules. Backscattering and fluorescent signals from the trapped nanoparticles were detected in real time with a strong enhancement. The demonstrated approach provides a potentially powerful tool for quantum dot assembly, biosensing and single-biomolecule studies.

14:00-14:15 | #2865

Nano-optical conveyor belt plasmonic metasurface with polarization control

Chi Zhang, Min Jiang, Yao Chang, Yang Liu, Guanghui Wang

Nanjing University

Abstract—Based on the near-field gradient force of the surface plasma structure, we propose a metasurface structure controlled by polarized light to capture and transport micron particles. At the same time, considering the Brownian force and viscous resistance of particles, the force of particles is analyzed in detail, and the sorting of particles with different diameters is given according to the results of the analysis. It is of great significance for the biomedical application of microfluidic system.

14:15-14:30 | #2868

Speckle noise reduction mechanism based on dual-density dual-tree complex wavelet in optical coherence tomography

Sang Xiaoyue, Yuan Zhaohui, Yu Xiaojun, Liu Linbo

Northwestern Polytechnical University

Abstract—Image quality is an important parameter characterizing the performances of an optical coherence tomography (OCT) system. Low image quality not only deteriorates the image analysis and interpretations, but also impacts on the clinical applications of OCT systems, leading to misdiagnosis. Speckle noise is always present in OCT signals, and thus inevitably affects the OCT image quality. This paper studies the speckle noise reduction problem in OCT systems, and tries to compare a variety of the wavelet transform based methods. Specifically, we give the logical flow diagram of the dual-density dual-tree complex wavelet method first, and then combine it with the local variance estimation based bivariate contraction model for speckle noise reduction. By performing experiments on OCT images of human retina, swine eye and human dental, we compare the speckle noise reduction effects of the dual-density method, dual-density dual-tree real wavelet method (R2D) and dual-density dual-tree complex wavelet (C2D) method. Results show that the C2D method can effectively eliminate the speckle noise while retaining the important edge detail information of the OCT images.

14:30-14:45 | #2873

Grooved Gold Grating-assisted Integrated Planar Waveguide Based Localized Surface Plasmon Polariton Microbiosensor

M. S. Aruna Gandhi, Qian Li

Peking University

Abstract—The promising research and development of sensing technology initiates innovative sensors achieving cost effective to promote the simple, portable and experimental realization. Sensing performances of the proposed self-referenced localized surface plasmon resonance (LSPR) based grooved gold grating-assisted integrated planar waveguide refractive index microbiosensor have been investigated by using the finite element method in this work. The sensor achieves a maximum spectral and amplitude sensitivities of 4000 nm/RIU and 328 RIU-1 in the analyte refractive-index from 1.33 to 1.34 for the chemical and biological applications.

T12 Optical Communication and Networks-B

Room: LM104-C | 13:00-14:00

Symposia Chair: Haizhi Song

Southwest Institute of Technical Physics, China

13:00-13:30 | Zixiong Wang

Tianjin University, China

Zixiong Wang received the Ph.D. degree from Nanyang Technological University in 2013. In the same year, he joined the Li-Fi R&D Centre at the University of Edinburgh. He is currently an associate professor in Tianjin University. His main research interests include optical wireless communications and microwave photonics.

----Invited Talk----

Performance analysis of NOMA VLC system using SM

Abstract—We propose a novel two-user non-orthogonal multiple access (NOMA) visible light communication (VLC) system. The spectral efficiencies of the two users can be increased by using spatial modulation (SM) and constellation rotation.

13:30-13:45 | #2852

Ultra-compact multimode waveguide bends based on the inverse design

Ning Zhu, Shangsen Sun

South China Normal University

Abstract—A method of designing silicon multimode waveguide bends using inverse design algorithm is presented in this paper. High–performance and ultra-compact multimode waveguide bending structures are realized by using a special curve consisting of multiple arcs with different radii of curvature. The bent waveguide supporting three modes with an effective bending radius of only 9.35um is designed and tested. The theoretical excess losses of TE0, TE1 and TE2 modes are less than 0.04 dB in a wide spectral range from 1500 to 1600 nm, and the crosstalks between all guided modes are all lower than −26 dB. Besides the fabrication of the present structure is simple without additional etching step.

13:45-14:00 | #2876

A Signal Modulation Parameters Extraction Method Based on Ultra-high Resolution Optical Spectra and Machine Learning Techniques

Haoyu Wang, Peishan Jiang, Yibo Zhong, Zhen Guo, Changjian Ke*, Deming Liu

Huazhong University of Science and Technology

Abstract—To keep up with the growing demands in data transmission, optical fiber communication systems are evolving toward the direction of large capacity, long distance, high speed and intelligence. In the future flexible heterogeneous optical networks, modulation formats, symbol rates and pulse shape schemes of optical signals propagate in the same fiber may be different and change with time. modulation formats and symbol rates identification is compulsory for the network management. Optical spectrum measurement is a powerful tool to analyze and monitor the performance of optical link as different types of optical signal have unique optical spectra and on the other hand, the spectra still exist distinction when suffering various distortions even if they belong to the same type of signal. The ultra-high resolution optical spectra containing precise features can provide more detailed spectrum information. Thus, on the basis of obtaining the optical spectra, it is expected that optical performance monitoring, especially modulation format identification can be realized by utilizing machine learning techniques.

In this paper, an effective optical signal modulation parameters extraction method based on the combination of a main-lobe width identification algorithm and machine learning techniques, namely principle component analysis (PCA) and support vector machine (SVM) is proposed. PCA is used for dimensionality reduction and data feature extracting while SVM is utilized for spectra classification in this method. The signal spectrum measured by an ultra-high resolution spectrometer based on stimulated Brillouin scattering is first classified according to its main lobe width and then processed by the machine learning algorithms for feature extraction and automatic classification. We also consider the effects on optical spectrum distortions caused by non-ideal modulation and transmission. The results show that this method can accurately extract the modulation parameters of 15 types of optical signals commonly used in WDM system, which bit rates range from 10Gb/s to 400Gb/s and modulation formats include OOK, BPSK, QPSK and 16QAM, with a high accuracy. This method is able to diagnose several optical distortions including OSNR degradation, modulation bias voltage drift and extinction ratio degeneration as well.

This method has the potential to be applied in the optical spectrum analyzers to extract more information from signal spectra without any extra hardware cost.

T13 Laser Technology-B

Room: LM104-B | 15:00-17:00

Symposia Chair:

Guiyao Zhou, South China Normal University, China

Tianye Huang, China University of Geosciences (Wuhan), China

15:00-15:30 | Chongxi Zhou

Institute of Optics and Electronics, Chinese Academy of Sciences, China

Prof. Zhou Chongxi, was born in September 1970, received his Bachelor's degree of Sci. from Huazhong University of Sciences and Technology in 1992, Master's degree from University of Chinese Academy of Sciences (UCAS) in 1995, and Ph. D Degree from Sichuan University in 1998. He is a research fellow and the head of the Micro-optics Group in State Key Lab of Optical Technologies on Nano-fabrication and Micro-Engineering, Institute of Optics and Electronics, Chinese Academy of Sciences. His research interests focus on the Micro-Nano Optics and its applications in laser techniques.

----Invited Talk----

Diffractive Beam Splitters with high uniformity and efficiencies in Laser parallel processing

Abstract—Laser has been used in many fields such as LiDAR and laser fabrication. With the increasing high power and narrower band of laser output, the multi-units laser parallel processing techniques are coming into the laser Lidar and laser processing. For the merits of flexible and light-weight and high efficiency, diffractive optics elements (DOEs) laser splitters have been as key optical elements in laser parallel processing to get a faster speed. Diffractive Laser Beam Splitters(DLBS) of linear 1D、grid 2D and multi-foci 3D kinds with 95% spots distribution uniformity and high diffraction efficiency more than 92% are R&D， the orders of diffraction range from 16 to 32,64 and even 128 etc., and full Field of view (FOV) is up to 10 degrees, and the maximum diameter of the DOE splitter is up to 6" and the level number gets to 32.

15:30-15:45 | #2877

Generation of Soliton Molecules Based on Spectral Filtering Effect

Zilong Li, Hairun Guo and Huanhuan Liu

Shanghai University

Abstract—We demonstrate that the bound-state soliton molecules with 52.39-ps pulse separation can be obtained by spectral filtering effect in erbium-doped mode-locked fiber laser. Experimental results indicate that spectral filtering effect is important to soliton molecules.

15:45-16:00 | #2879

Refractive Index Sensing Characteristics of Long-Period Fiber Gratings Near Dispersion Turning Points at 2um Waveband

Wei Wang, Yunhe Zhao, Zuyao Liu, Yunqi Liu, Yongsheng Yang, Xuping Zhang

Shanghai Maritime University

Abstract—In this paper, we demonstrate the surrounding refractive index (SRI) sensing characteristics of long-period fiber gratings

(LPFGs) near dispersion turning points (DTP) working at 2 μm waveband. The dependence of contrast and wavelength shift of LPFGs in different SRI range has been investigated. The contrast varies gradually from 4.5 dB to 12 dB in lower SRI region of 1.000-1.330, and an SRI sensitivity of 22.5 dB/RIU can be obtained. With the increasing SRI, the dip at DTP spilt into dual resonant dips. A high sensitivities of 3780 nm/RIU and 8233.3 nm/RIU can be achieved in the SRI regions of 1.320-1.420 and 1.420-1.450, respectively. The proposed LPFGs based SRI sensor has potential application in the field of fiber sensing.

16:00-16:15 | #15

Mid-infrared dual-comb spectroscopy with automatic feed-forward frequency interpolation

Xinyi Ren, Ming Yan and Heping Zeng

State Key Laboratory of Precision Spectroscopy East China Normal University, Shanghai, China

Abstract—Over the past decades, optical frequency comb that produces a broadband spectrum consisting of equidistant coherent frequency lines has evolved into a powerful light source for frequency metrology and molecular spectroscopy. Particularly, with two laser combs of slightly different line spacings heterodyning on a fast photodetector, dual-comb spectroscopy (DCS) offers an enabling spectroscopic technique for measuring molecular transitions without moving mechanicals and dispersive elements. The technique has been harnessed for interrogating fundamental ro-vibrational transitions of molecules in the mid-and far-infrared spectral regions with Doppler-limited spectral resolution, high accuracy and unprecedentedly high data acquisition speed, which opens up new opportunities for applications such as gas sensing and hyperspectral imaging. Recently, the advent of electro-optic comb technology has led to a simple and robust strategy for DCS with improved dual-comb mutual coherence and significantly reduced systematic complexity. However, in many cases, the line spacing of an electrooptic comb is so large (for instance, 25 GHz) that it is difficult to finely resolve absorption lines of molecules in gas phase. Spectral interpolation may make up for this problem. To this end, a frequency tunable laser that interrogates a sample is tuned and, meanwhile, stabilized to a frequency reference such as an OFC or an optical cavity at each tuning step. However, for precise tuning and control of a laser, feed-back servo electronics, which could be rather complicated and incompatible with fast tuning due to their limited response speed, are imposed on the laser, causing inconvenience for practical uses.

Here, we experimentally demonstrate a scheme of feed-forward frequency control that enables fast and precise tuning of a continuous-wave laser with a ramping speed up to 5.45 THz/s, in which an acousto-optic frequency shifter is employed to automatically lock the continuous-wave laser to an optical frequency comb (line spacing of 54.5 MHz). The technique is adopted for resolution enhancement of two broadband mid-infrared combs, spanning from 87.47 to 90.47 THz or 3313.72 to 3427.38 nm, with line spacings of ~25 GHz, produced by difference frequency generation of two nearinfrared electro-optic combs. As a result, without complicated electronics or control programs, our system is capable of simultaneous interrogation of multiple absorption lines of methane gas at a spectral resolution of 54.5 MHz. Our simple system with the broad spectrum and high spectral resolution may benefit many field applications including gas sensing.

16:15-16:30 | #2836

Stretched Noise-like Pulse for High-Resolution Fault Measurements

Ran Xia, Yiyang Luo, Perry Ping Shum, Yusong Liu, Wenjun Ni, Qizhen Sun, Luming Zhao, and Xiahui Tang

Huazhong University of Science and Technology, China

Abstract—Various solitons such as conventional solitons, dissipative solitons and stretched pulses have been both numerically and experimentally investigated in different regime of the mode-locked fiber lasers. Apart from the operation regimes of regular pulses, passively mode-locked fiber lasers can also deliver the noise-like pulse (NLP), which is essentially a pulse envelope consisting of a bunch of random femtosecond ultrashort pulses. The NLP is characterized by a broadband and smooth optical spectrum when using optical spectrum analyzer. Given that the time-averaged spectrum conceals the underlying information of NLPs, the dispersive Fourier transform (DFT) technique which maps the spectrum of each optical pulse into temporal waveform can be employed to obtain the real-time spectra of the NLPs. In fact, experimental results have shown that the single shot of NLP is coded by the chaotic spectral information of those random pulses and the shot-to-shot spectra of NLPs exhibit obviously stochastic spectral evolution in each roundtrip. Therefore, each stretched NLP can be considered as a randomly modulated chaotic signal, while the modulation is spontaneous in comparison with the traditional generation of chaotic signal.

Here, we propose a high-resolution fault measurement method using the noise-like pulse stretched by the DFT technique. Employing the single shot of the NLP as probe pulse, this method realizes the fiber fault measurement with a simple and stable

configuration. In the experiment, the fault location at 4.3525 m is successfully measured through the correlation between the echo pulse and reference pulse with the spatial resolution of 8 mm. Moreover, two faults with a distance of 27 cm can be detected and distinguished clearly even though two echo signals cannot be readily identified in the time domain. This proof-of-concept experiment shows that different fiber faults can be distinguished with 8-mm spatial resolution. We believe the proposed method is a promising solution for monitoring and precise fault location in fiber links.

16:30-16:45 | #2850

Study of Spectroscopic Properties of Pr3+ and Tb3+-Doped Glasses as Gain Fiber Materials

Yan Sun, Fei Yu, Meisong Liao, Xin Wang, Lili Hu and Jonathan Knight

Shanghai Institute of Optics and Fine Mechanics

Abstract—We report spectroscopic properties of Pr3+ doped aluminosilicate and Tb3+ doped phosphate glasses, which show promising potential as gain fiber materials for lasing at 610 and 541 nm wavelengths respectively.

T14 Infrared Technologies and Applications-A

Room: LM104-C | 14:15-17:15

Symposia Chair: Weida Hu

The Shanghai Institute of Technical Physics (SITP) of the Chinese Academy of Sciences, China

14:15-14:45 | Fang Wang

Shanghai Institute of Technical Physics, Chinese Academy of Sciences, China

Fang Wang received her Ph.D. degree in Science from East China Normal University, Shanghai, China, in 2019, and B.S. degree in Electronics and Information Engineering from Donghua University, Shanghai, China, in 2010. She is currently a postdoctor in Prof. Weida Hu's group in Shanghai Institute of Technical Physics, Chinese Academy of Sciences. Her research interests focus on characterization, fabrication and machanism of infrared photodetectors. She has authored and co-authored more than 20 journal papers and conference presentations.

----Invited Talk----

Novel Infrared Photodetector of High Gain

Abstract—The mechanisms of photocurrents magnification is an very important process in the infrared photodetectors, especially for the single-photon detection technique in the fields of quantum communication, molecular fluorescence lifetime measurement, atmosphere pollution inspection and so on. Here, typical mechanisms for magnifying photocurrents in nanoscale photodetectors is reported. It includes avalanche mechanism, photogating effect, light-induced junction field effect, and magnifying effect by integrating field effect transistors. Along with the typical magnifying mechanisms, the important characteristic parameters of high gain photodetectors will be reverted. We will compare the typical characteristic parameters in novel low-dimensional photodetectors and traditional evaluation method of infrared photodetectors. The Noise and Detectivity will be focused. In this presentation, the comprehensive progress and internal mechanism of photocurrents magnification will be described, and the typical characteristic parameters of infrared photodetectors will be reverted.

14:45-15:15 | Yi Gu

Shanghai Institute of Technical Physics, CAS, China; Shanghai Institute of Microsystem and Information Technology, CAS, China

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 110 papers in peer-reviewed journals. He was elected as the member of Youth Innovation Promotion Association CAS in 2013, IEEE senior member in 2015, and Shanghai Rising-Star in 2017. In 2012 and 2015, he was honored the 2nd prize of Science and Technology Progress Award and 3rd prize of Technical Innovation Award in Shanghai, respectively.

----Invited Talk----

III-V Semiconductors for Short-wave Infrared Optoelectronic Devices

Abstract—Short-wave infrared (SWIR) wavelength range of 1-3 μm is one of the important transmission windows of atmosphere

and the semiconductor detectors covering this wavelength range have attracted much attention due to the versatile applications in remote sensing and communication. III-V semiconductor InGaAs is a mature III-V ternary material with widely adjustable lattice constant and bandgap. By tailoring the composition or extending to its related quanternary InGaAsBi and InGaAsP materials, the bandgap is able to be extended to narrower and wider, corresponding to longer and shorter wavelength for optoelectronic devices, respectively.

In this presentation, I will introduce our recent works on the improvements of high-quality lattice-matched and lattice-mismatched high indium InGaAs detectors on InP. The material defects are restrained by the optimization of molecular beam epitaxy processing and material structure. The detectors with cutting off wavelength from 1.1 μm to 2.5 μm are demonstrated. Also, both PIN structure detectors and avalanche photodiodes as well as focal plane arrays are developed.

15:15-15:45 | Zhipeng Wei

State Key Laboratory of High Power Semiconductors Laser of Changchun University of Science and Technology, China

Professor Zhipeng Wei, doctor of Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, worked as the deputy director of state key laboratory of high power semiconductor laser of Changchun University of science and technology. Postdoctoral researched at Nanyang Technological University of Singapore. He was elected to top-notch talent, awarded "Science & Technology Award for Jilin Province Youth" and was team leader of Jilin province innovation team program. In recent five years, he published more than 50 papers on Nano Letters Nanoscale, ACS Applied Materials and Interfaces, Applied Physics Letters et.al. He led 3 NSFC projects and more than 10 projects from province or ministry. The research direction was mid-infrared semiconductor laser materials and devices. Recently, his study focused on III-V low-dimension materials, laser and photodetectors.

----Invited Talk----

Adjustment of photo-generated carriers and enhancement of response of GaAs-based low-dimension photodetector

Abstract—With the development of semiconductor technology, higher requirements on system integration and power consumption have been put forward for the semiconductor device system, which makes nano-optoelectronic devices get more and more attention. Compared with traditional materials, nanomaterials have a quantum size effect, which can effectively limit photons and electrons to a one-dimensional scale, and obtain high quantum efficiency and response characteristics. Therefore, nanoscale optoelectronics devices have broad application prospects in the field of on-chip integration and optical interconnection in the future. The researches on nanowire photodetector are of great significance. In our study, the GaAs nanowires are grown on Si substrate using self-catalyze vapor-liquid-solid method by molecular beam epitaxy. And then, a GaAs single nanowire photodetector is fabricated. In order to enhance the detectivity of photodetector, the sulfur passivation is applied to eliminate the surface states of nanowire. After passivation, the detectivity is enhanced about one order of magnitude. Then, Si doping is used to adjust the Fermi level of GaAs nanowire and strengthen built-in electric field to accelerate the separation speed in the photodetector. An outstanding responsivity of 1175 A/W is obtained. This is two orders of magnitude better than the responsivity of the undoped sample. To further improve the performance of nanowire photodetector, an AlGaAs/GaAs core-shell nanowire photodetector is designed. The responsivity is increased about one order of magnitude by building carrier channels. At last, a AlGaAs/GaAs core-shell multiple quantum well nanowire photodetector is fabricated to further enhance the response properties. In our works, many technologies have been employed to adjust the photo-generated carriers and improve the responsivity and the detectivity. The performance parameters of our devices are much higher than that of the state-of-the-art nanowire photodetectors. It lays a foundation for the application of GaAs-based nanostructure photodetector in optoelectronic device integration.

15:45-16:15 | Peng Wang

State Key Laboratory of Infrared Physics, Shanghai Institute of Technical Physics, Chinese Academy of Sciences

Peng Wang, assistant professor at Shanghai Institute of Technical Physics, Chinese Academy of Sciences. His main research interest is focus on the infrared photodetector. He has published more than 20 first author and corresponding author SCI papers in Nature communication, Advanced Materials, Nano Energy, Advanced Function Materials, ACS Nano, Small, etc. He has also coauthored in more than 50 SCI papers, which has more than 2,500 times citations with h index of 29. In 2019, he was selected as the candidate of "Shanghai Sailing

Program". He awarded the Young Scientist Award of IEEE ICOCN 2019, the Best Oral Award of ICON-2DMAT 2019, and Outstanding Graduate Student Award of Synergetic Innovation Center of Quantum Information & Quantum Physics in 2016.

----Invited Talk----

Novel Infrared detectors: Advances, challenges and new technologies

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 novel IR photodetectors.

16:15-16:45 | You Wang

Southwest Institute of Technical Physics

Prof. You Wang was born in China, in 1966. He received the B.S. degree in laser technology from Zhejiang University, Hangzhou, China, in 1986, and the M.Sc. degree in optics from Chinese Academy of Science (registered in Hefei University of Technology), Hefei, China, in 1991, respectively. He received the Ph.D. degree in electronics/communication from Tohoku University, Sendai, Japan, in 1997. After then, he worked as an assistant professor of Tohoku University, a researcher of the major institutes of RICOH Co. Ltd, and a laser scientist of both the Center Laboratory of HPK Co. Ltd and Institute of Physical and Chemical Research of Japan (RIKEN) for more than 15 years. He is currently a national distinguished professor of China with Southwest Institute of Technical Physics, Chengdu, Sichuan, China. He is also involved in various aspects of theory and practice of several types of lasers as well as their industrial applications. His current research interests include kinetic processes, molecular and atomic physics, solid-state lasers, semiconductor lasers, gas lasers, image processing, micro laser processing, special waveguides and optoelectronic technology. These works have been published in more than 150 refereed scientific papers (reviews) in the scientific journals and academic conferences. He has also applied 38 patents in the United States, Japan, China, and Europe Union.

----Invited Talk----

Recent Development of Mid-Infrared Optical Parametric Oscillator Lasers

Abstract—In the recent years, mid-infrared lasers have been paid a lot of attention in the fields of scientific researches, military detection, and civilian applications, etc. Optical parametric oscillator (OPO) is one of the most important and effective means of obtaining the mid-infrared laser radiation. Such a mid-infrared laser source has been found a lot of enabling applications in medical examination, gas sensing, environmental monitoring, and defense fields. Designing an optical parametric oscillator plays a very important role for the real development. The recent progresses of two typical mid-infrared optical parametric oscillators based on ZnGeP2 and MgO: PPLN is summarized for both domestic and foreign research agencies in this report. The merits and development prospects are analyzed for different structures. It is revealed that both high power and small size of an OPO are main significant developing directions in the near future. It is also indicated that bigger-size infrared crystal and higher performances of a pump source are the key elements of the development of OPOs . At last, the development trend of such mid-infrared OPO lasers is also pointed out for the next decade.

16:45-17:00 | #32

InGaAs NIR detector epitaxial design and device fabrication

Wenliang Hu, Zhiqiang Qi, Haochen Sun

Huazhong Institute of Electro-Optics, Wuhan National Laboratory for Optoelectronics

Abstract—This article uses semiconductor simulation software to simulate the composition and thickness of the epitaxial structure of the InGaAs near-infrared detector. By optimizing and adjusting different parameters, the surface dark current control of the detector structure is realized, making the overall performance of the infrared detector has been improved. The calculation results show that by reducing the thickness of the intrinsic layer within a certain range, the surface dark current of the device can be appropriately reduced, and the minimum dark current can be obtained under certain epitaxial doping. Under the condition of preparing the passivation layer, through a series of preparation processes such as metallization, the final InGaAs detector is obtained, and the test results of the detector are consistent with the calculation, and the dark current is controlled at the level of nA, which can be used for near infrared short-wave imaging .

17:00-17:15 | #2871

Highly polarized InGaAsP/InP-air-gap elliptical micropillar cavity for single photon source at 1.55 μm communication band

Shuai Huang, Xiumin Xie, Qiang Xu, Wei Zhang, You Wang, Guangwei Deng, Qiang Zhou, Haizhi Song

Southwest Institute of Technical Physics

Abstract—Elliptical micropillar cavity owns two orthogonally linearly polarized modes that split from the polarized degenerate fundamental mode of the circular micropillar cavity. The quantum dot embedded in such cavity can emit polarized single photon by coupling one polarized mode. However, if the emitted linewidth covers both modes, the polarization purity of the single photons may not be guaranteed. Here we present a novel elliptical micropillar cavity that may get rid of the disturbance of the other polarized cavity mode. The proposed microcavity is based on the InP-air-gap structure, which is able to solve the problem of low reflectivity in InP-based material systems. This unique cavity allows us to manipulate both quality factors and mode wavelengths of the linearly polarized cavity modes by regulating the InP-air-gap layers, and achieve high polarization characteristics and quality factor at 1.55 μm communication band with low eccentricity.

T15 Laser Technology-C

Virtual meeting on Zoom | 08:30-09:30

Symposia Chair: Tianshu Wang

Changchun University of Science and Technology, China

08:30-09:00 | Carel Martijn de Sterke

University of Sydney, Australia

Martijn de Sterke received his Ingenieur degree in applied physics from the University of Delft in 1982, and then did his PhD at the University of Rochester in the USA. After a postdoc in Toronto, he joined the University of Sydney where he is now a Professor in Physics. He was Editor-in-Chief of the journal Optics Express during 2007-2012, and was member of the Board of Directors of the Optical Society (OSA) 2017-2019. His research interests include nonlinear optics, guided-wave optics and plasmonics.

----Invited Talk----

Experimental demonstration of a pure quartic soliton laser

Abstract—We report a modelocked fibre laser that emits Pure Quartic Solitons, solitons that balance the Kerr nonlinearity with quartic dispersion. This shows that high-order dispersion can be used to access a previously unexplored regimes of ultrafast laser operation. Phase-resolved measurements show that the pulse energy scales with the third power of the inverse pulse duration--a much stronger increase than possible with existing soliton lasers.

09:00-09:15 | #2887

Research on beam quality evaluation system of high-energy laser beam combination

Jiang Maohua, Wang Ke, Wang Weize, Wang Tao, Zhang Yu, Zhu Renjiang, Zhang Peng

Chongqing Normal University, China

Abstract—Laser beam combination is an important technology means to achieve high-energy laser output, and the light field distribution after high-energy laser combination is very complicated, which brings many difficulties to how to evaluate the quality of the combined beam. In this paper, combining various specific conditions, an evaluation system for the combined beam is proposed. This system can not only evaluate the beam quality of the combined beam, but also evaluate the realization level of the combined technology and the quality of the combined method.

09:15-09:30 | #43

Dissipative soliton resonance pulses in all polarization-maintaining thulium-doped mode-locked fiber laser

Long Han, Guangbin Song, Runmin Liu, Wanzhuo Ma and Tianshu Wang

Changchun Univ of Science and Technology

Abstract—Nanosecond square-wave pulses are demonstrated experimentally in an all polarization-maintaining thulium-doped mode-locked fiber laser with nonlinear amplifying loop mirror mechanism. The fiber laser consists of dual controllable amplifier and two segments of active fibers. It is verified that the square wave pulse is the dissipative soliton resonance pulse. With increasing power of the dual amplifiers, the pulse width broadens linearly from 3.6 to 13.5 ns and the single pulse energy rises from 11.7 to 27.5 nJ. When the power of amplifier A1 is fixed, the output peak power changes from 3.25 to 2 W with increasing of power in amplifier A2. On the contrary, with fixed the power in amplifier A2, the peak power rises from 1.5 to 2 W by adjusting the power of amplifier A1. In addition, we change the length of polarization-maintaining fiber in NALM ring, which is equivalent to affecting the spectral filtering effect and saturation power in the resonator. The experimental results show that the dynamic characteristics of the output square-wave pulse have the same trend. The work provides an important reference value for the research of polarization-maintaining all-fiber lasers.

T16 Optoelectronic Devices and Applications-E

Virtual meeting on Zoom | 08:30-10:15

Symposia Chair: Qin Chen

Jinan University, China

08:30-09:00 | Yikai Su

Shanghai Jiao Tong University, China

Yikai Su received the Ph.D. degree in EE from Northwestern University, Evanston, IL, USA in 2001. He worked at Crawford Hill Laboratory of Bell Laboratories and he joined the Shanghai Jiao Tong University as a Full Professor in 2004. His research areas cover silicon photonic devices for information transmission and switching. He has over 400 publications in international journals and conferences, with more than 4000 citations (scopus search). He holds 6 US patents and ~50 Chinese patents.

Prof. Su served as an associate editor of APL Photonics (2016-) and Photonics Research (2013-2019), a topical editor of Optics Letters (2008-2014), and a guest editor of IEEE JSTQE (2008/2011). He is the chair of IEEE Photonics Society Shanghai chapter, a general co-chair of ACP 2012, a TPC co-chair of ACP 2011 and APCC 2009. He also served as a TPC member of a large number of international conferences including CLEO (2016-2018), ECOC (2013-2017), OFC (2011-2013), OECC 2008, CLEO-PR 2007, and LEOS (2005-2007).

----Invited Talk----

High-efficiency and compact silicon thermo-optic switch for high speed data

Abstract—We demonstrate a silicon photonic switch by using dual nanobeams in a Mach-Zehnder structure. The ultra-small mode volumes of the nanobeam resonators and their suspended structures enable ultra-low power consumption in the switching process. Experimental results show a device footprint of 16 μm × 60 μm, a high tuning efficiency of 7.5 nm/mW with a continuous tuning range of 25 nm, an ultra-low cross/bar switching power of 0.15 mW with a fast TO switching speed of ~ 2 μs, and a bandwidth of 86 GHz. System performance of high-rate data switching is also studied, which exhibits negligible power penalty at a 124-Gb/s raw data rate with a PAM4 format, verifying the proper bandwidth design of the nanobeam resonators.

09:00-09:30 | Andrew Wing On POON

The Hong Kong University of Science and Technology

Prof. Andrew W. O. Poon received his B.A. (Hons.) degree from The University of Chicago, Illinois, USA in 1995, and his M. Phil and Ph. D. degrees from Yale University, Connecticut, USA, in 1998 and 2001, all in Physics. In 2001, he joined the Department of Electrical and Electronic Engineering (now the Department of Electronic and Computer Engineering), The Hong Kong University of Science and Technology (HKUST), as an assistant professor. He is currently a full professor and Director of the HKUST Nanosystem Fabrication Facility (2016 - present). Prof. Poon has been conducting experimental research on microresonator optics and silicon photonics for two decades. He is a Senior Editor of the IEEE Photonics Technology Letters.

----Invited Talk----

Silicon nitride and III-V-on-silicon microresonators

Abstract—In this talk, we will briefly review our latest progress on silicon nitride microresonators for nonlinear and quantum photonics. We have recently demonstrated a 4" wafer-scale, CMOS-compatible fabrication for realizing Si3N4 waveguide-coupled microring and microdisk resonators, with a resonator quality factor in the order of 10^6. We will also briefly review our recent work on heterogeneous integration of III-V-on-silicon photonics using molecular wafer bonding. Our heterogeneously integrated microring resonators function as a gain-assisted optical switch and a multimode laser source.

09:30-10:00 | Ching Eng (Jason) PNG

IHPC, A*STAR

Ching Eng (Jason) Png is Director of the Electronics and Photonics Department at the Institute of High Performance Computing, Agency for Science Technology and Research, Singapore.

Jason received his Ph.D. degree in Silicon Photonics from Surrey University in 2004, and the executive MBA degree from INSEAD and Tsinghua University in 2014. He also completed the Innovative Business Leadership Program at MIT Sloan School in 2013.

----Invited Talk----

AI-Enabled Electronic-Photonic IC Design

Abstract—Techniques of Artificial Intelligence (AI) are widely used in image classification, natural language processing, automatic speech recognition and robotics. Apart from these traditional applications, recently machine learning methods have penetrated

vast area of science and engineering fields which conventionally explored by deterministic hard computing methods. In photonics, AI techniques have been used in improving the state of the art in optical fiber sensing, laser characterization, quantum communications, optical imaging, photolithography, inverse designs of photonic devices with targeted performances, and on – demand designs of metamaterials. In this presentation, we will illustrate the application of AI techniques in the developments of methodologies for photonic IC design. We will demonstrate competitive advantages and capabilities of the proposed AI approach in terms of the performance, reliability and robustness.

10:00-10:15 | #2851

Structural and Optical properties of the ultrathin 4 nm TiO2/ITO structure

Jianling Meng, Guibai Xie, Shuntian Jia, Wenbin cao, Ying Liu, Yanqing Zhang

Shaanxi University of Science and Technology

Abstract—Ultrathin TiO2 deposited on ITO substrate plays an important role in the miniaturization of application devices. In this paper, 4 nm TiO2 is deposited on ITO through atomic layer deposition (ALD) method. The amorphous TiO2 is characterized by XPS, XRD, Raman and AFM. In addition, the dependence of transmittance spectra on the annealing temperature is measured to evaluate the thermal stability of the 4 nm TiO2/ITO structure. It is found that when the annealing temperature is increased to 300℃, 400℃and 500℃, the transmittance decreases in the visible light region due to the increased surface roughness while increases in the infrared region due to the ultrathin thickness of TiO2 which can permit the atmospheric component reaching to the ITO layer.

T17 Precision Optics-B & Biophotonics and Biomedical Optics

Virtual meeting on Zoom | 09:45-12:00

Symposia Chair: Ximeng Zheng

Chinese University of Hong Kong

09:45-10:15 | Yaocheng Shi

Zhejiang University, China

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

----Invited Talk----

Silicon based Sub-wavelength waveguide grating devices

Abstract—The sub-wavelength grating (SWG), which is a one-dimensional array of deeply sub-wavelength nano-strips, can provide precise control over modal confinement, effective index, dispersion and birefringence, showing great potentials in high-performance nano-photonic devices. The SWG based on silicon waveguides thereby opening up new approaches to manipulate the optical responses and control the flow of light. In this talk, we will introduce some of our recent work on the silicon metamaterial based silicon integrated devices, including the bent multi-mode waveguides, multi-mode crossings, and also the polarization manipulation devices.

10:15-10:45 | Ximeng Zheng

Chinese University of Hong Kong, China

Dr. Ximeng Zheng started his Ph.D. as a European Marie-Curie Fellow at the research institute XLIM of CNRS for the miniaturization of atom&molecular optics devices based on the hollow-core photonic crystal fiber (HC-PCF). Then he received his Ph.D. degree in high-frequency electronics, photonics, and system from the University of Limoges, France in 2017. Following his graduate work, he became a postdoctoral researcher at the same research institute. He is currently working as a Research Associate in the multiscale precision instrumentation laboratory at the Chinese University of Hong Kong. His research interests include the hollow-core PCF design, the miniaturization, and the integration of atom&molecular-confined hollow-core PCF and the potential applications for such devices e.g. fiber-based quantum sensors, metrology, fiber laser, and fundamental research, etc.

----Invited Talk----

Progress in hollow-core photonic crystal fibers based atom optics

Abstract—The emerging atomic vapor photonic devices base on hollow-core photonic crystal fibers (HC-PCFs) has opened up vast possibilities for atomic or quantum applications such as HC-PCF based slow light, frequency standard, quantum sensor, atomic fiber laser, atomic nonlinear optics, coherent optics, etc. atom or molecular-confined HC-PCF has been proven as a compact and integrated platform thanks to the salient features with its long efficient interaction length, the enhanced laser medium nonlinearities, and the high absorption contrast. However, the micrometric scale of the hollow-core harboring atom/molecular vapor raises several scientific questions. Firstly, the small core of HC-PCF (5~100 μm) making the atom/molecular very easily to lose their polarization after an optical pumping process. This is due to the strong collision with the inner wall surface of HC-PCF that induces spectral broadenings by the atom-surface interaction. Secondly, the large surface-to-volume ratio of HC-PCF enhances atom-surface effects like physio-chemical processes, surface material adsorption, Van-der- Waals (VW) interaction and Casimir Polder forces that cannot be negligible, which play a significant role in spectroscopic features that strongly differ from the conventional macroscopic vapor cells. Thus, understanding in-fiber gas-phase dynamics such as time of flight, modal of atom/molecular distribution, coherence/decoherence dynamics, dwell time on the wall surface, and the nature of atom- surface interaction becomes very important for the aforementioned applications. Here, we firstly report the theoretical simulation based on Monte-Carlo simulation for the atom/molecular distribution. 2D mapping of the particle distribution is well simulated at the cross-section of the hollow core which depends on the surface activation energy and time of flight of the free particles. The fractional number of atom/molecular close to the inner wall surface and in the center of hollow is normalized as well. The results show that 60% of the total number of particles are approaching the vicinity of the inner surface, and particles spend 90% of time near the inner surface of the hollow wall. Then, the experimental investigations of the gas-phase dynamics by using a modified pump-probe configuration that enables measuring the atomic/molecular polarization relaxation time in-situ along the longitudinal direction of the HC-PCF. Meanwhile, the hollow-core PCFs have been coated by three different anti- relaxation materials e.g. Alumino-silicate, PDMS, and OTS. Thus, the related activation energies for different coating materials have been deduced through the measurement. We found a good agreement with the view of the simulation. Furthermore, we also investigate the reduction of physio-chemical reaction and the spectral broadening from the Electromagnetically Induced Transparencies (EIT) with the different anti-relaxation materials. We got the narrower EIT features in the transmission spectrum. Thus, the anti-relaxation materials are desirable for optical spectroscopy applications to avoid the dephasing problem and the physio-chemical reaction.

10:45-11:15 | Quan Liu

Nanyang Technological University, Singapore

Dr. Quan Liu received the PhD degree in Biomedical Engineering from the University of Wisconsin, Madison. 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 optical imaging and spectroscopy for medical diagnostics. Dr. Liu has published more than fifty journal papers and held sixteen US patents/applications in the field of biomedical optics. He has also secured a total mount of external funding more than four million USD to support his group. Dr. Liu has served as a reviewer for several top journals, such as Optics Letters, Optics Express and Nature Communication, and multiple international funding agencies as well as a subcommittee member and session chair for multiple international conferences such as European Conferences in Biomedical Optics (ECBO) and Photonics West. Dr. Liu is a senior SPIE member and a regular OSA member.

Dr. Quan Liu and his group's research in biomedical optics, i.e. biophotonics, focus on developing "optical biopsy" methods based on optical imaging and spectroscopy including diffuse reflectance, fluorescence and Raman techniques. These methods can non-invasively characterize the pathological status of tissues for medical diagnostics to reduce or even remove the need of performing physical biopsies. This group aims to address fundamental challenges that prevent these techniques from being clinically applicable by developing novel optical methods and/or incorporating other complementary techniques such as elastography, nanotechnology enabled plasmonics and ultrasound imaging, in a purpose to enhance the capability of optical biopsy methods in the accuracy, the signal to noise ratio, the spatial resolution and multiplexing capability. We are also interested in looking at the therapeutic effect of laser enabled therapy in cancer and the identification of rare tumor cells with optical spectroscopy. In parallel to technical development, his group also performs translational research to transfer these powerful optical techniques from benchtop to beside.

----Invited Talk----

Development of high-speed optical spectrometry techniques

Abstract—Spectroscopic analysis has been playing an important role in the characterization of biochemical molecules. The current spectrometers can be in general classified as several categories by working principle and each category has its own advantages and disadvantages. When performing spectrometry to observe fast-changing phenomena, it is necessary to accelerate data acquisition often at the cost of sacrificed spectral resolution. I will introduce our earlier development in the technique of bandpass imaging followed by spectral reconstruction for hyperspectral imaging, which is applicable to hyperspectral imaging. Then I will discuss our recent development of compressive spectrometry based on Hadamard transform. The presentation will conclude with potential applications.

11:15-11:45 | Jun Qian

Zhejiang University, China

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

----Invited Talk----

In vivo high-order nonlinear optical microscopy

Abstract—High-order nonlinear optical effects (e.g. 3-photon fluorescence (3PF) and third-harmonic generation (THG)) dramatically reduces the out-of-focus background in regions far from the focal plane, improving the signal to background ratio (SBR) by orders of magnitude when compared to 2-photon fluorescence (2PF). Thus, high-order nonlinear optical microscopy can improve spatial resolution and imaging contrast, and theoretically increase imaging depth. In our study, we have developed optical systems such as 3-photon fluorescence intensity/lifetime microscope and third-harmonic generation microscope. These setups have been employed in cerebral neuron and blood vessel imaging of small animals.

11:45-12:00 | #21

Enhance the backaction force mediated by photonic nanojet with a broadband supercontinuum source

Yuxuan Ren, Yi Zhou, Huade Mao, Leiming Zhou, Sheng Wang, Cihang Kong, Xinglin Zeng, Chengwei Qiu, Kevin Tsia and Kenneth Wong

The University of Hong Kong

Abstract—Optical radiation force originates from the photon momentum transfer to the absorptive microparticle, and has inspired important applications, including atom cooling and the Bose-Einstein condensates. However, the momentum flux points forward, and microparticle thus experiences a forward radiation force ('positive force'). In practice, the negative optical force ('negative force'), which points backwards, has also attracted extensive research efforts, including the tailoring of the beam wavefront, the polarization, and the background medium. The dielectric microparticle concentrates the light into a photonic nanojet with transverse size smaller than the wavelength. The molecules heat up and lead to temperature rise inside the photonic nanojet. We have observed the backaction force of the dielectric particles under a mode-locked laser oscillating at 1.57m. Since the polymer microsphere presents chromatic dispersion, the photonic nanojet dimension extends along the longitudinal direction when the incident laser adopts the supercontinuum source. We built an all-fiber mode-locked laser (MLL) as seed light with central

wavelength of 1.55 μm, and repetition rate of 44 MHz. The pulses were first chirped by dispersion compensating fiber (DCF) before amplification using an erbium doped fiber amplifier (EDFA, IPG photonics). The amplified laser was compressed by passing through a single mode optical fiber (SMF). The supercontinuum light was created through self-phase modulation in the high-nonlinear optical fiber (HNLF-SPINE, 50 m). Due to self-phase modulation in the fiber, the spectrum broadens from ~ 50 nm to ~ 400 nm. The collimated supercontinuum beam directly entered the cuvette containing the dielectric microparticle suspension. In contrast, we bypassed the HNLF and applied the MLL for the experiment. The detection arm is orthogonal to the supercontinuum beam, similar to the light-sheet fluorescence microscopy, but with separate visible light for illumination. In the presence of either supercontinuum or MLL laser, the particles are all attracted to the laser source. In contrast to single beam optical trap, the photonic nanojet mediated optical backaction provides parallel manipulation of all particles simultaneously. The speed increases with laser power for both the MLL and the supercontinuum cases, moreover, the magnitude of force under supercontinuum illumination is greater than that under MLL. Such force enhancement attributes to the spreading of the photonic nanojet with broadband spectrum, which suggests the possibility to augment the backaction by shaping the spectrum of the laser. Since the spectrum of our supercontinuum source only covers ~ 400 nm, the magnitude of the backaction force can be further enhanced by using a laser with broader spectrum. In conclusion, we built a supercontinuum source with spectrum spanning ~ 400 nm in high nonlinear fiber, and applied the supercontinuum beam to enhance the backaction force owing to the increased volume of photonic nanojet. Such backaction force mediated by the supercontinuum source may find various applications, e.g., large-scale particle manipulation, and particle classification.

T18 Optoelectronic Devices and Applications-F

Virtual meeting on Zoom | 10:30-12:15

Symposia Chair:

Yikai Su, Shanghai Jiao Tong University, China

Qin Chen, Jinan University, China

10:30-11:00 | Shangjian Zhang

University of Electronic Science and Technology of China, China

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

----Invited Talk----

Self-calibrated Frequency Response Measurement of Optoelectronic Devices based on Spectral Mapping

Abstract—In this talk, we demonstrate a self-calibrated extraction of microwave characteristic parameters of optoelectronic devices including modulators and photodiodes with self-reference and on-chip capability based on heterodyne spectral mapping. The method saves half bandwidth or extends twice measuring frequency range, since the frequency response of DUT at f is determined from the electrical components at about f/2 (LD and EAM cases), or with two driving signals at about f/2 (PD case). Furthermore, we extended the spectral mapping method to segmental up-conversion for ultra-wide and scalable measurement of PDs with 2M-fold measuring frequency range (M>10). In contrast to the VNA swept frequency method, ours realizes the frequency response measurement with self-reference and on-chip capability, promising for fully integrated wafer-level devices or circuits.

11:00-11:30 | Luo Yu

Nanyang Technological University

Dr. Yu Luo received his Ph.D of Physics from Imperial College London in 2012. He then remained as a research associate in the same university. Since January 2015 Luo has been an assistant professor in the School of Electrical and Electronic Engineering of Nanyang Technological University.

Yu Luo has worked on a wide range of topics within the realm of metamaterials and plasmonics ranging from the design of invisibility cloaks and plasmonic light- harvesting devices to the study of nonlocal and quantum phenomena in mesoscopic plasmonic systems. He has authored more than 60 international refereed journal papers published on Science, Nature Physics, Nature Communications, PNAS, PRL, Nano Letters, Advanced Materials etc., and is attributed with over 1,400 citations. His work has been highlighted by many scientific magazines and public media, including Nature Photonics, Nature Physics, Physics World, Phys.org, BBC News, Guardian, etc.

----Invited Talk----

Metasurface-based super-resolution imaging

Abstract—Sub-diffraction-limiting imaging using structured illumination microscopy (SIM), usually requires complex and expensive optical setup. Moreover, traditional SIM has limited resolution and is difficult to resolve object with feature sizes smaller than one quarter of the illuminating wavelength. In this talk, I will show how to use flat plasmonic metasurfaces to simplify the structured illumination microscope and to overcome its resolution limit. Our devices cannot only flatten and shrink the complex optical setup of SIM, but can also enhance its resolution and improve its imaging speed.

11:30-12:00 | Changzheng Sun

Tsinghua University, China

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

----Invited Talk----

Nonlinear Optics in AlN-based Microring Resonators

Abstract—AlN-on-sapphire is an attractive platform for integrated nonlinear optics, which boasts both intrinsic second- and third-order nonlinearities. Broadband Kerr comb generation as well as Raman lasing in high-Q AlN microring resonators will be demonstrated.

12:00-12:15 | #20

Highly sensitive nanoscale optical sensor based on plasmonic nanocavity array

Yunjie Shi, Guangyuan Li, Guoquan Liu, Liang Zhang, Degui Sun, Yuming Dong

Changchun University of Science and Technology, and Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences

Abstract—Micro-nanoscale optical sensors based on plasmonic nanocavities have attracted increasing attention in diverse applications. In this work, we propose a novel highly sensitive optical sensor based on plasmonic nanocavity array, which is promising in pressure and displacement sensing. The sensor is composed of a metal-insulator-metal (MIM) nanopillar array, which is covered by a gold film with a nanometer spacing, forming an array of nanocavities. A small displacement or pressure change can be detected by the large spectral shift due to the nanoscale change of the spacing between the MIM nanopillar and the metal film. Results show that one nanometer change of the spacing can lead to a shift of the reflectance dip of up to 42 nm with good linearity. We expect that this new nanocavity optical sensor will find potential applications in artificial intelligence, manufacturing industry, and medical diagnosis.

T19 Fiber-Based Technologies and Applications-C

Virtual meeting on Zoom | 13:00-15:00

Symposia Chair: Zhilin Xu

Huazhong University of Science and Technology

13:00-13:30 | Kenneth Kin-Yip Wong

The University of Hong Kong

Prof. Kenneth Kin-Yip Wong received combined B.E. (1st class honor with medal award) degree in electrical engineering and B. S. degree in physics from the University of Queensland, Brisbane, Australia, in 1997. He received the M.S. degree in 1998 and the Ph.D. degree in 2003, both in electrical engineering at Stanford University. His research field included DWDM systems, fiber nonlinearity, fiber optical parametric amplifiers, microwave photonics, and biophotonics. He is author or coauthor of over 400 journal and conference papers. Prof. Wong is currently a Professor in the Department of Electrical and Electronic Engineering in the University of Hong Kong, where he won the Best Teacher Award 2005-06, Outstanding Young Researcher Award 2008-09, Outstanding Teaching Award 2012-13 (Team), and Outstanding Research Student Supervisor Award 2018-19. He served as an Associate Editor of IEEE Photonics Technology Letters and is now an Associate Editor of OSA Optics Express. During the 2009-10 academic year, he joined the Empower Teacher Program, organized by department of Electrical Engineering Computer Science (EECS) at the Massachusetts Institute of Technology (MIT) by co-teaching a sophomore course and living in a graduate residence. He was the recipient of OSA New Focus Student Award and IEEE/LEOS Graduate Student Fellowship, both in 2003.

----Invited Talk----

Electro-optic-based dual-comb imaging

Abstract—In this talk, we will present some recent advances in electro-optic (EO) based dual-comb imaging, particularly in the forms of energy-efficient spectrally encoded confocal microscopy and video-rate centimeter-range optical coherence tomography at a relaxed detection bandwidth requirement.

13:30-14:00 | Simon Fleming

University of Sydney, Australia

Simon Fleming has over thirty year's research experience in photonics and optics with ~360 journal and conference publications. His research focus is specialty optical fibres, from their design and fabrication to their application. He has recently been exploring the broader application of the fibre drawing technique as a micro-fabrication approach for realisation of a wide range of structures from metamaterial hyperlenses to biomedical devices. He has worked in industry and academia, the latter in roles frequently involving end-user engagement. He headed the University of Sydney's Optical Fibre Technology Centre (OFTC) from 1997 to 2008. He has served on several company boards and been actively involved in research translation. He is currently Professor of Optics in the School of Physics at the University of Sydney, and Director of the Research and Prototype Foundry, the University's micro- and nano-fabrication user facility. He is Past President of the Australian Optical Society, a Fellow of IET, and a Chartered Engineer.

Title: "Novel Polymer Fibres for Biomedical Applications"

Authors: S.Fleming, S.Farajikhah, A.Stefani, I.Rukhlenko, M.Large

Abstract—Specialty fibre has transformed telecommunications, lasers and sensing; and there are significant opportunities for impact in biomedical applications. However, these applications tend to require special materials. We will present recent work on drawing fibres from novel polymer materials for applications on and in the body to address significant biomedical problems.

14:00-14:30 | Ya-nan Zhang

Northeastern University, China

Ya-nan Zhang was born in Anhui, China, in June 1989.

She received her B.A., M.A. and Ph.D. degrees, respectively, in 2010, 2012 and 2015 from the College of Information Science and Engineering, Northeastern University, Shenyang, China.

She is currently working as a professor in the College of Information Science and Engineering, Northeastern University, Shenyang, China. Her research interests include optical fiber sensors, gas sensors, liquid sensors,

photonic crystal waveguide sensors, slow light technology and its sensing applications. She has authored and co-authored more than 50 scientific papers and conference presentations.

----Invited Talk----

Investigation on optical microcavity biochemical sensing technology

Abstract—Biochemical sensor is the main device necessary for biochemical quantity detection, which has been widely used in biomedical, environmental monitoring, food safety and other fields. In recent years, optical microcavities with the size of optical wavelength have become a research hotspot in the field of biochemical sensing because of their advantages such as high quality factor and small mode volume, which can effectively increase the interaction time between the light field and the substance to be measured. In order to improve the selectivity, stability and anti-interference ability of biochemical sensor, we proposed and demonstrated several biochemical sensors based on the optical microcavities of photonic crystal, Fabry-Perot cavity, and whispering gallery mode resonator. This talk will discuss the sensing mechanisms, structure designs, sensing system constructions and characteristic tests of several optical microcavity biochemical sensors.

14:30-14:45 | #2888

Carbon-steel tube surface mounted FBG sensors under high-temperature environment, part 1: Polyimide coated and femtosecond laser written

Aayush Madan, Ouyang Liu, Wenyu Jiang, Yixin Wang, Perry Ping Shum and Jianzhong Hao

Nanyang Technological University Singapore

Abstract—Fiber Bragg grating (FBG) sensors must be mounted at the outer surface of a metallic test-piece or embedded into a testing surface to be able to perform continuous condition monitoring. Robust mounting and reliable operation of such sensors for parameter monitoring in high-temperature operating environment is still a key challenge. Here, in the second part of the two-part article, we focus on the mounting of gold-coated femtosecond laser written FBG sensors on a carbon-steel tube bend and performance monitoring of the packaged sensors for temperature up to 500C, for five consecutive thermal cycles. The sensors experience a remarkable sensitivity to temperature, 28 pm/C.

14:45-15:00 | #2889

Carbon-steel tube surface mounted FBG sensors under high-temperature environment, part 2: Gold coated and femtosecond laser written

Aayush Madan, Ouyang Liu, Jun Long Lim, Wenyu Jiang, Yixin Wang, Perry Ping Shum and Jianzhong Hao

Nanyang Technological University Singapore

Abstract—Fiber Bragg Grating (FBG) sensors need to be mounted at the outer surface of any metallic test piece to monitor its structural integrity through measuring physical quantities, such as strain, pressure, vibration, and temperature. High-temperature epoxies or ceramic epoxies are used to mount the said sensors to operate under high-temperature environment conditions. The unsteadiness of the outer surface of the metallic piece and non-uniformity of the applied epoxy over the sensing head, affect its operation and measurement accuracy in the long run. Here, in the first part of a twopart article, we have investigated the reliable functioning and spectrum evolution of the FBG sensors, mounted on a carbonsteel tube bend, for temperature up to 500C. Polyimide coated femtosecond laser written FBG sensors are surface mounted on the said tube using a high-temperature adhesive. There is no peak splitting, and chirp phenomenon experienced by the sensors at the end of two thermal cycles. The second part of the two-part article focuses on the mounting and operation of gold-coated FBG sensors in the high-temperature operating environment.

T20 Optical Communication and Networks-C

Virtual meeting on Zoom | 13:00-15:30

Symposia Chair: Alan Pak Tao Lau

Hong Kong Polytechnic University

13:00-13:30 | Boon S. Ooi

King Abdullah University of Science and Technology (KAUST)

Boon S. Ooi is a Professor and Chair of Electrical Engineering at KAUST. Ooi received the Ph.D. degree in electronics and electrical engineering from the University of Glasgow (Scotland, U.K). He has served as faculty at Nanyang Technological University (Singapore) and Lehigh University (Pennsylvania, USA). In the U.S., his research was primarily funded by NSF, DoD and ARO. At KAUST, major funding support for his lab is from KACST, Aramco, SABIC, Qatar National Research Fund (QNRF), the U.S. Office of Navy Research-Global (ONR) and Lockheed Martin. His research interest includes the study of III-Nitride based materials and devices, distributed fiber sensors, visible light communication (LiFi) and underwater optical communication. He has served on the technical program committee or organizing committees of CLEO, OFC, PW, IPC, ISLC and IEDM. He is the associate editor of Optics Express and IEEE Photonics Journal. Ooi is a Fellow of the U.S. National Academy of Inventors (NAI), OSA, SPIE and IoP (UK).

----Invited Talk----

Gbit/s Visible Light Communication

Abstract—Visible light communication (VLC or LiFi) has been a topic of intense research after the idea was proposed in 2011. To date, a data rate of multiple 100s Mbps has been demonstrated using LED as light source. At KAUST, we are developing the next generation of SSL lighting using visible laser diodes (LDs) and superluminescent diodes (SLDs). Laser diodes and SLDs do not suffer efficiency droop at high current densities. This allows for the design of lamps using a single, small footprint, light-emitting chip operating at high current densities. Using a single chip reduces system costs compared with LEDs because the system uses less material per chip, requires fewer chips, and employs simplified optics and a simplified heat-sink. The chip area required for LED technologies will be significantly reduced using LD/SLD-based solid-state lighting. This technology will also enable highly controllable beams in term of tunable throw distance, tunable color temperature and rendering index. Multiple Gbit/s VLC links have been demonstrated using LD/SLD as transmitters. In this paper, I will focus on the recent progress of visible diode LD/SLD-based lighting technology and high-speed transmitters and receivers for multiple-Gbps VLC and underwater wireless optical communication.

13:30-14:00 | Yong Liu

University of Electronic Science & Technology of China

Liu Yong received the Master's degree from the University of Electronic Science and Technology of China, Chengdu, China, in 1994, and the Ph.D. degree from Eindhoven University of Technology, Eindhoven, The Netherlands, in 2004. In 2003, he was awarded an IEEE/LEOS (now called IEEE Photonics) Graduate Student Fellowship. Since 2007, he worked as a professor in University of Electronic Science & Technology of China. He has (co) authored more than 200 journal and conference papers. These publications have been cited more than 1200 times (Web of Science).

----Invited Talk----

High-resolution and self-referenced frequency response measurement of high-speed optoelectronic devices

Abstract—High-spectral-efficiency optical communication systems and hyper-fine microwave photonic systems require to manipulate optical signals with high precision and multiple dimensions (amplitude and phase). The frequency response characterization with high-resolution, multi-parameter and high-accuracy is very critical to support the innovation and breakthrough in optoelectronic devices and the related system fields. The conventional optical spectrum analysis is restricted to low resolution (GHz) limited by the grating-based optical spectrum analyzer, while the high-resolution electrical spectrum analysis is only applicable to amplitude/intensity modulation. Furthermore, it also requires a standard optical-to-electrical or electrical-to-optical transducer as a reference with extra calibration. In this talk, we propose and demonstrate a high-resolution, multi-dimensional optoelectronic response measurement based on frequency-shifted optical heterodyne. The scheme achieves heterodyning spectrum mapping from optical to electrical domain, which enables self-calibrated measurement of multi-dimensional optoelectronic frequency responses, including optical intensity/phase modulators, photodetectors, etc. In addition, on-wafer/chip testing with built-in self-testing function is a trend for future photonic integration, and self-calibrated testing is considered as a prerequisite, which can provide a strong support for the future photonic integration.

14:00-14:30 | Daoxin Dai

Zhejiang University, China

Daoxin Dai received the Ph.D. degree from the Royal Institute of Technology, Stockholm, Sweden, in 2005. He joined ZJU as an Assistant Professor in 2005 and became a Full Professor in 2011. He worked at the University of California, Santa Barbara, USA, during the years of 2008-2011. Currently he is the QIUSHI Distinguished Professor at ZJU and is leading the Silicon Integrated Nanophotonics Group and the Joint International Research Laboratory of Photonics (Ministry of Education). He has published >190 refereed international journal papers in Nature, Nature Comm., Light Sci. Appl., Laser Photon. Rev., Optica, etc. Dr. Dai is one of Most Cited Chinese Researchers in 2015-2019 (Elsevier). He has given >80 keynote/invited talks and served as the TPC Chair/Member for many prestigious international conferences (e.g., OFC). He is also serving as the Topical Editor of Optics Letters, the Associate Editor of the Journals of IEEE Photonics Technology Letters, Photonics Research (2013-2019), and Optical and Quantum Electronics. He also served as the Guest Editor of special issues of IEEE JSTQE (2018) and IEEE JLT (2019).

----Invited Talk----

Wavelength-selective silicon photonic devices for optical communications

Abstract—In this talk, the recent progress of wavelength-selective silicon photonic devices for optical communications will be reviewed. Here we will focus on novel silicon photonic devices including microring resonators and multimode waveguide grating filters.

14:30-15:00 | Yan Li

Beijing University of Post and Telecommunication

Yan Li received her B.S., M.S. and Ph.D degrees in optical engineering from Tianjin University in 2002, 2004 and 2007. She is now an Associate Professor with State Key Laboratory of Information Photonics and Optical Communications, Beijing University of Post and Telecommunications. She is the author of three books, more than 150 articles, and more than 10 inventions. Prof. Li was an IEEE member and OSA member. She obtained Natural Science Prize of Ministry of Education in 2013. Her research interests include high speed optical transmission, free space optical communication, and optical communication devices.

----Invited Talk----

Parallel Implementation of Kramers-Kronig Receiver

Abstract—We investigate the parallel and real-time performance of the conventional Kramers-Kronig (KK) receivers in a 112-Gbit/s 16-ary quadrature amplitude modulation (16-QAM) system over 1440-km standard single-mode fiber (SSMF). A low complexity time-domain finite-impulse response (FIR) filter is firstly used for Hilbert transform approximation to implement the parallel KK receiver. Meanwhile, a joint overlap approach and bandwidth compensation filter (OLA-BC) architecture is presented to mitigate the edge effect caused by Hilbert transform and the bandwidth suppression induced by the FIR filter in parallel KK receiver, respectively. Parallel KK receivers based on the presented OLA-BC architecture can effectively mitigate the edge effect and the bandwidth suppression together with more than two-orders of magnitude improvement in terms of bit-error-ratio (BER) compared with OLA-BC free KK receivers in back-to-back (B2B) case. By using the OLA-BC based parallel KK receivers, we successfully transmit the 16-QAM signals over 960-km SSMF with a BER lower than 7% hard-decision forward error correction (HD-FEC) threshold (3.8x10-3) and 1440-km SSMF with a BER lower than 20% soft-decision FEC (SD-FEC) threshold (2x10-2). We also calculate and compare the computational complexity of the OLA-BC based parallel KK/WDU-KK receivers. Finally, we verify the performance of RT-KK receiver through simulation and hardware experimental platform, and make a detailed analysis and comparison with OLA-BC-PKK in terms of complexity, power consumption and other key parameters.

15:00-15:15 | #16

Microwave photonics down conversion based on optical frequency comb

Yushuang Ji, Yongfeng Wei, Hao Li, Minghua Tian, Caili Gong

Inner Mongolia University

Abstract—A flexible and efficient multi-band microwave signal down-conversion scheme based on optical frequency comb (OFC) is presented and demonstrated. In the proposed scheme, we can achieve that microwave signal at 30GHz can be down converted to 3GHz (S band), 7GHz (C band), 11GHz (X band), 15GHz (Ku band), 19GHz (K band) and 23GHz (Ka band) signals simultaneously. By changing the spacing of OFC, microwave signal at 30GHz can be down converted to 2~12GHz intermediate frequency (IF)

signals with a step frequency of 1GHz. The proposed method is proven to be flexible, low-cost and easily implemented, which can be applied in satellite communications and some other areas.

15:15-15:30 | #2

DHT-OFDM Based Spatial Modulation for Optical Wireless Communication

Chen Chen, Xin Zhong, Min Liu, and H. Y. Fu

Chongqing University

Abstract—The combination of orthogonal frequency division multiplexing (OFDM) and spatial modulation (SM) can enhance the capacity of optical wireless communication (OWC) systems with low complexity. In this paper, we propose a novel SM scheme for intensity modulation/direct detection (IM/DD) OWC systems by employing discrete Hartley transform based OFDM (DHT-OFDM). Due to the use of DHT with one-dimensional constellations, the Hermitian symmetry constraint, which is generally imposed in conventional discrete Fourier transform based OFDM (DFT-OFDM) to obtain a real-valued output signal, is not required in DHT-OFDM. As a result, DHT-OFDM based SM can achieve much higher spectral efficiency than that of DFT-OFDM based SM in OWC systems. Simulation results show that, for an indoor 4 × 4 SM-OWC system with a spectral efficiency of 6 bits/s/Hz, DHT-OFDM achieves a remarkable 4.5-dB transmit signal-to-noise ratio reduction for an overall bit error rate of 10-3 in comparison to conventional DFT-OFDM.

T21 Fiber-Based Technologies and Applications-D

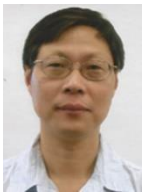
Virtual meeting on Zoom | 15:15-16:45

Symposia Chair: Ya-nan Zhang

Northeastern University, China

15:15-15:45 | Baishi Wang

Thorlabs Vytran Division, USA



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

----Invited Talk----

Advanced monolithic fiber-based probes for medical imaging applications

Abstract—In comparison to traditional methods, x-ray angiography, ultrasound, and magnetic resonance imaging, optical imaging methods, e.g. optical coherence tomography (OCT), have been increasingly used for in vivo morphological biomedical imaging of retina, vasculature and gastrointestinal tract. Key advantages of optical methods are high spatial resolution at the micro level, fast measurement throughput, and noninvasiveness. Fiber-based probes, which offer compact, flexible, and cost-effective solution for flexible and reliable beam control, play an important role in these optical imaging systems. In this paper, we will present some advanced fiber-based probes, and discuss underlying optics based on fiber waveguide theory describing beam propagation through these probes. Furthermore, we will describe various fiber glass processing techniques for producing these probes and manipulating beam inside different interconnected and processed specialty fibers, such as single-mode fibers, multi-mode or graded index fibers. As a result, various all-fiber imaging components, similar to lens systems in free optics, can be fabricated for both R&D and mass production use. Finally, we will show some examples of monolithic all-fiber probes used in biomedical OCT imaging applications.

15:45-16:15 | Xinyu Fan

Shanghai Jiao Tong University, China

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

----Invited Talk----

Spectroscopy with high spectral resolution using a wideband ultra-linearly swept optical source

Abstract—We propose a phase-dispersion spectroscopy with high spectral resolution by developing a wideband ultra-linearly swept optical source (ULSOS). Highly-precise optical frequency sweeping is achieved by externally modulating a narrow-linewidth fiber laser with a linearly-swept radio-frequency signal. By using injection-locking technique and high-order four-wave-mixing process, the sweeping span is enlarged to be 98 GHz, while the sweeping nonlinear error is as low as 136 kHz. Benefiting from the high-performance of the ULSOS, a spectrometer with an ultrahigh spectral resolution (136 kHz, determined by the sweeping nonlinear error of the ULSOS) is developed. Besides, an unbalanced Mach-Zehnder interferometer is used in the system with sample under test (SUT) incorporated inside it, and a phase extraction algorithm is employed to characterize the phase-dispersion features of the SUT. Moreover, a sweeping nonlinearity compensation technique is utilized to remove the noise in the measured transmission phase caused by the sweeping nonlinear error of the ULSOS. As a proof of the concept, the transmission intensity and phase spectra of HCN gas and fiber resonators with MHz-level bandwidth are characterized. The proposed technique opens new possibility for spectroscopy with sub-MHz spectral resolution and the capability of dispersion measurement, without the usage of costly mode-locked laser.

16:15-16:30 | #25

Investigation of volatile organic compound gas sensor based on polydimethylsiloxane self-assembled Fabry-Perot interferometer

Bufan Shi, Naisi Zhu, Ya-nan Zhang

Northeastern University

Abstract—A Fabry-Perot (F-P) interferometric fiber-optic sensor based on polydimethylsiloxane (PDMS) coated single-mode fiber (SMF) end is proposed, and the gas sensing characteristics of the sensor to volatile organic compound (VOC) gas are studied in detail. Due to the swelling effect of the PDMS, the cavity length and refractive index of the F-P cavity change with the concentration of VOC gas, which will then induce the wavelength shift of the F-P interferometer. It is proved that the wavelength shift is inversely proportional to the polarity of VOC gas. For weak-polar toluene gas with concentration changes from 0 to 560 ppm, the interference wavelength shifts 2.841 nm. Besides, the proposed sensor behaves fast response property, good time stability, and excellent repeatability.

16:30-16:45 | #2891

Crack opening estimate of reinforced concrete using optical fiber sensor

Lili Wang, Jinguang Hao, Yaozhang Sai

Ludong University, China

Abstract—The crack width of concrete structure was investigated and discussed in this paper. The paper used a post-processing method to calculate the crack width with a 3D FEM of loaded concrete slab. The FBG stresses of three directions were extracted from the 3D FEM, and then were used to calculate the spectrum distortion of FBG sensor. Experiments were carried out with a FBG sensor installed inside a concrete slab, and the experimental results of crack width of concrete slab were given also. The results demonstrated that the spectrum deformation could be applied as an effective indicator to evaluate the crack width of reinforced concrete.

T22 Infrared Technologies and Applications-E

Virtual meeting on Zoom | 15:45-18:30

Symposia Chair: Haizhi Song

Southwest Institute of Technical Physics, China

15:45-16:15 | E Wu

East China Normal University, China

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

----Invited Talk----

Infrared single-photon frequency upconversion and its applications

Abstract—As a novel technique for the infrared, single-photon frequency upconversion detection has attracted a lot of research interest, which uses visible photon-detectors to counting the sum-frequency replicas of the infrared single photons, avoiding the drawbacks of the. According to the theory of quantum frequency conversion, the unity single-photon upconversion could be realized by means of sum-frequency generation (SFG) under a strong pump in a quadratic nonlinear medium with a large effective nonlinear coefficient. In this talk, I will demonstrate several different kinds of single-photon frequency upconversion detectors and their applications in imaging and spectroscopy.

16:15-16:45 | Chuantao Zheng

Jilin University

Chuantao Zheng is a Professor in State Key Laboratory of Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, China. His research interests include infrared 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 doctoral 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 17 projects of National Natural Science Foundation of China, national key R & D program and national science and technology program. As a first or corresponding author, he has published 168 papers (118 indexed by SCI and 50 by EI). He has applied for 11 national invention patents (7 authorized), published one academic monograph, and won the Jilin Natural Science Academic Achievement Award in 2014.

----Invited Talk----

Mid-infrared Chalcogenide Suspended Slot Waveguide for Gas Sensing

Abstract—A chalcogenide (ChG) vertical slot waveguide and a ChG horizontal slot waveguide racetrack resonator were proposed for gas sensing. The vertical slot waveguide and the upper strip waveguide of the horizontal slot waveguide are suspended to enhance light-gas interaction. The waveguide sensors were optimized and the sensing performances were studied numerically.

16:45-17:15 | Yiding Wang

Jilin University

Yiding Wang received his MS degree in Physics in 1991 from Jilin University. Now he is a professor in State Key Laboratory of Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, China. From 2004 to 2005, as a national public visiting scholar, he conducted cooperative research at the Southern University Institute of Electronics, the Second University and Acsademy of Sciences in Montpellier II (Montpellier), France. In 2012, as a senior research scholar of the national government, he conducted cooperative research in the Department of Electronic Engineering of the University of Maryland. He is an evaluation expert of the Information Science Department of the National Natural Science Foundation of China, an expert in the field of high-tech (863) projects in the Ministry of Science and Technology, an expert in the International Science and Technology Cooperation Program of the Ministry of Science and Technology, and an evaluation member of the Chinese Medical Science and Technology Award. He is the member of the International Society of Optical Engineering (SPIE), senior member of the Chinese Institute of Electronics, and member of the Chinese Physical Society. He is active in the fields of gas sensors using infrared techniques and the fabrication of mid-infrared LEDs

and LDs. He has published more than 200 articles, including ACS Sensors, Sensors and Actuators B: Chemical, Analytical Chemistry, Optics Letters, Optics Express, etc. He has obtained 2 patents and published 2 monographs. He has presided over and participated in 40 national, provincial and ministerial topics. In the past 5 years, he has presided over a total of 17 topics (including 7 national-level projects, such as 3 863 plan projects and 2 support plan projects).

----Invited Talk----

Mid-Infrared Absorption Spectroscopy for Gas Sensing and Application

Abstract—Gas sensors play an important role in many applications ranging from chemical processing analysis, medical diagnostics to atmospheric pollution monitoring. The application of sensitive mid-infrared (MIR) absorption spectroscopy technique was reported for multiple gas detection, including methane (CH4), carbon monoxide (CO) and carbon dioxide (CO2). With respect to CH4 detection, a direct laser absorption spectroscopy (SA-DLAS) architecture was proposed exploiting an interband cascade laser (ICL). With respect to CO detection, a MIR CO system was developed based on a broadband light source and a dual-channel sensing scheme. With respect to CO2 detection, a MIR monitoring sensor system was implemented by using a single-source dual-channel approach with a compact gas cell. The three demonstrated gas sensor systems were deployed for monitoring atmospheric CH4 and green house CO2 concentration levels.

17:15-17:45 | Baile Chen

ShanghaiTech University, China

Dr. Baile Chen received his bachelor degree in physics from Department of Modern Physics in University of Science and Technology of China in Hefei, China, in 2007. He received his master degree in physics and Ph.D degree in electrical engineering both from University of Virginia, Charlottesville, VA, USA in 2009 and 2013, respectively. In February of 2013, he joined in Qorvo Inc in Oregon as RF product development engineer working on various RF power amplifiers and BAW filters for RF wireless communication systems. In January, 2016, He joined in the School of Information Science and Technology in Shanghai Tech University as a tenure track assistant professor. Currently, Dr. Baile Chen has published more than 20 journal papers as the first-author or corresponding author.

His research interests include III-V semiconductor materials and devices, SWIR/MWIR photodiodes and laser diodes, high speed/high power photodiodes, UV photodiodes and silicon photonics.

----Invited Talk----

High speed SWIR/MWIR type-II superlattice photodetectors

Abstract—Short-wave infrared (SWIR) and Mid-wave infrared (MWIR) frequency comb are expected to dramatically improve the precision and sensitivity of molecular spectroscopy. For high resolution application, high speed photodetector is one of the key components, however, high speed photodetector operating beyond 1.7μm is still not as mature as that in 1.55μm wavelength band.

In this work, I will report high speed photodetectors with type-II superlattice as absorber for SWIR and MWIR detection. For SWIR detection, a normal incident high speed photodiode with InGaAs/GaAsSb type-II multiple quantum wells absorber on InP was demonstrated with a 3dB bandwidth of 25 GHz at room temperature, which is, in our knowledge, the fastest photodiode at 2-micron wavelength. The device has dark current of around 3nA at -3V, and optical response of 0.07A/W at 2μm. Eye diagram up to 30Gbit/s was demonstrated.

For MWIR detection, I will present GaSb based uni-traveling carrier photodiode with InAs/GaSb type-II superlattice absorber. The device exhibits a 3dB bandwidth of around 6.5GHz, cutoff wavelength of 5.6μm at 300K. These promising results show the device has potential to be utilized in high speed applications such as frequency comb spectroscopy*, free space communication and others.*

17:45-18:00 | #2878

A Reconfigurable All-dielectric Metasurface Based on Vanadium Dioxide for Independently Control of the Mie Resonances

Tongtong Kang, Jun Qin, Shuang Xia, Wei Yan, Chaoyang Li, Jianliang Xie, Longjiang Deng and Lei Bi

UESTC

Abstract—All-dielectric metasurfaces have attracted great research interest due to their low loss and versatility to control light. In this paper, we report an active all dielectric metasurface based on Si/VO2 hybrid meta-atoms operating in the long wave infrared (LWIR) wavelength range. We show that by judiciously designing the location of VO2 layer in the meta-atom, the magnetic dipole

resonance can be independently and reconfigurably turned on/off upon phase transition of the VO2 material, leaving the electric dipole resonance intact. Our work paves the way for independently control of different Mie resonances in all dielectric metasurfaces for infrared camouflage, radiation control and photodetection applications.

18:00-18:15 | #12

Characterization of VCSEL devices for 3D sensing applications according to international laser safety norm IEC60825-1

Katharina Predehl, Armin Heinrichsdobler

Instrument Systems GmbH

Abstract—Even though vertical-cavity surface-emitting lasers (or VCSELs) have been employed in various industrial applications for more than three decades, they have gained great popularity and have experienced drastic growth only recently in 3D sensing applications since the release of Apple's iPhone X and its Face ID functionality. Due to their unique features such as very high conversion efficiency, a narrow spectrum, high beam quality, and low production costs, VCSEL devices are perfectly suited for 3D sensing applications using e.g. structured light or time-of-flight technology to scan objects in 3D. According to a recent market study by YOLE, the VCSEL market will drastically grow at a compound annual growth rate of over 30% within the next years and reach a market volume of $3.7bn in 2024. One the one hand, VCSEL technology is predicted to have its breakthrough in consumer electronics and will become a standard part of mobile phones and AR/VR systems. On the other hand, VCSELs as part of LIDAR systems could become indispensable components for autonomous driving.

However, like all types of lasers, VCSELs present potential harm to the human eye and skin and may cause severe health damages such as retina destruction, skin burn, or even cancer. Therefore, the consumer electronics and LiDAR manufacturers are obliged to carry out laser safety assessment for their products following the international laser safety norm IEC60825-1 or equivalent national safety regulations. For safe use in public laser class 1 in the infrared region of the optical spectrum must not be exceeded.

VCSELs have special properties in contrast to other typical laser sources: VCSEL arrays are highly divergent, and can be considered as an "extended" light source (rather than the usual point sources). Another striking difference is the VCSELs multimodal beam profile causing a doughnut-shaped emission. As a result, the classification of a VCSEL array is more complex and a couple of additional aspects have to be considered that would not apply for "normal" lasers. Consequently, the validation of a VCSEL's laser class is not trivial, and even more so as no easily understandable guideline for the assessment of VCSEL safety has been published yet.

With our investigations, we want to fill this gap. In this contribution, we present the results of our laser safety considerations based on the international laser safety norm specially applied to typical pulsed VCSEL arrays as they are often employed in consumer electronics and automotive LiDAR applications.

By following the calculation and measurement guidelines of the international laser safety norm IEC60825-1 we deduct the laser class of three different samples from II-IV. We identify critical parameters such as, for instance, the beam divergence, pulse length, or the duty cycle. Variation of these parameters clearly show their strong influence on safe laser operation. We also demonstrate the importance of accurate measurements and an absolute error budget in order to exploit full power efficiency of the VCSEL while preserving safe operation. Finally, yet importantly, we discuss the manipulation of the beam profile by placing diffractive optical elements or micro lens arrays in front of the emitter. This helps to mitigate its effect on human tissue and helps to improve the VCSEL safety while keeping the output power constant.

18:15-18:30 | #2854

Multi-pixel Photon Counter Calibration and Its Application in NV Center Magnetometry

Yu Chen, Yujie Cai, Youying Rong, Xiuliang Chen, E Wu

East China Normal University

Abstract—The commercial single-photon detectors (SPD) such as silicon avalanche photodiode (Si-APD) and InGaAs/InP APD is a type of on-off detector, which can only output no-photon and one-photon events respectively. However, for the high photon flux applications, we cannot get enough photon number information because of detector response nonlinearity. Recently, due to the photon number resolving capability, various photon-number-resolving detectors (PNRDs) including superconducting transition edge sensors (TESs), time-multiplexed detectors (TMDs) and spatial-multiplexed detectors are widely developed and applied in many areas such as quantum key distribution (QKD), laser radar, super-resolution and so on. One type of spatial-multiplexed detector called multi-pixel photon counter (MPPC) has attracted much attention because of its superior performance. With many

advantages such as wide spectral response range, excellent photon-number-resolving capability, insensitivity to magnetic fields and large dynamic range, MPPC has an extensive application prospect. Especially in the nitrogen-vacancy (NV) center ensemble magnetometry, high photon flux will cause nonlinearity of SPD and further reduce the fluorescent contrast of optically detected magnetic resonance (ODMR) spectrum. MPPC has the potential to improve the signal to noise ratio (SNR) of ODMR as a consequence of its remarkable photon-number-resolving capability. Therefore, a reliable calibration method to characterize the detector's performance is essential to its application. Conventional calibration methods need to consider various parameters such as efficiency and dark counts and crosstalk. A prior physical model is usually required to be constructed. As the complexity of detectors increases, such as MPPC, more and more parameters need to be included in the conventional calibration. A new versatile calibration method called quantum detector tomography (QDT) is proposed. In QDT, tomographic reconstruction of positive operator-valued measure (POVM) enables us to describe MPPC more completely and precisely. The detector could be treated as a “black box” and the prior physical model is no longer required. Here, MPPC and Si-APD were calibrated in continuous wave (CW) mode at 650 nm and POVM of two detectors were reconstructed by QDT. Experimentally probability distributions of detectors based on the coherent states are used to obtain POVM elements. According to POVM of detectors, the reconstructed probability distribution and reconstructedly detected photon numbers as function of incident photon numbers of detector could be attained. The high fidelity between the reconstructed probability distribution and the measurement outcome of the detector proves that POVM could describe the detector reliably. Through theoretical derivation, fluorescent contrast of ODMR spectrum with NV center ensemble as a function of NV’s number could be obtained. An intuitive conclusion and constructive decision can be made on the detector's performance, MPPC is a necessary replacement of Si-APD which could get saturated in NV center ensemble magnetometry. According to its photon number resolving capability, MPPC is still in photon counting mode when Si-APD is near saturation. Consequently, when the number of NV centers is relatively high, the contrast of ODMR measured by MPPC can be effectively enhanced. It is obvious that this method is valuable for quantum sensing with NV center ensemble. MPPC is expected to become relevant in quantum optics applications.

<Workshop> Emerging Techniques for Detection/Control of Infectious Diseases

Room LM104-C (1F) | 一楼会议室 LM104-C

The recent global outbreak of coronavirus has prompted many countries to review their strategies for disease control. This special workshop is organised to provide a forum for sharing of latest information by experts from healthcare and instrumentation disciplines. Stakeholders who have interest in exploring opportunities in this domain are encouraged to attend.

General Chair:
Prof. Aaron Ho, Chinese University of Hong Kong, Hong Kong, China
Co-Chairs:
Prof. Zhugen Yang, Cranfield University, UK
Assoc. Prof. Guanghui Wang, Nanjing University, China
Dr. Jinna Chen, South University of Science and Technology of China, China

Speech Title: Paper-origami device enabling rapid diagnosis and sewage testing for early warning of pandemic: COVID-19
By Prof. Zhugen Yang, Cranfield University, UK
Speech Title: Rapid antimicrobial susceptibility testing from positive blood cultures based on Stimulated Raman Scattering Imaging analysis
By Prof. Xixiong Kang, Beijing Tiantan Hospital,Capital Medical University, China
Speech Title: Tailoring Microscale Thermodynamic Force for Particle/cell Manipulation and Nucleic Acid Amplification
By Prof. Jiajie Chen, Shenzhen University, China

<Workshop> Progress in Laser Cleaning Technique and Applications

Room LM104-B (1F) | 一楼会议室 LM104-B

Laser cleaning has been a mature solution to replace traditional chemical and mechanical cleaning methods in many industrial fields in recent years. Serving a fast-growing market, the design, control and process have been developed quickly. This workshop focuses on the progress of laser cleaning technique and its applications. We encourage all the CIOE participants who are interested in this fields to attend the workshop for state-of-art techniques and pioneering application information.

General Chair:
Dr. Kevin Liu, Shenzhen JPT Opto-electronics Co., Ltd.
Co-chair:
Dr. Lulu Wang, Shenzhen JPT Opto-electronics Co., Ltd.

Opening Remarks
By Jianmin Chen, Deputy Chief Executive of the Longhua District Government
Speech Title: History, mechanisms, and state-of-art techniques of laser cleaning
By Dr. Daishu Qian, Shenzhen JPT Opto-electronics Co., Ltd.
Speech Title: Laser Cleaning and Surface Modification of CFRP
By Prof. Yanqun Tong, Jiangsu University, China
Speech Title: Applications of Laser Cleaning Technology
By Dr. Jiao Jiao, The University of Manchester, UK
Speech Title: Nanosecond laser-based surface treatment techniques of materials: cleaning, texturing and polishing
By Prof. Chunming Wang, Huazhong University of Science and Technology, China
Speech Title: Progress on surface treatment technologies by laser
By Prof. Xiaodong Yuan, China Academy of Engineering Physics, China

SPECIAL EVENT / Sept. 10, 2020

Photonics Global Student Conference (PGSC)

Video-view link: https://pgsc2020.weebly.com/presentations.html

Keynote Speaker

Carmen Menoni

Colorado State University

President, IEEE Photonics Society, USA

Fellow of IEEE, OSA and SPIE

Carmen Menoni shines bright in the world of lasers and photonics – a field that pushes the frontiers of light to enable technologies of the future, from lasers for advanced medical devices to fiber optics for global communications.

The University Distinguished Professor of Electrical and Computer Engineering at Colorado State University has been selected to serve as president of the Institute of Electrical and Electronics Engineers (IEEE) Photonics Society in 2020.

"This well-deserved honor underscores Carmen's impact as a leader, role model and mentor in engineering and science," said ECE Department Head Tony Maciejewski. "She has helped shape the field of lasers and photonics. We are proud she is representing our department in this prominent role."

TALK ON

Optical and structural properties of thin film amorphous oxides for photonic structures

Abstract: Thin film metal oxides, as Ta2O5, HfO2 and SiO2, are excellent candidates for photonics applications as they are transparent in the ~0.3 to 5 μm wavelength range. The Ta2O5/SiO2 or HfO2/SiO2 combinations offer in addition a large refractive index contrast that has been exploited for the engineering of photonics structures, such as grating couplers, and low loss waveguides. Our application is in the engineering of multilayer interference coatings that are ubiquitous in laser components, in adaptive optics and the optics of high finesse interferometric cavities. For these applications superior control of the absorption and scattering losses at near infrared wavelengths is critical.

In this talk I will describe the fundamental properties of amorphous thin films of Ta2O5, HfO2 and SiO2 deposited by ion beam sputtering (IBS). The IBS metal oxide nanoceramic thin films are highly disordered. X-ray diffraction spectra show broad peaks that are characteristics of an amorphous-like structure. The films are stoichiometric. Their refractive index is almost that of their bulk counterparts. Optimization of the deposition process enables one to realize tens of part per million (~-100 dB) absorption loss at near infrared wavelengths. Using these optimized materials we engineer dielectric multilayer structures for two specific applications: low mechanical loss coatings for in high finesse optical cavities and in gravitational wave interferometers and ultrahigh intensity near infrared solid state lasers.

SPECIAL EVENT / Sept. 10, 2020

Photonics Global Student Conference (PGSC)

Video-view link: https://pgsc2020.weebly.com/presentations.html

Keynote Speaker

Sune Svanberg

Lund University, Sweden

Fellow APS, OSA and SPIE

Sune Svanberg was born in 1943 in Trollhättan, Sweden, Swedish Citizen. He received his PhD in the field of atomic resonance spectroscopy in 1972 at Gothenburg University, Sweden. After a post-doc year at Columbia University, New York and initial work on atomic laser spectroscopy, he continued laser-based spectroscopy at Chalmers in Gothenburg up till 1980, when he became professor and head of the Atomic Physics Division at Lund Institute of Technology (technical faculty at Lund University) up till 2008. In 1995 he was appointed as director of the newly established Lund Laser Center. He remained its director until 2010, and continued as Senior Professor at the center. Since 2011 he has been a Distinguished Professor at the South China Normal University, Guangzhou, China. He is a member of 6 scientific academies: Royal Swedish Academy of Sciences (and during 10 years a member of its Nobel Committee for Physics; two years as chairman), Royal Swedish Academy of Engineering Sciences, Royal Society of Sciences, Académie Royal de Belgique, Lithuanian Academy of Science, and the Third World Academy of Sciences. He is Fellow of the American Physical Society (APS), Optical Society (OSA), European Optical Society, SPIE and the Electromagnetic Academy. He became honorary doctor/professor at 8 universities, including Jilin University, Harbin Institute of Technology and Zhejiang University. He was the recipient of the first European Physical Society Quantum Electronics Prize (1996) and recipient of the first Azko Nobel Science Award (1999). In 2004 he was awarded the SKAPA Innovation Prize, in 2005 the W.E. Lamb Medal, in 2006 the Celsius Gold Medal (Uppsala), in 2009 the Memorial Gold Medal (Lund) and the V.K. Zworykin Award of the International Federation of Medical and Biological Engineering, in 2010 the Adelskold Medal of the Royal Academy of Sciences and the Large Gold Medal from the Royal Academy of Engineering Sciences, Stockholm, and in 2012 the Gold Medal of His Majesty the King of Sweden. He is an "Einstein Professor" of the Chinese Academy of Sciences since 2006.

He serves on numerous international conference-, evaluation- and advisory committees. He has supervised a large number of graduate students to their PhD in Physics. Being the co-author of more than 650 scientific papers and around 40 patents and patent applications, he had scientific collaboration with major international companies and helped in the formation of several spin-off companies. He worked extensively with physicists in developing countries, and helped arrange hands-on workshops where realistic equipment related to medicine, environment and agriculture was introduced.

TALK ON

Interdisciplinary laser spectroscopy – Applications to environment, ecology, agriculture, food safety and medicine

Abstract: Spectroscopy using laser sources has had major impact in the energy, environmental as well as the medical sectors. The author will give a broad account of his experience in applied laser spectroscopy during an extended time. The focus will be on recent developments with a clear focus on practical implementation. Examples from applications related to the environment, ecology, agriculture, food safety and medicine will be given. The talk emphasizes the value of cross-disciplinary work to help solving important societal issues.

Photonics Global Student Conference (PGSC)

Video-view link: https://pgsc2020.weebly.com/presentations.html

Student Speakers

Title: Optical fiber SPR sensor for highly-sensitive detection of cholesterol concentration
Speaker: Wanlu Zheng
Authors: Wanlu Zheng, Bufan Shi, Xuegang Li, Ya-nan Zhang
Affiliation: College of Information Science and Engineering Northeastern University Shenyang, China
Abstract: A reflective surface plasmon resonance (SPR) cholesterol sensor based on cholesterol oxidase was proposed. Due to the enzymatic reaction between cholesterol and cholesterol oxidase, the refractive index of the solution near the sensor area change, which will then induce the wavelength shift of the SPR spectrum. Experimental results showed that in the concentration range of 0-500nM, the SPR spectrum wavelength shifts 27.691nm. In the concentration range of 0-30nM and 50-500nM, the measurement sensitivities of the SPR sensor could reach 0.39nm/nM and 12.34nm/lg[M] respectively. In addition, the sensor behaves small in size and good stability, which has great potential application in biomedicine and human health monitoring.

Title: Coding Schemes for Transmitter Diversity in Indoor Optical Wireless Communications
Speaker: Tingting Song
Authors: Tingting Song, Ampalavanapillai Nirmalathas, Christina Lim, Elaine Wong and Ke Wang
Affiliation: Department of Electrical and Electronic Engineering The University of Melbourne, Parkville, VIC 3010, Australia
Abstract: Line-of-sight optical wireless communications (LoS-OWC), with unique advantages of high scalable bandwidth, immunity to RF interference, and easy implementation via the fiber-to-the-premise/home broadband networks, has become a promising solution to support the dramatic increase of remote working/education activities in current indoor wireless networks. We present our proposed coding schemes for transmitter diversity that provide up to multi-gigabit data rates wireless transmission by leveraging an infrared laser-based 2×1 multiple-inputs-single-output (MISO) channel configuration. These coding schemes offer novel practical solutions to achieve transmitter diversity in a gigabit/s indoor LoS-OWC system, and provide a guideline for the future massive deployment of reliable LoS-OWC links.

Title: Detaching Gold Nanoparticles from Optical Fiber Surface – A Dynamic LSPR Sensing Mechanism Demonstrated with Glutathione Detection
Speaker: Miao Qi
Authors: Lei Wei, Miao Qi, and Nancy Meng Ying Zhang
Affiliation: School of Electrical and Electronic Engineering Nanyang Technological University, Singapore
Abstract: We propose and demonstrate a new LSPR sensing mechanism, for the first time to the best of our knowledge, where AuNPs are directly “cut” and detached from fiber surface by analyte molecules, introducing the change of plasmonic behavior. We further validate the proposed mechanism through the detection of glutathione (GSH). We synthesize a novel molecule in which a triethoxysilyl (TES) and an adamantane group linked by a disulfide bond (triethoxysilyl-disulfide-adamantane, TES-S-S-Ada). The TES side is further used for microfiber functionalization, and the adamantane part can form complex with β-Cyclodextrin (β-CD). As a result, the proposed biosensor with AuNPs-detaching sensing mechanism can achieve a low limit of detection (LOD) of 0.1 M for GSH, which is far less than the typical 1-2 mM GSH concentration in most cells.

Title: Epsilon near Zero Mode in Optical Fiber
Speaker: Jingyi Yang
Authors: Jingyi Yang[1,2], Khant Minn[2], and Ho Wai Howard Lee[1,2]
Affiliation: [1] Department of Physics & Astronomy, University of California, Irvine, CA 92697, United States
[2] Department of Physics, Baylor University, Waco, TX 76798, United States
Abstract: We demonstrated the excitation of epsilon near zero (ENZ) mode in side-polished optical fiber coated with ultrathin layer of aluminum-doped zinc oxide (AZO). The 30-nm-thick AZO layer on the fiber, fabricated by atomic layer deposition, has vanishing real part of permittivity (ENZ properties) at a near-infrared wavelength of ~1550 nm. Transmission measurement shows a resonant dip at an operation wavelength of 1600 nm with a loss of 6 dB in an ~1cm long AZO-coated side-polished optical fiber, which matches with full-wave simulation and phase matching condition. Our results show the first experimental demonstration on the highly confined ENZ mode in optical fiber platform, which can find applications in active optical fiber devices.

Title: Demonstration of a Photonic Digital-to-Analog Converter based PAM-4 Transmitter
Speaker: Shivangi Chugh
Authors: Shivangi Chugh and Shalabh Gupta
Affiliation: Department of Electrical Engineering, IIT Bombay, Mumbai–400076, India
Abstract: This work proposes use of high-speed photonic digital-to-analog converters for multi-level signal transmitters. A 12.4 Gbaud PAM-4 transmitter has been demonstrated using a 2-bit photonic DAC implemented on a 220nm silicon photonics platform.

Title: Study on the dynamics of clathrin-coated pits by super-resolution single-molecule localization microscopy
Speaker: Rui Ma
Authors: Rui Ma, Gerd Ulrich Nienhaus
Affiliation: Karlsruhe Institute of technology-institute of applied physics, China scholarship council
Abstract: By the dynamic nature of clathrin-mediated endocytosis, the SMLM data for the CCPs contains clusters with both varied densities and inhomogeneous noises, which makes it a challenge for further data analysis. In this study, we introduced a clustering algorithm, by which the dynamics of the pits, especially the lifetime of the abortive candidates, were investigated.

Title: Improved SERS-based photonic crystal fiber: a step further towards next generation liquid biopsy needle
Speaker: Flavien Beffara
Authors: Flavien Beffara, Jayakumar Perumal, Aniza Puteri Mahyuddin, Mahesh Choolani, Saif A. Khan, Jean Louis Auguste, Sylvain Vedraine, Georges Humbert, Dinish U. S, Malini Olivo
Affiliation: 1 Lab of Bio-Optical Imaging, Singapore Bioimaging Consortium, Agency for Science Technology and Research (A*STAR), 11 Biopolis Way, 138667, Singapore
2 XLIM Research Institute, UMR 7252 CNRS / University of Limoges, 123 avenue Albert Thomas, 87000 Limoges, France
3 Department of Obstetrics and Gynecology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore
4 Department of Chemical and Bimolecular Engineering, National University of Singapore, Singapore
Abstract: We present a suspended core PCF (SC-PCF) that exhibits record-breaking reproducibility of approximately 1.5% and repeatability of 4.6%. We studied the configuration that gives the strongest signal between i) pre-mixing the nanoparticles (NPs) and the analyte prior to the injection inside the fiber and ii) injecting the analyte after having anchored the NPs on the inner walls of the PCF. We also studied numerically and experimentally the effect of the core size on the sensitivity and reliability of the sensor in order to select the best compromise available We envision that this study could help in developing the next generation of liquid biopsy needle probe.

Title: Fabrication and characterization of solution processed CZCTSSe thin films for solar cell application
Speaker: Aliaksandr Khinevich
Authors: Aliaksandr Khinevich[1], Yeqing Shao[2], Andrei Stsiapanau[1], Xinghui Wang[2], Aliaksandr Smirnov[1], and Siarhei Zhuk[1]
Affiliation: [1]Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus
[2]College of Physics and Information Engineering, Institute of Micro-Nano Devices and Solar Cells Fuzhou University, Fuzhou, China
Abstract: In this work, synthesis of Cu2(Zn,Cd)Sn(S,Se)4 (CZCTSSe) thin films using spin-coating of precursor solution followed by rapid thermal selenization at 480°C is presented. Structural properties of the prepared thin films are characterized with X-ray diffraction spectroscopy and Raman spectroscopy. Moreover, morphology and composition of the CZCTSSe thin films are studied using scanning electron microscopy and energy dispersive spectroscopy. Photovoltaic properties of the ITO/CdS/CZCTSSe/Mo/SLG solar cells are characterized with light current density-voltage characteristics measured at AM 1.5G solar spectrum and illumination intensity of 100 mW/cm2. The best solar cell device exhibits open-circuit voltage of 348 mV, short-circuit current density of 32.07 mA/cm2, fill factor of 52.72% resulting in power conversion efficiency of 5.88%. The obtained results show the potential for the application of CZCTSSe solar cell as a bottom cell for hybrid kesterite-perovskite tandem photovoltaic devices.

Title: Adoption of Photonics Research in Africa
Speaker: Kithinji Muriungi
Authors: Kithinji Muriungi
Affiliation: Diversity & Inclusion Committee, IEEE Photonics Society Nairobi, Kenya
Abstract: While demand of photonics technology keeps on increasing globally, there is still low photonics research being done in Africa. In this paper, we explore widely through different sources, analyze deeply, and evaluate the current and future factors associated with adoption of photonics research in Africa.

Title: Characterization and Modelling of an IM – DD Radio-over-Fiber Link using Design of Experiments
Speaker: Bernalyn Decena
Authors: Bernalyn Decena, Paul Jason Co, Marc Rosales, Jhoanna Rhodette Pedrasa
Affiliation: University of the Philippines Diliman - Electrical and Electronics Engineering Institute
Abstract: A low cost intensity modulation - direct detection radio-over-fiber link is statistically characterized and modeled using design of experiments. Equations to describe the performance in gain and bandwidth are created using response surface methodology and tested.

Title: Underwater wireless optical communications: progress and future prospects
Speaker: Mohammed Sait
Authors: Mohammed Sait, Tien Khee Ng and Boon S. Ooi
Affiliation: Photonics Laboratory, King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Saudi Arabia
Abstract: To build robust UWOC links that mitigate the effect of turbulence, several novel solutions can be adopted. For example, the implantation of non-line-of-sight (NLOS) UWOC configuration can relax the requirement of strict positioning, acquisition and tracking (PAT), while providing high-speed communication. Seeking for high data rate, low power consumption and longer distance communication led to a plethora of research efforts on efficient modulation schemes. DMT modulation with probabilistic constellation shaping is a promising candidate to maximize the use of the channel capacity and approach Shannon capacity limit. Recent work demonstrated 7.4 Gbps transmission by using wavelength-selective and large bandwidth (1 GHz) semi-polar InGaN/GaN μPD, which can greatly enhance the bandwidth for underwater communication links.

TRAFFIC INFO

公共交通 | PULIC TRANSPORTATION

地铁接驳线
Shuttle Service between Metro Station and Shenzhen World

从11号线塘尾地铁站到深圳国际会展中心(直达)
服务时间：08:30-17:30
停靠站点：塘尾地铁场站、深圳国际会展中心①、国际会展中心场站

From Tangwei Station on Metro Line 11 to Shenzhen World(Nonstop)
Service time: 08:30-17:30
Stops: Tangwei Metro Station Bus Terminal, Shenzhen World Station①, Shenzhen World Bus Terminal

从国际会展中心场站到11号线塘尾地铁站(直达)
服务时间：09:30-19:00
停靠站点：国际会展中心场站、会展南站①、塘尾地铁站、塘尾地铁场站

From Shenzhen World to Tangwei Station on Metro Line 11(Nonstop)
Service time: 09:30-19:00
Stops: Shenzhen World Bus Terminal, Shenzhen World South Station①, Tangwei Metro Station, Tangwei Metro Station Bus Terminal

公交巴士B892
By Bus: Route No.B892

从桥头综合场站到国际会展中心
服务时间：06:30-21:00
停靠站点：会展中心北站作为线路终点站(下客点)

From Qiaotou Bus Terminal to Shenzhen World
Service time: 06:30-21:00
Stop: Shenzhen World North Bus Terminal (Arrival)

从深圳国际会展中心到桥头综合场站
服务时间：07:30-21:30
停靠站点：会展中心南站作为线路始发站(上客点)

From Shenzhen World to Qiaotou Bus Terminal
Service time: 07:30-21:30
Stop: Shenzhen World South Bus Terminal (Departure)

机场接驳线
Shuttle Service between Shenzhen Bao'an International Airport and Shenzhen World

从宝安机场到深圳国际会展中心(直达)
服务时间：08:00-17:00
停靠站点：宝安机场场站、机场新航站楼、深圳国际会展中心①、国际会展中心场站

From the Airport to Shenzhen World(Nonstop)
Service time: 08:00-17:00
Stops: Airport Bus Terminal, Airport T3 Station, Shenzhen World①, Shenzhen World Bus Terminal

从国际会展中心场站到宝安机场场站(直达)
服务时间：09:30-18:30
停靠站点：国际会展中心场站、会展南站①、机场新航站楼、宝安机场场站

From Shenzhen World Bus Terminal to the Airport(Nonstop)
Service time: 09:30-18:30
Stops: Shenzhen World Bus Terminal, Shenzhen World South Station①, Airport T3 Station, Airport Bus Terminal

福永码头
From Fuyong Ferry

建议搭乘出租车直达展馆
Taxi is recommended

高铁站
From Railway Station

深圳北站、深圳东站
搭乘地铁5号线(赤湾方向)到前海湾，再转乘11号线(碧头方向)到塘尾，出站搭乘地铁接驳专线公交直达展馆

From Shenzhen North and Shenzhen East Railway Stations
Railway Station to Qianhaiwan Station and switch to Tangwei Station by metro, and then take the shuttle bus

福田站
搭乘地铁11号线(碧头方向)到塘尾，出站搭乘地铁接驳专线公交直达展馆

From Futian Railway Station
Railway Station to Tangwei Station by metro, and then take the shuttle bus

深圳站(罗湖)
搭乘地铁1号线(机场东方向)到车公庙，换乘11号线(碧头方向)到塘尾，出站搭乘地铁接驳专线公交直达展馆

From Shenzhen Station(Luohu)
Railway Station to Chegongmiao Station and switch to Tangwei Station by metro, and then take the shuttle bus

TRAFFIC INFO

TRANSPORTATION TO SHENZHEN WORLD

Shenzhen World is located right next to Shenzhen Bao'an International Airport, neighbouring Fuyong Port, close to S3 Highway, and directly linked to the metro lines and city rails, featuring extremely convenient transportation resources.

Air way: 7 km to T3 of Shenzhen International Airport, 3 km to T4, and only 75 km to HK Airport.

Water way: Closely located to Fuyong port, 1 hour to HK, Macao, Guangzhou, Zhuhai by ferry.

Freeway: Directly linked to two freeways (S3 and Guangzhou-Shenzhen Highway) and one express road (Haibin Boulevard). The overpass project featuring Shenzhen World toll gates along S3 Phase II has been open. The project is also going to link Shenzhen-Zhongshan Tunnel, and the interchange between Shenzhen International Airport and He'ao to form a highly connected transportation system.

Metro: The Fuyong and Qiaotou stations in the current Metro Line 11 are only 5 km from the venue. Line 12 and Line 20 under construction will directly serve the venue with two metro stations, Shenzhen World South and Shenzhen World North. Line 20 connects Shenzhen World with the Shenzhen Airport with only one metro station in between and offers transfers to Line 11 and the Guangzhou-Dongguan-Shenzhen inter-city railway. Line 12 will offer transfers to Line 2 in Dongguan in Guangzhou.

Railways and High-speed rail: The venue is next to the Sea Garden Station along the Shenzhen-Maoming Railway under construction and the Guangzhou-Dongguan-Shenzhen Inter-city Railway expected for services in 2019. Planning for construction of the high-speed train station in Shenzhen International Airport has already been officially approved.

Shuttle bus: Shuttle bus services are provided to facilitate transportation between the venue and metro stations, Shenzhen International Airport, bus terminals, business centers and hotels nearby.