Contents

General Information
Light Conference 2019

Date: July 16-18, 2019

Conference Venue: Academic Exchange Center, Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Dongnanhu Road 3888, Changchun, China.

Welcome to CIOMP

On behalf of Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS), I welcome you to join the Light Conference 2019. Light Conference was primarily initiated by the journal *Light: Science & Applications.* Our institute has sponsored and organized a series of Light Conference in recent years. Now it is our pleasure and honor to host this conference in Changchun, China again.

CIOMP is honored as 'The Cradle of China's Optics'. Since founded in 1952, CIOMP has made great contributions to the optical research and engineering in China and significantly impacts China's science and technology development.

We have established scientific collaborations and long-term exchange programs with more than 30 countries.

CIOMP will continue its efforts to contribute to research and development, both national and international. We cooperate with all kinds of scientific research organizations and industries around the world and look forward to forging new partnerships and collaborations. If you are interested in joining the CIOMP research community or working with us, we invite you to contact us to explore new opportunities in the cradle of China's optics.

We hope you will enjoy the Light Conference 2019. I wish you a pleasant stay in Changchun, China. Thank you!

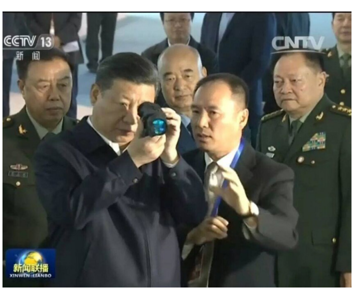
Prof. Ping JIA
President
Changchun Institute of Optics, Fine Mechanics and Physics
Chinese Academy of Sciences

The Cradle of China’s Optics

The Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) was founded in 1952 focusing on luminescence, applied optics, optical engineering, and precision mechanics and instrumentation. There are currently 2,363 professionals working at CIOMP, including 3 CAS academicians, 303 professors and 710 associate professors.

Since CIOMP's establishment, led by a group of scientists including WANG Daheng and XU Xurong, CIOMP has developed more than a dozen “First of China” advanced instruments such as the first ruby laser and the first large theodolite, etc. The research has resulted in more than 1,000 patents and 1,700 completed research projects. By sponsoring and helping to set up more than 10 research institutes, colleges, and enterprises, CIOMP has contributed 2,200 professionals to other national institutions, among whom 23 professionals have been elected as academicians of the Chinese Academy of Sciences (CAS) or the Chinese Academy of Engineering (CAE). One of CIOMP’s outstanding scientists, JIANG Zhuying, has become a model Chinese intellectual and inspired many. CIOMP has been involved in many important national projects, such as the "Two bombs, One Star" and manned space projects. CIOMP has made great contributions to China's defense construction, economic development, and social progress.

CIOMP has formulated an integrated “Research, Industry, and Education”, and is increasing its abilities to realize the full potential of a wide range of endeavors. For instance, by breaking through key technological barriers, CIOMP successfully developed payloads for the Shenzhou V and Shenzhou VI rockets - part of the manned space program and the Tiangong-1 space station. In addition, CIOMP now hosts an International Optoelectronic Innovation Cluster, 6 State Key Laboratories and research centers, and 2 CAS Key Laboratories. There are more than 20 high-tech companies in the CAS Changchun Optoelectronics Industrial Park with investment support from CIOMP and total assets of 403 million USD. By serving almost 100 companies,



the national optoelectronic industry incubator provides an important public service platform for technology transfer in Jilin Province.

CIOMP is also a key base for CAS graduate student education. It offers 8 masters degree programs, 6 doctoral degree programs and 3 postdoctoral programs. Currently, CIOMP has 929 graduate students, of which 451 are completing a Ph.D.

CIOMP closely follows principles that encourage open thinking that leads to flourishing activity. It actively undertakes international cooperation and communication with scientific institutes and universities at home and abroad. CIOMP has hosted many high-level international academic conferences such as the 20th Congress of the International Commission for Optics. CIOMP participates in many international collaborative projects such the Thirty Meter Telescope Project and carries out cooperation with globally recognized scientific institutes.

Partnering with Nature Publishing Group, CIOMP launched the international English language journal *Light: Science & Applications* in 2012.

Now CIOMP has obtained a close cooperation with more than 10 countries including USA, Canada, Australia, Germany and UK, etc,. In 2016 Chunlei Guo China-US Photonics Laboratory was built by CIOMP and University of Rochester in CIOMP. CIOMP has also established extensive scientific partnerships and long-term exchange programs with science and technological units such as Delft University of Technology, University of Manchester, Abbe photonics center, Swinburne University of Technology and so on.

In future CIOMP's focus is on research in optoelectronic technology and its application to the engineering and fabrication of precision instruments. By ensuring that our research in basic and applied optics is transformed and translated more broadly, CIOMP is aiding the development of related industries as well as nurturing a deep and valuable pool of experts.

Introduction of *Light: Science & Applications*

Light: Science & Applications (LSA) is co-published by Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS) and Springer Nature (formerly known as Nature Publishing Group). It publishes high quality optics and photonics research from around the world.

Launched on March 29th 2012, LSA now publishes every week (online version, since 2018 May 18). Printed version is bimonthly (It was quarterly between 2012-2017). Since 2013, LSA has been accepted by SCI, Scopus, DOAJ, Ei, CSCD, PubMed, CNKI and VINITI successively.

In 2014, LSA received its first impact factor of 8.476, ranking No.4 of 82 in optics (JCR 2013). Thereafter, LSA received a record-high impact factor of 14.603, ranking No.2 of 86 in optics, No.95 of 8618 SCI journals (JCR 2014). By far, LSA has received four impact factors and manages to maintain Top 5 in optics.

LSA has established an international editorial board, including 64 editors from 13 countries. Till now, over 400 papers have been published with more than 13000 citations. The h-index is 62.

In 2013, LSA was granted with PIIJ C (Project for Enhancing International Impact of China STM Journals) (2013-2015) from China Association for Science and Technology and other five national ministries. In 2016, LSA was granted with Mount Everest action plan and again PIIJ A (2016-2018). From 2014 to 2017, LSA was supported by CAS scientific publication funds. In 2015 and 2017, LSA was awarded as top one hundred research journals separately. Since 2016, LSA has launched regional offices in Peking University, Fudan University, Taiwan Cheng Kung University, University of Rochester, University of Technology Sydney, University of Singapore, ESIEE Paris and University College London.

General Chairs & Committees

General Co-chairs	
Qihuang Gong	Peking University, China
Xuejun Zhang	CIOMP, China
Wolfgang Osten	University of Stuttgart, Germany
Andries Meijerink	Utrecht University, the Netherlands
Technical Committee	
Jian-lin Cao	Ministry of Science and Technology, China
Tian-hong Cui	University of Minnesota, USA
Ping Jia	CIOMP,China
Stefan Kaierle	Laser Zentrum Hannover e.V., Germany
Hong-bo SUN	Jilin University, China
Luc Thévenaz	EPFL Ecole Polytechnique Fédérale de Lausanne
General Secretary	
Yu-hong Bai	CIOMP, China

"Rising Stars of Light" Awards Committees

Committee Chair	
Wolfgang Osten	University of Stuttgart, Germany
Committee Members	
Martin Booth	University of Oxford, United Kingdom
Tarik Bourouina	ESIEE Paris, France
Neal J. Brock	4D Technology, Tucson, Arizona, USA
Xingdan Chen	CIOMP, China
Tianhong Cui	University of Minnesota, USA
Peter de Groot	Zygo Corporation, USA
Wolfgang Freude	Karlsruhe Institute of Technology (KIT), Germany
Qihuang Gong	Peking University, China
Tom Gregorkiewicz	University of Amsterdam, Netherlands
Min Gu	University of Shanghai for Science and Technology (USST), Australia
Ping Jia	CIOMP, China
Xiangqian Jiang	University of Huddersfield, United Kingdom

Stefan Kaierle	Laser Zentrum Hannover e.V. (LZH), Germany
Diaa Khalil	Ain Shams University (ASU), Egypt
Jeffrey R. Kuhn	University of Hawaii, USA
Lin Li	University of Manchester, United Kingdom
Guilu Long	Tsinghua University, China
Yongfeng Lu	University of Nebraska-Lincoln, USA
Hervé Maillotte	FEMTO-ST Institute, France
Andries Meijerink	Utrecht University, the Netherlands
Aydogan Ozcan	University of California, Los Angeles, USA
Min Qiu	Westlake University, China
Manijeh Razeghi	North western University, USA
Werner Schmutz	ETH Zurich, Switzerland
Mark I. Stockman	Georgia State University, USA
Hongbo Sun	Tsinghua University, China
Jianshun Tang	University of Science and Technology of China, China
Luc Thévenaz	EPFL, Switzerland
Cunzhu Tong	CIOMP, China
Eric Tournié	IES, Université de Montpellier, CNRS, France
Xiaojun Wang	Georgia Southern University, USA
Jiaqi Wang	CIOMP, China
Lijun Wang	CIOMP, China
Xuejun Zhang	CIOMP, China

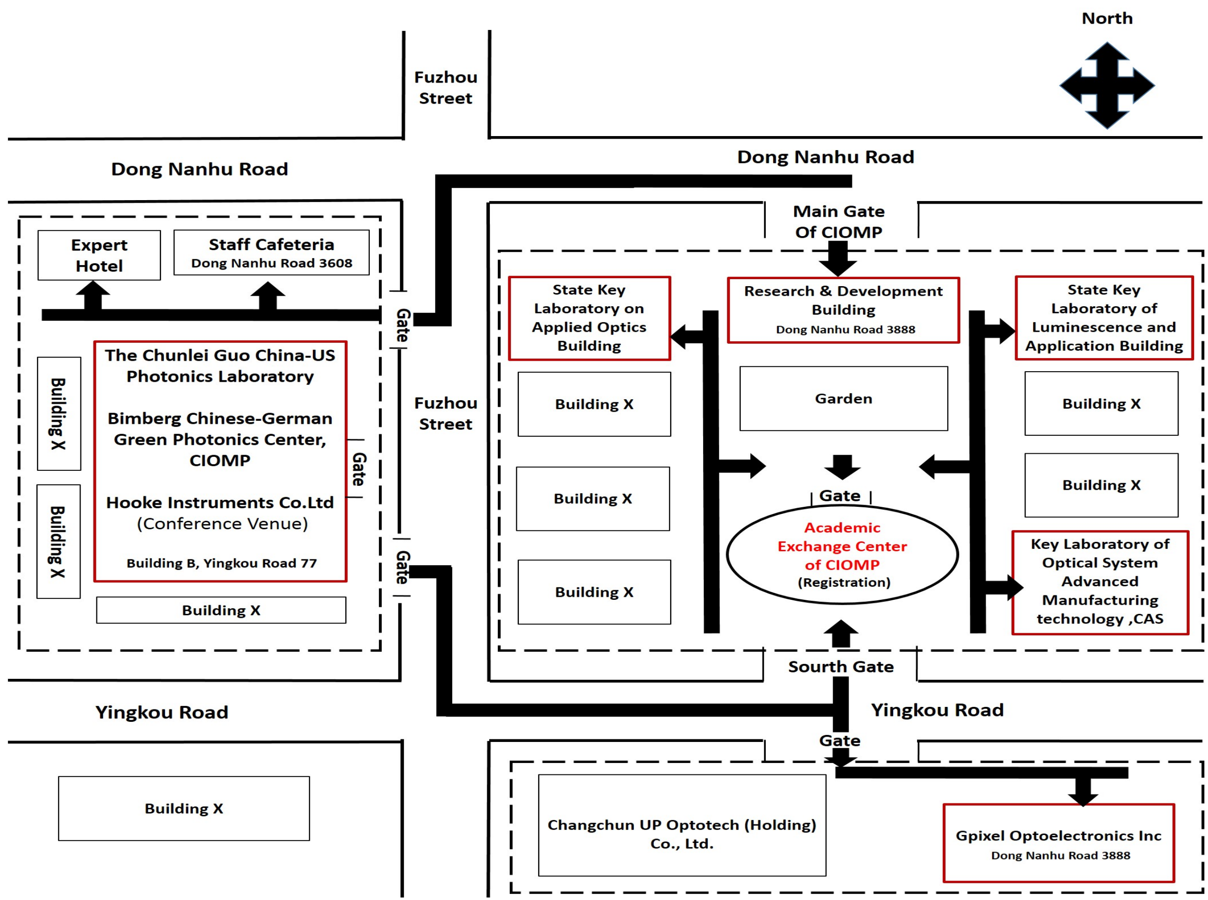
Conference Venue List

Conference	Room	Building	Chairs
Main conference	Main Auditorium	Academic Exchange Center	--
Symposium 1	Main Auditorium	Academic Exchange Center	Wolfgang Osten, Xuejun Zhang
Symposium 2	Room 2	Academic Exchange Center	Andries Meijerink, Xiaojun Wang
Symposium 3	Academic Hall	R&D Building	Jianli Wang
Symposium 4	Room 5	Academic Exchange Center	Yan Zhang
Symposium 5	Room 3	Academic Exchange Center	Donglin Xue, Dong Liu
Symposium 6	Room 6	Academic Exchange Center	Gerard Thuillier, Peng Zhang, Wolfgang Finsterle, Ping Zhu
Symposium 7	Bimberg Chinese-German Green Photonics Center		Cunzhu Tong, Huiyun Liu
Symposium 8	The Guo China-US Photonics Laboraory		Jianjun Yang, Feng Chen
Symposium 9	Room 1	Academic Exchange Center	Luc Thévenaz, Guilu Long
Symposium 10	Hooke Instruments Co.Ltd		Martin J Booth, Bei Li
Symposium 11	Internal Meeting		Ping Jia

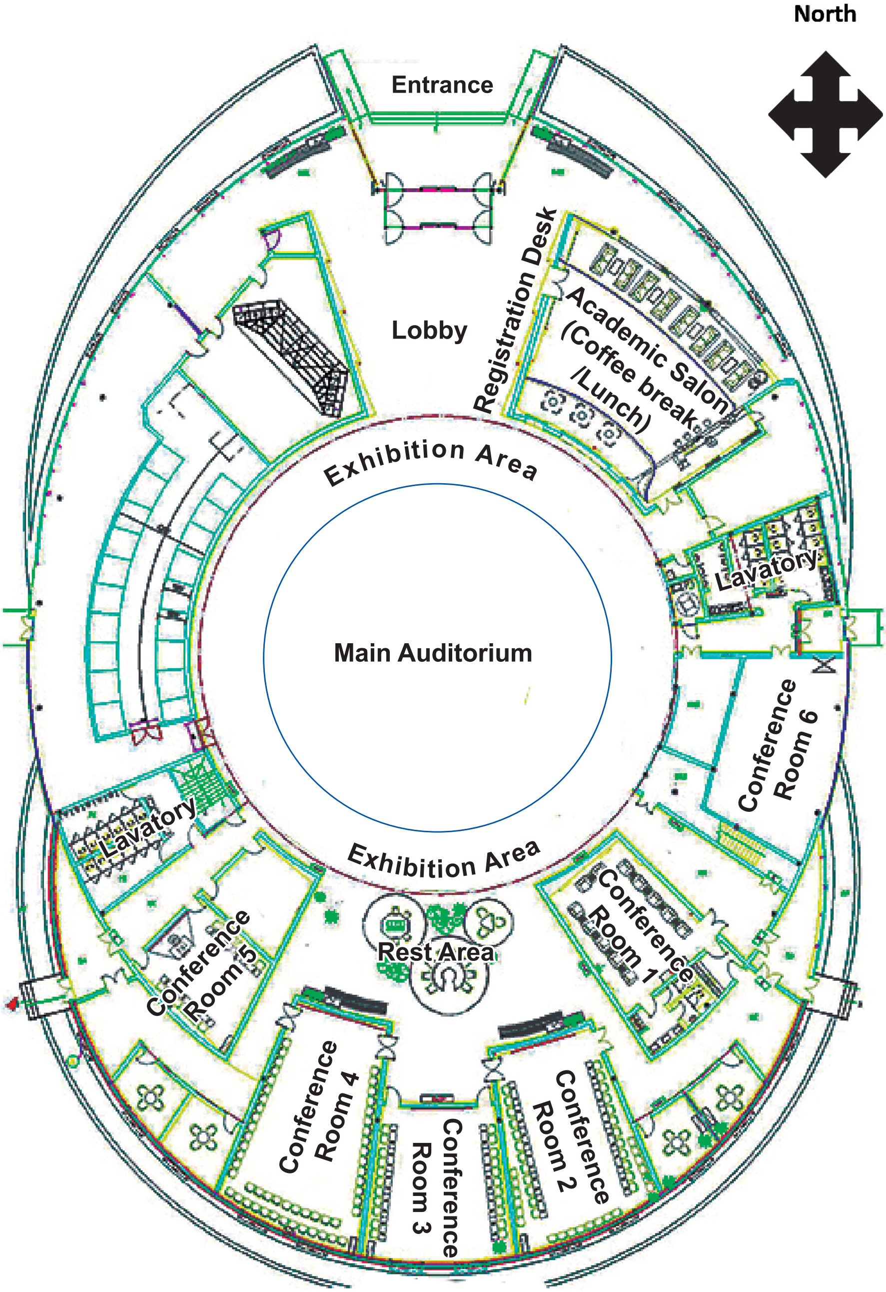
Staffs Responsibility & Contact Information

Symposium	Topic	Contact	Telephone
1	Aspheres and freeforms: design, fabrication, inspection and application	Zhendong Hao	13756491115
2	High power density white light fluorescent LED	Zhendong Hao	13756491115
3	Intelligent optical imaging system and application (In Chinese)	Jin Cao	13504464214
4	Terahertz technology and applications	Shuping Wang	13944124439
5	Young scientists forum: Aspheric and free-form surface: technology and application	Yaobiao Li	15948387915
6	Solar & Terrestrial radiation, measurement, modeling and applications	Guang Zhang	13894821313
7	Semiconductor lasers and detectors	Zile Li	13756538011
8	Ultrafast laser material processing	Jingze Yuan	13844080268
9	Next generation light science & technologies	Wei Chang	15104431524
10	The application of optics in life sciences	Jingze Yuan	13844080268
11	Airborne optical imaging and measurement (Internal Meeting)	Si Qin	18504415487

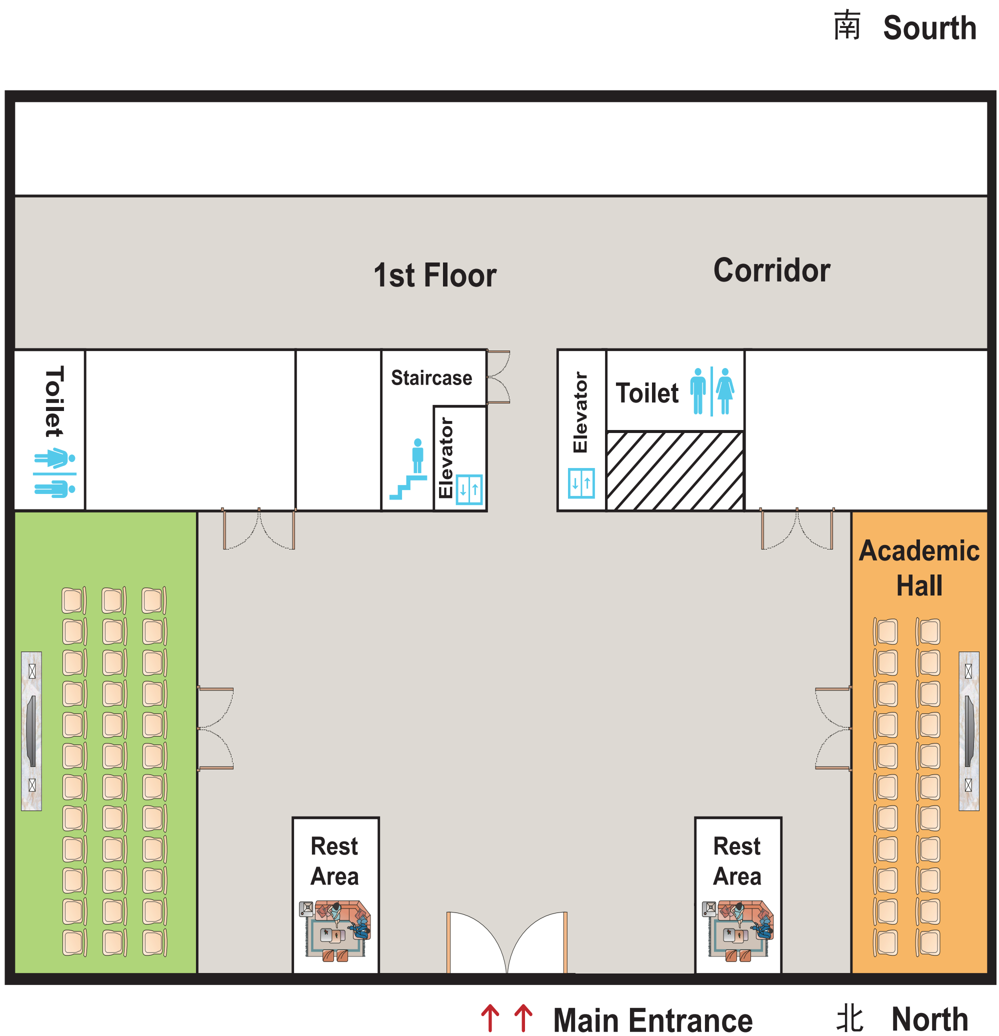
CIOMP Compus Guide Map



Academic Exchange Center



Research and Development Building



Notice: only 1-3 floors are accessible！

Light Conference 2019 Program

Time	Content	
Wednesday, July 17th (Main Auditorium, Academic Exchage Center)		
Opening Ceremony, Chair: Prof. Xuejun Zhang, CIOMP Vice-president		
08:30-08:50	Prof. Ping Jia (CIOMP President); Conference Co-chairs: Qihuang Gong (Peking University, China) Wolfgang Osten (Universitaet Stuttgart, Germany) Welcome remarks	
08:50-09:20	Prof. Tianhong Cui (Executive Editor in Chief, *Light: Science & Applications*) Introduction to Journal *Light: Science & Applications* Award Ceremony for Excellent Contributors to *Light: Science & Applications*	
Award Ceremony&Plenary Talk for the 15th Wang Daheng Optics Awardin 2018 (COS) **Chair:Prof. Xu Liu, Secretary-General of COS**		
09:20-09:30	**Award Ceremony for The Wang Daheng Optics Award**	
09:30-09:55	**Prof. Cunzhu Tong (CIOMP, China) (The winner of the 15th Wang Daheng Optics Award for young and middle-aged scientists and researchers in 2018, Plenary Talk)** Title: Mode Engineering of High Power Semiconductor Lasers	
09:55-10:20	**Prof. Jian-Shun Tang (University of Science and Technology of China) (The winner of the 15th Wang Daheng Optics Award for young and middle-aged scientists and researchers in 2018, Plenary Talk)** Title: A bubble-induced ultrastable and robust single-photon emitter in hexagonal boron nitride	
10:20-10:50	***Coffee break***	
Chair: Prof. Andries Meijerink (Utrecht University, the Netherlands)		
10:50-11:25	**Prof. Jeffrey R. Kuhn (University of Hawaii, USA)** Title: Beyond the World's Largest Telescopes: New Technologies and New Opportunities	**Plenary Talk**
11:25-12:00	**Prof.Werner Schmutz (ETH Zurich, Switzerland)** Title:The solar influence on the terrestrial climate	**Plenary Talk**
12:00-12:35	**Prof. Eric Tournié (IES, Université de Montpellier, CNRS, France)** Title: Epitaxial Integration of GaSb-based mid-IR devices on Silicon	**Plenary Talk**
12:35-14:00	***Lunch***	

14:00-18:00	**Symposium 1** Co-Chairs: Wolfgan Osten Xuejun Zhang	**Symposium 2** Co-Chairs: Andries Meijerink Xiaojun Wang	**Symposium3** Chair: Jianli Wang **(In Chinese)**	**Symposium 4** Chair: Yan Zhang	**Symposium 5** Co-Chairs: Donglin Xue Dong Liu	**Symposium 6** Co-Chairs: Gerard Thuillier Peng Zhang Wolfgang Finsterle Ping Zhu
	Topic: Aspheres andfreeforms:design, fa-brication, inspectionand application	Topic: High power density white light fluorescent LED	Topic: Intelligent optical imaging systemand application	Topic: Terahertz technology and applications	Topic: Young scientists forum:Aspheric and free-form surface:technology and application	Topic: Solar and Terrestrial radiation, measurement, modeling & applications
	Symposium 7 Co-Chairs: Cunzhu Tong Huiyun Liu	**Symposium 8** Co-Chairs: Jianjun Yang Feng Chen	**Symposium 9** Co-Chairs: Luc Thévenaz Guilu Long	**Symposium 10** Co-Chairs: Martin Booth Bei Li	**Symposium 11** Chair: Ping Jia (Internal Meeting)	
	Topic: Semiconductor lasers and detectors	Topic: Ultrafast laser material processing	Topic: Next generation light science &technologies	Topic: The application of optics in life sciences	Topic: Airborne Optical Imaging and Measurement	
19:00-20:00	***Banquet***					
Thursday, July 18th	**(Main Auditorium, Academic Exchage Center)**					
08:30-12:00	**Symposium 1** Co-Chairs: Wolfgan Osten Xuejun Zhang	**Symposium 2** Co-Chairs: Andries Meijerink Xiaojun Wang	**Symposium3** Chair: Jianli Wang **(In Chinese)**	**Symposium 4** Chair: Yan Zhang	**Symposium 5** Co-Chairs: Donglin Xue Dong Liu	**Symposium 6** Co-Chairs: Gerard Thuillier Peng Zhang Wolfgang Finsterle Ping Zhu
	Topic: Aspheres andfreeforms:design, fa-brication, inspectionand application	Topic: High power density white light fluorescent LED	Topic: Intelligent optical imaging systemand application	Topic: Terahertz technology and applications	Topic: Young scientists forum:Aspheric and free-form surface:technology and application	Topic: Solar and Terrestrial radiation, measurement, modeling & applications
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	Topic: Semiconductor lasers and detectors	Topic: Ultrafast laser material processing	Topic: Next generation light science &technologies	Topic: The application of optics in life sciences	Topic: Airborne Optical Imaging and Measurement	

Chair: Prof. Martin Booth (University of Oxford, UK)		
13:30-15:30	**Candidates Reports —"Rising stars of light" Award**	
15:30-16:00	***Coffee break***	
Chair: Prof. Hongbo Sun (Tsinghua University, China)		
16:00-16:35	**Prof. Min Gu(University of Shanghai for Science and Technology, China)** Title: Information photonics empowered by artificial intelligence	**Plenary Talk**
16:35-17:10	**Prof. Neal J. Brock (4D Technology, Tucson, Arizona, USA)** Title: The Remarkable Technological Progress in the Inspection of High-precision Optical Surfaces Under Harsh Environmental Conditions Enabled by Instantaneous Phase Measuring Technology	**Plenary Talk**
17:10-17:45	**Prof. Xuejun Zhang (CIOMP, China)** Title: Implement nanometer shape accuracy on large SiC mirror	**Plenary Talk**
17:45-18:20	**Prof. Peter de Groot (Zygo Corporation,USA)** Title: Challenges and solutions for the interferometric measurement of aspherical and freeform optics	**Plenary Talk**
18:20-18:50	**"Rising stars of light" Award Ceremony&Closing Remark**	
19:00-20:30	***Buffet***	

Agenda - Symposium 1

Venue: Main Auditorium, Academic Exchange Center

Time	Content	
	July 17th	
14:00-17:40	**Session 1, Chair: Mitsuo Takeda**	
14:00-14:45	**Prof. Wolfgang Osten (Universitaet Stuttgart, Germany)** Title: Optical metrology in times of digital transition	**Invited Talk**
14:45-15:30	**Prof.Jane Jiang (University of Huddersfield, UK)** Title: Infrastructure for Freeform Surface Characterization	**Invited Talk**
15:30-16:30	***Coffee Break & Laboratories Visit***	
16:30-17:40	**Session 2, Chair: Peterde Groot**	
16:30-17:15	**Prof. Fengzhou Fang (Tianjin University/MNMT-Dublin, University College Dublin)** Title: Design and Manufacturing of Freeform Optics	**Invited Talk**
17:15-18:00	**Dr. Rainer Schuhmann (Berliner Glas KGaA Herbert Kubatz GmbH & Co., Germany)** Title: From aspheres to non-circular cylindrical lenses – manufacturing and testing	**Invited Talk**
19:00-20:00	***Banquet***	
	July 18th	
08:30-11:00	**Session 3, Chair: Wolfgang Osten**	
08:30-09:00	**Prof. Oltmann RIEMER (Leibniz Institute for Materials Engineering - Laboratory for Precision Machining LFM, Bremen, Germany)** Title: High-precision micro-machined fabrication of optical functional surfaces	**Invited Talk**
09:00-09:30	**Dr. Katsuyoshi Endo (Osaka University, Osaka, Japan)** Title: Non-contact three-dimensional profiler with sub-nanometer precision using normal vector method	**Invited Talk**

09:30-10:00	**Dr. Andreas Lange (Mahr GmbH Göttingen, Germany)** Title: Advanced Technologies for in-line Inspection of Aspheres and Freeforms	**Invited Talk**
10:00-11:00	***Coffee Break & Laboratories Visit***	
11:00-12:00	**Session 4, Chair: Fengzhou Fang**	
11:00-11:30	**Prof. Mitsuo Takeda (Utsunomiya University, Utsunomiya, Japan** Title: Fourier fringe analysis and its application to metrology of extreme physical phenomena: a review	**Invited Talk**
11:30-12:00	**Prof. Sen Han (University of Shanghai for Science and Technology, Shanghai, China)** Title: Absolute Calibration of Smooth Surface and Cylindrical Surface Meaurement	**Invited Talk**
12:00-12:30	**Dr. Goran Baer (Baer Optical Engineering, Germany)** Title: Unification of system calibration and optical design	**Invited Talk**
12:30-13:30	***Lunch***	

Agenda - Symposium 2

Venue: Room 2, Academic Exchange Center

Time	Content	
July 17th		
14:00-15:30	**Session 1, Chair: Andries Meijerink**	
14:00-14:30	**Prof. Yuansheng Wang (Fujian Institute of Research on the Structure of Matter, CAS, China)** Title: Chromaticity-tunable Phosphor-in-glass for Long-lifetime High-power Warm W-LEDs	**Invited Talk**
14:30-15:00	**Prof. Rongjun Xie (Xiamen University, China)** Title: Design of Luminescent Materials for Laser-driven Solid State Lighting	**Invited Talk**
15:00-15:30	**Prof. Rushi Liu (National Taiwan University, China)** Title: Narrow Emission Band Phosphors for the Application in LEDs	**Invited Talk**
15:30-16:30	***Coffee Break & Laboratories Visit***	
16:30-18:20	**Session 2, Chair: Xiaojun Wang**	
16:30-17:00	**Prof. Yongfu Liu (Ningbo Institute of Materials Technology and Engineering, CAS, China)** Title: $Gd_3Al_4GaO_{12}:Ce^{3+}$ Transparent Ceramics for High-Power LEDs and LDs with Warm White Light	**Invited Talk**
17:00-17:30	**Prof. Jiang Li (Shanghai Institute of Ceramics, CAS, China)** Title: Composite ceramic phosphors for high-power white LED applications	**Invited Talk**
17:30-17:50	**Prof. Andries Meijerink (Utrecht University, the Netherlands)** Title: Luminescent materials for high power density light sources	**Contributed**
17:50-18:10	**Prof. Xiaojun Wang (Georgia Southern University, USA)** Title: Functional Optical Materials and Their Spectroscopies	**Contributed**

18:10-18:20	**Dr. Yu Cao (Nanjing Tech University, China)** Title: Perovskite light-emitting diodes based on spontaneously formed submicrometre-scale structures	Oral Talk
19:00-20:00	***Banquet***	
July 18th		
08:30-10:00	**Session 3, Chair: Xiaojun Wang**	
08:30-09:00	**Prof. Hongwei Song (Jilin University, China)** Title: Our Recent Progresses in Perovskite Solar Cells and Perovskite Quantum Dots	**Invited Talk**
09:00-09:30	**Prof. Zhiguo Xia (South China University of Technology, China)** Title: Structural design and emerging LED applications of the UCr_4C_4-type phosphors with narrow-band emission	**Invited Talk**
09:30-10:00	**Prof. Jing Wang (Sun Yat-Sen University, China)** Title: New Strategy, Luminescence Properties and the Mechanism of High-efficiency Moisture-resistant Micro-nano Narrow-band Luminescent Materials for Wide Color Gamut Display	**Invited Talk**
10:00-11:00	***Coffee Break & Laboratories Visit***	
11:00-12:00	**Session 4, Chair: Andries Meijerink**	
11:00-11:30	**Dr. Meng Han (SLD laser, China)** Title: Diode laser pumped light sources	**Invited Talk**
11:30-12:00	**Dr. Matthias Sabathil (OSRAM Opto Semiconductors, Malaysia)** Title: Performance of light sources based on laser excited phosphor conversion	**Invited Talk**
12:30-13:30	***Lunch***	

Agenda - Symposium 3

Venue: Academic Hall, R&D Building

时间	内容	
7 月 17 日		
14:00–14:15	开幕式及致欢迎词（王建立） 大会主席（王建立） 主持人（白雨虹）	
14:15–15:30	Session 1, 主席：赵永强	
14:15–14:40	王建立（长春光机所） 报告题目：智能光学成像系统与应用	邀请报告
14:40–15:05	郝伟（西安光机所） 报告题目：天基高平稳跟踪技术的探讨	邀请报告
15:05–15:30	邵晓鹏（西安电子科技大学） 报告题目：从计算成像到极简光学系统设计	邀请报告
15:30–15:55	茶歇 & 实验室参观	
15:55–18:00	Session 2, 主席：郝 伟	
15:55–16:20	赵永强（西北工业大学） 报告题目：红外偏振视频感知	邀请报告
16:20–16:45	牛照东（国防科技大学） 报告题目：基于随机有限集的空间弱小目标跟踪滤波技术	邀请报告
16:45–17:10	郝寅雷（浙江大学） 报告题目：集成光学器件与下一代望远镜技术	邀请报告
17:10–17:35	蔡红星（长春理工大学） 报告题目：基于近场抑制和多光谱技术的水下成像研究	邀请报告

17:35–18:00	胡长虹（长春光机所） 报告题目：像素级可调谐视频高光谱智能成像	邀请报告
19:00–20:00	晚宴	
7 月 18 日		
08:30–10:35	Session 3，主席：李洪文	
08:30–08:55	李宏壮（长春光机所） 报告题目：哈特曼传感器与主动光学波前校正技术	邀请报告
08:55–09:20	吴小霞（长春光机所） 报告题目：大口径大视场主动光学	邀请报告
09:20–09:45	王斌（长春光机所） 报告题目：一种高性能的机器学习算法中正则项系数个性化自动选取策略的理论、实验及工程应用	邀请报告
09:45–10:10	林旭东（长春光机所） 报告题目：长春光机所基于压电变形镜的自适应光学研究进展	邀请报告
10:10–10:35	安其昌（长春光机所） 报告题目：大口径光学红外望远镜智能辅助装调	邀请报告
10:35–11:00	李剑锋（长春关机所） 报告题目：基于液压浮动支撑的大口径主镜位置控制技术	邀请报告
11:00–11:30	茶歇 & 实验室参观	
12:30–14:00	午餐	

Agenda - Symposium 4

Venue: Room 5, Academic Exchange Center

Time	Content	
	July 17th	
14:00-15:30	**Session 1, Chair: Yan Zhang**	
14:00-14:35	**Prof. Harald Schneider (Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Germany)** Title: Nonlinear Terahertz Spectroscopy of III-V Semiconductor Quantum Wires and Quantum Wells Using a Free-electron Laser	**KeynoteTalk**
14:35-15:00	**Dr. Ciling Pan (National Tsing Hua University, Taiwan, China)** Title: Terahertz Radiation Generated by Multi-Color Laser Filaments in Air: The Role of Pump Power Ratio and Relative Phase	**Invited Talk**
15:00-15:25	**Dr. Liangliang Zhang (Capital Normal University, China)** Title: Strong Terahertz Wave Generation from Liquid Water	**Invited Talk**
15:30-16:30	***Coffee Break & Laboratories Visit***	
16:30-18:10	**Session 2, Chair: Harald Schneider**	
16:30-16:55	**Dr. Marc P. GEORGES (Liège Université Centre Spatial de Liège - STAR Unit, Belgium)** Title: Holography from Thermal Infrared to Terahertz in View of Applications in Metrology and Nondestructive Testing	**Invited Talk**
16:55-17:20	**Prof. Wolfgang Freude (Karlsruhe Institute of Technology (KIT), Germany)** Title: Wireless THz-to-optical Conversion with an Electro-optic Plasmonic Modulator	**Invited Talk**
17:20-17:45	**Prof. Aleksandar D. Rakić (University of Queensland, Australia)** Title: Towards High Speed Imaging with Pulsed Terahertz Quantum Cascade Lasers	**Invited Talk**

17:45-18:10	**Prof. Hua Li (Shanghai Institute of Microsystem and Information Technology, CAS, China)** Title: Terahertz Multiheterodyne Dual-Comb Spectroscopy Based on Quantum Cascade Lasers	**Invited Talk**
19:00-20:00	***Banquet***	
July 18th		
08:30-10:00	**Session 3, Chair: Jinghua Teng**	
08:30-09:05	**Prof. Weili Zhang (Oklahoma State University, USA)** Title: All-Dielectric Terahertz Metasurfaces and Meta-Devices	**Keynote Talk**
09:05-09:30	**Prof. Qiong He (Fudan University, China)** Title: Efficient Manipulations of Circularly Polarized Terahertz Waves with Transmissive Metasurfaces	**Invited Talk**
09:30-09:55	**Prof. Tahsin Akalin (IUT A Lille, France)** Title: Metasurfaces and original design for Terahertz microscopy	**Invited Talk**
10:00-11:00	***Coffee Break & Laboratories Visit***	
11:00-12:30	**Session 4, Chair: Weili Zhang**	
11:00-11:25	**Prof. Jinghua Teng (IMRE, A*STAR, Singapore)** Title: THz Components Made from 2D Materials and Structures.	**Invited Talk**
11:25-11:50	**Prof. Dong Sun (Peking University, China)** Title: Berry Curvature Enhanced Nonlinear Photo Response of Type-II Weyl Semimetals	**Invited Talk**
11:50-12:15	**Dr. Spencer Windhorst Jolly (Center for Free-Electron Laser Science and Universität Hamburg, Germany & Université Paris-Saclay, CEA Saclay, France)** Title: Spectral Phase Tuning for High Energy Narrowband Terahertz Pulses	**Invited Talk**
12:30-13:30	***Lunch***	

Agenda - Symposium 5

Venue: Room 3, Academic Exchange Center

Time	Content	
	July 17th	
14:00-15:40	**Session 1, Chair: Donglin Xue**	
14:00-14:20	**Benny C.F. Cheung (Hong Kong Polytechnic University, China)** Title: Advances in the Ultra-precision Machining and Measurement of Optical Freeform and Structured Surfaces and Applications	**Invited Talk**
14:20-14:40	**Zhiwei Zhu (Nanjing University of Science and Technology , China)** Title: Enhanced tool servo diamond turning of complex optical surfaces	**Invited Talk**
14:40-15:00	**Prof. Peng Yao (Shandong University, China)** Title: High Efficiency and Precision Machining of RB-SiC with Fluid Jet	**Invited Talk**
15:00-15:20	**Guogan Liu (Shanghai modern advanced Ultra Precision Manufacturing Center Co., Ltd, China)** Title: High-precision thin spherical surface lens manufactuing	**Invited Talk**
15:20-15:40	**Chao Wang (Changchun University of Science and Technology, China)** Title: Aberration correction technology for aspheric window optical system	**Invited Talk**
15:40-16:30	***Coffee Break & Laboratories Visit***	
16:30-18:10	**Session 2, Chair: Qun Hao**	
16:30-16:50	**Dong Liu (Zhejiang University, China)** Title: Interferometric measurement of freeform surface using irregular subaperture stitching	**Invited Talk**
17:50-18:10	**Dewen Cheng (Beijing Institute of Technology, China)** Title: Design and evaluation of near eye display with freeform optics	**Invited Talk**
17:10-17:30	**Shanyong Chen (National University of Defense Technology, China)** Title: Versatile CGHs for interferometric test of freeform surfaces	**Invited Talk**
17:50-18:10	**Hua Shen (Nanjing University of Science and Technology, China)** Title: Tilted carrier non-null common-path interferometry	**Invited Talk**
16:50-17:10	**Feng Shi (National University of Defense Technology, China)** Title: Intelligent manufacturing equipment and process for complex shape nano-precision optical components	**Invited Talk**

19:00-20:00	***Banquet***	
	July 18th	
08:30-10:10	**Session 3, Chair: Dong Liu**	
08:30-08:50	**Qun Hao (Beijing Institute of Technology, China)** Title: Partial compensation interferometry for freeform measurement: progress and challenge	**Invited Talk**
08:50-09:10	**Zhenrong Zheng (Zhejiang University, China)** Title: Design of freeform illumination optics: a nonlinear boundary problem for the elliptic Monge-Ampère equation	**Invited Talk**
09:10-09:30	**Xiaokun Wang (CIOMP, CAS, China)** Title: Testing Large Convex Asphere by Subaperture Stitching Interferometry	**Invited Talk**
09:30-09:50	**Xing Zhao (Nankai University, China)** Title: Model of radial basis functions with slope-based shape factor and distribution for optical freeform surface	**Invited Talk**
09:50-10:10	**Zhouping Su (Jiangnan University, China)** Title: Construct freeform surface quickly for off-axis Multiple-mirror system by seed curve extension and Genetic Algorithm	**Invited Talk**
10:10-10:30	***Coffee Break***	
10:30-12:30	**Session 4, Chair: Benny C.F. Cheung**	
10:30-10:50	**Jun Zhu (Tsinghua University, China)** Title: Design method for freeform optical systems containing diffraction gratings	**Invited Talk**
10:50-11:10	**Lingjie Wang (CIOMP, CAS, China)** Title: Distortion optimization design of free-form large field camera	**Invited Talk**
11:10-11:30	**Jun Chang (Beijing Institute of Technology, China)** Title: Improvement of lobster-eye lenses imaging by free-form surface (Canceled)	**Invited Talk**
11:30-11:50	**Haodong Shi (Changchun University of Science and Technology, China.)** Title: Nodal aberration theory in non-rotationally symmetric freeform optical system design	**Invited Talk**
11:50-12:10	**Qun Yuan (Nanjing University of Science and Technology, China)** Title: Partial null interferometry for a freeform Zernike mirror	**Invited Talk**
12:10-12:30	**Tong Yang (Beijing Institute of Technology, China)** Title: Applications of the point-by-point method in designing nonsymmetric imaging systems	**Invited Talk**
12:30-13:30	***Lunch***	

Agenda - Symposium 6

Venue: Room 6, Academic Exchange Center

Time	Content	
	July 17th	
14:00-15:30	**Session 1, Chair: Peng Zhang**	
14:00-14:30	**Gérard Thuillier (PMOD/WRC, Switzerland)** Title: Recent UV to IR reference solar spectra for use in Solar, Atmospheric and Climate physics	**Invited Talk**
14:30-14:50	**Xiuqing Hu (NSMC/CMA, China)** Title: Lunar spectral irradiance observation for lunar reference model improvement	**Invited Talk**
14:50-15:10	**Wolfgang Finsterle (PMOD/WRC, Switzerland)** Title: Solar radiometry at PMOD/WRC - latest developments	**Invited Talk**
15:10-15:30	**Xin Ye (CIOMP/CAS, China)** Title: Space absolute radiometry payload and on-orbit traceable radiometric calibration system	**Invited Talk**
15:30-16:30	***Coffee Break & Laboratories Visit***	
16:30-18:10	**Session 2, Chair: Gérard Thuillier**	
16:30-16:50	**Wei Fang (CIOMP/CAS, China)** Title: The Joint Total Solar Irradiance Monitor for FY-3E Satellite	**Invited Talk**
16:50-17:10	**Silvio Koller (PMOD/WRC, Switzerland)** Title: JTSIM-DARA engineering concept and architecture	**Invited Talk**
17:10-17:30	**Jin Qi (NSMC/CMA, China)** Title: Total Solar Irradiance record from FY-3C/SIM-II	**Invited Talk**
17:30-17:50	**Michel van Ruymbeke (ROB, Belgium)** Title: Micro-calorimetry dedicated to radiative transfer monitoring	**Invited Talk**

19:00-20:00	***Banquet***	
	July 18th	
08:30-10:00	**Session 3, Chair: Wolfgang Finsterle**	
08:30-09:00	**Peng Zhang (NSMC/CMA, China)** Title: Radiation Budget Measurements from Current and Future FY-3 Satellites	**Invited Talk**
09:00-09:30	**Gérard Thuillier(PMOD/WRC, Switzerland)** Title: Solar Spectral Irradiance and Solar radius for validating Solar Models used in Atmosphere and Climate Physics	**Invited Talk**
09:30-10:00	**Ping Zhu (CIOMP/CAS, China; ROB, Belgium)** Title: The Earth's Energy Imbalance and its importance to study climate change	**Invited Talk**
10:00-11:00	***Coffee Break & Laboratories Visit***	
11:00-12:30	**Session 4, Chair: Ping Zhu**	
11:00-11:30	**Alexander Shapiro (MPI, Germany)** Title: Activity of the Sun and Sun-like stars	**Invited Talk**
11:30-11:50	**Hong Qiu (NSMC/CMA, China)** Title: Earth Radiation Measurements on Chinese New Generation Polar Orbit Satellites	**Invited Talk**
11:50-12:10	**Xiaohu Yang (CIOMP/CAS, China)** Title: The Solar Spectral Irradiance Monitor on FY-3 Satellite E	**Invited Talk**
12:10-12:30	**Gerhard Schmidtke (IPM/Fraunhofer, Germany)** Title: SOLACER – A new auto-calibrating system to record solar spectral irradiance	**Invited Talk**
12:30-13:30	***Lunch***	

Agenda - Symposium 7

Venue: Bimberg Chinese-German Green Photonics Center

Time	Content	
	July 17th	
14:00-15:30	**Session 1, Chair: Huiyun Liu**	
14:00-14:30	**Prof. Justin Norman (UCSB, USA)** Title: Epitaxial quantum dot lasers on silicon with high performance and reliability	**Invited Talk**
14:30-15:00	**Prof. Fengqi Liu (Institute of Semiconductors, CAS, China)** Title: Quantum dot cascade laser: from concept to practice	**Invited Talk**
15:00-15:30	**Dr. Siming Chen (University College London, UK)** Title: III-V quantum-dot lasers grown on silicon for silicon photonics	**Invited Talk**
15:30-16:30	***Coffee Break & Laboratories Visit***	
16:30-18:00	**Session 2, Chair: CunzhuTong**	
16:30-17:00	**Prof. Tao Yang (Institute of Semiconductors, CAS, China)** Title: MBE growth of high-performance InAs/GaAs quantum dots and their devices application	**Invited Talk**
17:00-17:30	**Prof. Jun Wang (BUPT, China)** Title: III-V semiconductor lasers directly grown on silicon by metalorganic chemical vapor deposition	**Invited Talk**
17:30-18:00	**Prof. Ting Wang (Institute of Physics, CAS, China)** Title: III-V microcavity lasers monolithically grown on SOI substrates for silicon photonic integration	**Invited Talk**
19:00-20:00	***Banquet***	
	July 18th	
08:30-11:00	**Session 3, Chair: CunzhuTong**	

08:30-09:00	**Prof. Zhaoyu Zhang (The Chinese University of Hong Kong, China)** Title: Optically-pumped micro-lasers directly grown on silicon	**Invited Talk**
09:00-09:30	**Dr. Guangwei Cong (AIST, Japan)** Title: Silicon photonics technologies for advanced information systems	**Invited Talk**
09:30-10:00	**Prof. Baile Chen (Shanghai Tech University, China)** Title: Si based MWIR Photodetectors	**Invited Talk**
10:00-11:00	***Coffee Break & Laboratories Visit***	
11:00-12:30	**Session 4, Chair: Huiyun Liu**	
11:00-11:30	**Dr. Zizheng Cao (Eindhoven University of Technology, the Netherlands)** Title:Recent progress in advanced indoor infrared wireless communications	**Invited Talk**
11:30-12:00	**Prof. Xinlun Cai (Sun Yat-sen University, China)** Title: High-performance hybrid silicon and lithium niobate Mach–Zehnder modulators	**Invited Talk**
12:00-12:10	**Qiang Wang (Beijing University of Technology, China)** Title: Growth and optoelectronic properties of intrinsic acceptor-rich ZnO single-crystal microtubes	**Oral Talk**
12:30-13:30	***Lunch***	

Agenda - Symposium 8

Venue: The Guo China-US Photonics Laboraory

Time	Content	
July 17th		
14:00-15:30	**Session 1, Chair: Feng Chen**	
14:00-14:20	**Prof. Hongbo Sun (Tsinghua University, China)** Title: Femtosecond laser manufacturing of high-performance optical components from diamonds and sapphires	**Invited Talk**
14:20-14:40	**Prof. Yan Li (Peking University, China)** Title: Femtosecond laser 3D microfabrication with single exposure and 1D scan	**Invited Talk**
14:40-15:00	**Dr. Jiale Yong (Xi'an Jiaotong University, China)** Title: Bio-inspired control of surface wettability by a femtosecond laser	**Invited Talk**
15:00-15:20	**Prof. Yongfeng Lu (University of Nebraska-Lincoln,USA)** Title: 3D nanofabrication of functional structures using blended resins	**Invited Talk**
15:30-16:30	***Coffee Break & Laboratories Visit***	
16:30-18:00	**Session 2, Chair: Tianqin Jia**	
16:30-16:50	**Prof. Mark I. Stockman (Georgia State University, USA)** Title: Solids in Ultrafast Strong Laser Fields: Topological Phenomena	**Invited Talk**
16:50-17:10	**Prof. Zhiyi Wei (Institute of Physics and National Laboratory for Condensed Matter Physics,CAS, China)** Title: Development of high average power ultrafast lasers and applications	**Invited Talk**
17:10-17:30	**Prof. Guohong Ma (Shanghai University, China)** Title: Influence of oxygen adsorption on the ultrafast carrier dynamics in monolayer graphene and MoS_2 viewed by transient THz spectroscopy	**Invited Talk**

17:30-17:50	**Dr. Weili Yu (CIOMP, CAS, China)** Title: The perovskite crystal femtosecond laser processing and its charge transport properties	**Invited Talk**
17:50-18:00	**Dr. WanzhuoMa (Changchun University of Science and Technology, China)** Title: Observation and optimization of 2-micron all-fiber ultra-fast laser dynamic	**Oral Talk**
19:00-20:00	***Banquet***	
July 18th		
08:30-10:00	**Session 3, Chair: Jianjun Yang**	
8:30-8:50	**Prof.Jianrong Qiu (Zhejiang University, China)** Title: Fs laser induced periodic microstructures and their applications	**Invited Talk**
8:50-9:10	**Prof. Quanzhong Zhao (SIOM, China)** Title: Femtosecond laser induced luminescence in glasses	**Invited Talk**
9:10-9:30	**Prof. Tianqing Jia (East China Normal University, China)** Title: Periodic ripples on Si surface induced by a single temporal shaped femtosecond laser pulse	**Invited Talk**
9:30-9:50	**Prof. Wu Qiang (Nankai University, China)** Title: Femtosecond Laser Hyperdoping Crystal: Principle and Applications	**Invited Talk**
10:00-11:00	***Coffee Break & Laboratories Visit***	
11:00-12:30	**Session 4, Chair: Mark I. Stockman**	
11:00-11:20	**Prof.Diaa Khalil (Ain Shams University, Egypt)** Title: MEMS Based Swept Laser Source	**Invited Talk**
11:20-11:40	**Prof. Yonglai Zhang (Jilin University, China)** Title: Laser fabrication of graphene-based soft robots	**Invited Talk**
11:40-12:00	**Prof. Karl Unterrainer (Technische Universität Wien, Austria)** Title: THz Quantum Cascade Lasers with Novel Active Regions and Resonators	**Invited Talk**
12:30-14:00	***Lunch***	

Agenda - Symposium 9

Venue: Room 1, Academic Exchange Center

Time	Content	
	July 17th	
14:00-15:30	**Session 1, Chair: Tiejun Cui**	
14:00-14:25	**Prof. Tarik Bourouina (Université Paris-Est, ESIEE Paris, France)** Title: Ultra-black silicon: an ultra broadband light absorber with extraordinary wetting properties	**Invited Talk**
14:25-14:50	**Prof. Cheng-Wei Qiu (National University of Singapore, Singapore)** Title: Atomically thin monolayer metasurface	**Invited Talk**
14:50-15:15	**Dr. Kamaraju Natarajan (Indian Institute of Science Education Research Kolkata, India)** Title: NIR femtosecond pulses to probe electron-phonon dynamics in condensed matter systems	**Invited Talk**
15:15-15:25	**Dr. Wenwei Liu (Nankai University, China)** Title: Energy tailorable multi-functional metasurfaces with full fourier components	**Oral Talk**
15:30-16:30	***Coffee Break & Laboratories Visit***	
16:30-18:05	**Session 2, Chair: Tarik Bourouina**	
16:30-16:55	**Prof. Tiejun Cui (Southeast University, China)** Title: Smart metamaterials and metasurfaces	**Invited Talk**
16:55-17:20	**Prof. Shulin Sun (Fudan University, China)** Title: Efficient coupling and wavefront tailoring of surface plasmons with metasurfaces	**Invited Talk**
17:20-17:45	**Prof. Maria Antonietta Loi (University of Groningen, The Netherlands)** Title: Photophysics of Sn-based metal halide perovskites	**Invited Talk**
17:45-17:55	**Dr. Xiaoyi Liu (Université Paris-Est, ESIEE Paris, France)** Title: High-quality multilayer microstructure based upon hybrid SPP mode	**Oral Talk**
17:55-18:05	**Dr. Song Yue (Institute of Microelectronics of Chinese Academy of Sciences, China)** Title: CMOS-compatible plasmonic hydrogen sensors with a detection limit of 40 ppm	**Oral Talk**

19:00-20:00	***Banquet***	
July 18th		
08:30-10:00	**Session 3, Chair: Guilu Long**	
08:30-08:55	**Prof. Luc Thévenaz (Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland)** Title: Optoacoustics in optical fibres: a powerful tool for smart interactions between light and matter	**Invited Talk**
08:55-09:20	**Prof. Yosuke Mizuno (Tokyo Institute of Technology, Japan)** Title: World's fastest distributed Brillouin reflectometry	**Invited Talk**
09:20-09:45	**Prof. Junpeng Guo(University of Alabama in Huntsville, USA)** Title: Plasmonics for sensors and filters	**Invited Talk**
09:45-09:55	**Dr. Peng Chen (Nanjing University, China)** Title: Photo-patterning self-assembled chiral superstructures for optical vortex processing	**Oral Talk**
10:00-11:00	***Coffee Break & Laboratories Visit***	
11:00-12:30	**Session 4, Chair: Luc Thévenaz**	
11:00-11:25	**Prof. Guilu Long (Tsinghua University, China)** Title: Practical quantum secure direct communication	**Invited Talk**
11:25-11:50	**Prof. Sukhdeep Dhillon (Laboratoire de Physique de l'Ecole normale supérieure, ENS, Université PSL,CNRS, Sorbonne Université, Université Paris-Diderot, Sorbonne Paris Cité, Paris, France)** Title: Generating THz pulses from modelocked quantum cascade lasers	**Invited Talk**
11:50-12:00	**Dr. Minjie Wan (Nanjing University of Science and Technology, China)** Title: An overview of infrared search and tracking system	**Oral Talk**
12:30-13:30	***Lunch***	

Agenda - Symposium 10

Venue: Hooke Instruments Co.Ltd

Time	Content	
	July 17th	
14:00-15:30	**Session 1, Chair: Martin J Booth**	
14:00-14:35	**Prof. Chris Xu (Cornell University, USA)** Title: Imaging Deeper and Faster: Watching the Brain in Action with Ultrafast Lasers	**Keynote Talk**
14:35-15:00	**Prof. Judith Su (University of Arizona, USA)** Title: Label-free, single molecule detection using frequency-locked microtoroid optical resonators	**Invited Talk**
15:00-15:25	**Prof. Jiong Ma (Fudan University, China)** Title: Development of super-resolution microscopy for special biological target	**Invited Talk**
15:30-16:30	***Coffee Break & Laboratories Visit***	
16:30-18:00	**Session 2, Chair: Chris Xu**	
16:30-16:55	**Prof. Martin J Booth (University of Oxford, UK & Universität Erlangen-Nürnberg, Germany)** Title: Beyond the World's Largest Telescopes: New Technologies and New Opportunities	**Invited Talk**
16:55-17:20	**Prof. Bei Li (CIOMP, CAS, China)** Title: Applications of Raman spectroscopy in disease diagnosis	**Invited Talk**
17:20-17:55	**Prof. Zhongping Chen (University of California, USA)** Title: Twenty years of Doppler OCT and OCT angiography: translation of functional OCT technology from bench to bedside	**Keynote Talk**
19:00-20:00	***Banquet***	

July 18th		
08:30-10:00	**Session 3, Chair: Bei Li**	
08:30-09:05	**Prof. Tianhong Cui (University of Minnesota, USA)** Title: Shrink Polymer Biosensors: Manufacturing from Micro to Nano	**Invited Talk**
09:05-09:30	**Prof. Pietro Ferraro (Institute of Applied Sciences & Intelligent Systems, Italy)** Title: New perspectives in biomedical sciences: single cell analysis through continuos in-flow phase-contrast tomography	**Invited Talk**
09:30-09:55	**Dr. Peng Liang (CIOMP, CAS, China)** Title: Single cell sorting based on laser induced forward transfer(LIFT)	**Oral Talk**
10:00-11:00	***Coffee Break & Laboratories Visit***	
11:00-12:30	**Session 4, Chair: Tianhong Cui**	
11:00-11:25	**Dr. Ke Wei (National University of Defense Technology, China)** Title: Ultrafast Carrier Transfer and Interlayer Coulomb Coupling in 2D/3D Perovskite Heterostructures	**Oral Talk**
11:25-11:50	**Dr. Deying Luo (Peking University, China)** Title: Reduced non-radiative losses for efficient inverted planar heterojunction perovskite solar cells	**Oral Talk**
11:50-12:15	**Dr. Dongdong Han (Jilin University, China)** Title: Bioinspired graphene actuators prepared by unilateral UV irradiation	**Oral Talk**
12:30-13:30	***Lunch***	

Agenda –'Rising Stars of Light' Final Competition

Time	Content
	July 18th
13:30-15:30	**Session Chair: Martion Booth**
13:30-13:40	**Dr. Chao He (University of Oxford, United Kingdom)** Title: Complex vectorial optics through gradient index lens cascades
13:40-13:50	**Dr. Junsuk Rho (POSTECH,Korea)** Title: Dielectric metasurfaces for holography, color printing and crypto-display
13:50-14:00	**Dr. Hao Sun (Tsinghua University, China)** Title: Observation of excitonic gain in two-dimensional layered semiconductors well below the Mott transition
14:00-14:10	**Dr. Purushothaman Varadhan (King Abdullah University of Science and Technology, Kingdom of Saudi Arabia)** Title: 15% solar-to-fuel conversion using solar-driven CO_2 reduction by employing triple junction III-V photoelectrode
14:10-14:20	**Dr. Hui Wang (University of Science and Technology of China, China)** Title: Towards optimal single-photon sources from polarized microcavities
14:20-14:30	**Dr. Fan Yang (EPFL, Switzerland)** Title: Large nonlinear optical amplification in gas: from sensing to lasing
14:30-14:40	**Dr. Yi Yang (Massachusetts Institute of Technology, USA)** Title: A general theoretical and experimental framework for nanoscale electromagnetism
14:40-14:50	**Dr. Jinwei Zhang (Max-Planck-Institute of Quantum Optics, Germany)** Title: Mode-locking beyond the emission bandwidth limit
14:50-15:00	**Dr. Yinan Zhang (Jinan University, China)** Title: Coloring solar cells with simultaneously high efficiency by low-index dielectric nanoparticles
15:00-15:10	**Dr. Jie Zhao (Australian National University, Australia)** Title: Demonstration of a high-fidelity heralded squeezing gate
15:10-15:30	***Judge round***

The remarkable technological progress in the inspection of high-precision optical surfaces under harsh environmental conditions enabled by instantaneous phase measuring technology.

4D Technology, Tucson, Arizona, USA

Neal J. Brock

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Over the past twenty years interferometers utilizing instantaneous phase technology have enabled the measurement of large optical systems that previously were extremely difficult or impossible to measure. The vibration and large optical paths encountered when testing these optics make conventional interferometric systems virtually useless. Manufacturers of large terrestrial and space-based telescopes such as the James Webb Space Telescope and the Giant Magellan Telescope as well as earth imaging satellites have come to rely on interferometers with instantaneous phase technology for ensuring that their optical surfaces perform as designed. Today dynamic interferometers are deployed in high-technology manufacturing and inspection environments where measurement speed and/or portability can be paramount such as in semiconductor fabs and jet engine re-work facilities. This talk will review several of the different types of dynamic interferometers that have been developed and the challenging applications that they have been used for.

Short Bio:

Neal J. Brock is an accomplished photonics scientist, inventor, author, and entrepreneur. He co-founded 4D Vision Technology in 2000 and 4D Technology in 2002. Previously he held leadership and research and development roles with NASA-Ames Research Center and the commercial metrology companies: Aerometrics Inc., and Metrolaser Inc. He is also a veteran of the USMC and is a retired US Navy Reserve officer. He has published over 55 research papers and one book chapter covering subjects such as flow visualization, high-speed and dynamic interferometry, resonant holographic interferometry, 3D profilometry, and polarimetry. He has several patents awarded and pending. He is also one of the inventors of 4D Technology's core instantaneous phase technology.

Challenges and solutions for the interferometric measurement of aspherical and freeform optics

Zygo Corporation, USA

Peter de Groot

Email: peterd@zygo.com

Interferometers are most accurate when the comparison between the test and reference wavefronts approaches a null test. Consequently, aspherical or freeform surfaces presents significant challenges. Here we consider solutions based on techniques that minimize local slope by means of a sequence of data acquisitions with the object in different positions or orientations. A first approach involves axial scanning through a series of annular fields or measurement zones, where the measured diameter of these zones together with the known axial position provides sufficient information for determining aspheric form. A second approach involves measurement of local surface shape and fine-scale roughness using interference microscopy, followed by software correlation of the high spatial-frequency microstructure to lock together successive measurement fields independent of stage motion. The presentation includes examples of "lessons learned" about asphere and freeform fabrication from detailed interferometric measurements of form and surface texture.

Short Bio:

Peter de Groot is the Executive Director of R&D at Zygo Corporation, where he manages and contributes to innovation and new product discovery. He is also an Honorary Professor at the University of Nottingham, and an active member of the Applied Optics community as a lecturer and author.

Information photonics empowered by artificial intelligence

University of Shanghai for Science and Technology, China

Min Gu

Photonics has been identified as a key enabling information technology platform in industry revolution 4.0. Nanophotonics, which studies optical science and technology at a nanoscale, has enabled the development of optical and photonic devices that provide a green information technology platform that has transformed massively our everyday life and global economy for a sustainable future. On the other hand, artificial intelligence based on ever-increasing computing power including neuromorphic computing has heralded a disruptive horizon in many ways of our life. In this talk, I will show the integration of artificial intelligence with nanophotonics enabling on-chip optical angular momentum multiplexing and vectorial holography. I will also present a potential for generating on-chip photonic neuromorphic computing.

Short Bio:

Min Gu is Executive Chancellor and Distinguished Processor of University of Shanghai for Science and Technology. He was Distinguished Professor and Associate Deputy Vice-Chancellor at RMIT University and a Laureate Fellow of the Australian Research Council. He is an author of four standard reference books and has over 500 publications in nano/biophotonics. He is an elected Fellow of the Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering as well as Foreign Fellow of the Chinese Academy of Engineering. He is also an elected fellow of the AIP, the OSA, the SPIE, the InstP, and the IEEE. He was President of the International Society of Optics within Life Sciences, Vice President of the Board of the International Commission for Optics (ICO) (Chair of the ICO Prize Committee) and a Director of the Board of the Optical Society of America (Chair of the International Council). He was awarded the Einstein Professorship, the W. H. (Beattie) Steel Medal, the Ian Wark Medal, the Boas Medal and the Victoria Prize for Science and Innovation. Professor Gu is a winner of the 2019 Dennis Gabor Award of SPIE.

Beyond the world's largest telescopes: new technologies and new opportunities

University of Hawaii, USA

Jeffrey R. Kuhn

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The World's Largest Telescopes (WLTs) for remote sensing, communication, and astronomy will soon be a few 10's of meters in diameter. Although the opto-mechanical requirements for such large coherent optical systems are severe, after nearly a generation of planning, the construction phase for 20-30 m aperture optical/IR telescopes has begun. These WLTs are close relatives to existing largest optics like the Keck Telescopes on Hawaii. Compelling scientific questions, such as detecting life in the nearby Universe, are already driving the development of more and larger aperture telescopes. Meta-materials and additive manufacturing combined with fast information processing will make large optics beyond the Keck-era feasible at much lower cost. This talk presents some of the physical principles, and engineering progress that illustrate how 100 m-class telescopes could be built within just a few years.

Short Bio:

Jeffrey R. Kuhn is a senior Humboldt prize winner and Sloan fellow. He joined the University of Hawaii Institute for Astronomy in 1996, where he is a Regents Prize professor. He was the founding director of the Institute for Astronomy's Advanced Technology Research Laboratories on Maui, for a decade. His PhD is in Physics from Princeton but he works often in astrophysical problems and on unusual optical and detector systems. Some of his ideas are at the heart of telescopes like the Giant Magellan and the US National Science Foundation's $340M Daniel K. Inouye Solar Telescope, for which he is a co-principle investigator. He is the principle founder of the PLANETS Foundation and MorphOptics Inc.

The solar influence on the terrestrial climate

Physikalisch-Meteorologischen Observatorium Davos and Weltstrahlungszentrum (PMOD/WRC); ETH Zurich , Switzerland

Werner Schmutz

A full assessment of the current climate change requires a characterization of the contribution by natural influences on the observed changes. Such an assessment is also required in order to provide competent answers to climate skeptics. A first estimate of the magnitude of such effects has been recently published by Arsenovic etal. (2018), in which it is concluded that the solar influence might damp the climate warming in a scenario of 4 ℃ warming within the next 100 years by 0.5 ℃. I will present the hypotheses behind this estimate and explain what we know about solar variations and what we don't know. Referencer Arsenovic P., Rozanov E., Anet J., Stenke A., Schmutz W., Peter T., 2018, Atmos. Chem. Phys. 18, 3469, Implications of potential future grand solar minimum for ozone laver and climate.

Short Bio:

Werner Schmutz is since 1999 director of the Physikalisch-Meteorologischen Observatorium Davos und Weltstrahlungszentrum (PMOD/WRC). In 2002 he was awarded the title of adjunct professor at the ETH Zurich. He is an astronomer, investigating the solar radiation and its effects on the terrestrial climate.

He was born on August 29, 1952 in Zürich. Dates of his academic Career: 1979 diploma in Physics, 1984 doctorate in Natural Sciences and 1995 habilitation at the ETH Zurich.

He is president of the Siwss Commission on Space Research and Swiss delegate to COSPAR. He is also president of the International Radiation Commission, a commission of IAMAS and member of the Comité consultative de photométrie et radiométrie of OICM. Since 1991 he is lecturer for various astrophysical themes at the ETH Zurich.

Epitaxial integration of GaSb-based mid-IR devices on silicon

IES, Université de Montpellier, CNRS, France

Eric Tournié

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Sb-based materials rely on the GaSb, InAs, AlSb, InSb binary compounds and their quaternary or pentanary alloys (AlGaAsSb, GaInAsSb, AlGaInAsSb...). This technology exhibits several distinctive properties as compared to other semiconductors: type-I to type-III band alignments, giant band offsets, low effective masses of electrons and holes, direct bandgaps between 0.15 and 1.7 eV. They are particularly well suited to the development of mid-IR optoelectronic devices for sensing applications. The evolution toward smart, integrated, sensors requires integrating GaSb-based optoelectronic devices on Si-based platforms. We have demonstrated a variety of epitaxially integrated optoelectronic devices such as laser diodes, photodetectors and the first ever QCL grown on Si. In this presentation we review the recent results obtained on the integration of antimonide-based optoelectronic devices epitaxially grown on Si substrates. We will show that this technology is very attractive for future III-V on Si integration, and we will discuss future integration schemes.

Short Bio:

Eric Tournié is a Professor of Electrical Engineering at Université de Montpellier (F) where he leads the mid-IR research group of Institut d'Electronique, UMR CNRS 5214. His current work focuses on the epitaxial integration of GaSb-based devices on Si platforms. From 1990 to 1993 he was with the Max-Planck-Institute in Stuttgart (D), working on InAs-based highly-strained heterostructures on InP and GaAs substrates. In 1993 he joined CRHEA/CNRS, Valbonne (F), to work on ZnSe-based heterostructures for blue-green lasers. In 1999 he initiated a program on GaInNAs heterostructures for telecom applications. He has been appointed as a Professor by U. Montpellier in 2002. E. Tournié is a member of the Program Committee and/or Int. Advisory Committee of the Int. Conf. on Mid-Infrared Optoelectronics: Materials and Devices (MIOMD), Int. Molecular-Beam Epitaxy conference (MBE), Int. Symposium on Compounds Semiconductors (ISCS)conference series. He chaired the ISCS 2014, MIOMD 2014 and IC-MBE 2016 conferences. E. Tournié has published more than 250 papers in refereed journals and gave more than 60 invited conferences.

Implement nanometer shape accuracy on large SiC mirror

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Short Bio:

Xuejun Zhang is the Vice President of CIOMPand director of Key Laboratory of Optical Manufacturing and Testing. Dr. Zhang was born in 1968 and works at CIOMP since 1993.Dr. Zhang received his Ph.D degree from Changchun Institute of Optics and Fine Mechanics (CIOMP) in 1997. Dr. Zhang has been engaged in optical system design, manufacturing and testing for more than 20 years, as principle investigator, he has completed numbers of national research projects and won three National Awards for Achievements in Science and Technology (1999, 2008, 2011). He is now in charge of 5 national projects and completed the well-known world largest 4m Class SiC Mirror Technology project in 2018. He is also the leader of the team of 30 Meter Telescope (TMT) Tertiary Mirror Manufacturing. Dr. Zhang is the fellow of SPIE and member of OSA. He has published over 100 peer reviewed technical papers.

Mode engineering of high power semiconductor lasers

CIOMP, CAS, China.

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

Short Bio:

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

A bubble-induced ultrastable and robust single-photon emitter in hexagonal boron nitride

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Jianshun Tang

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Quantum emitters in van der Waals (vdW) materials have attracted lots of attentions in recent years, and shown great potentials to be fabricated as quantum photonic nanodevices. Especially, the single photon emitter (SPE) in hexagonal boron nitride (hBN) emerges with the outstanding room-temperature quantum performances, whereas the ubiquitous blinking and bleaching restrict its practical applications and investigations critically. The bubble in vdW materials exhibits the stable structure and can modify the local bandgap by strains on nanoscale, which is supposed to have the ability to fix this photostability problem. Here we report a bubble-induced high-purity SPE in hBN under ambient conditions showing stable quantum-emitting performances, and no evidence of blinking and bleaching for at least one year. Remarkably, we observe the nontrivial successive activating and quenching dynamical process of the fluorescent defects at the SPE region under low pressures for the first time, and the robust recoverability of the SPE after turning back to the atmospheric pressure. The pressure-tuned performance indicates the SPE origins from the lattice defect isolated and activated by the local strain induced from the bubble, and sheds lights on the future high-performance quantum sources based on hBN.

Short Bio:

Jianshun Tang is currently a professor of University of Science and Technology of China. His primary research field is the quantum light source and its applications in the study of quantum-information technologies and the fundamental problems of quantum physics. Over ten papers have been published in the SCI journals of Nature Photonics (2), Nature Communications (1), Phys. Rev. Lett. (3), Optica (1) etc., as the first or corresponding author. The H factor is 10. He derived the Rao Yutai First Prize in Fundamental Optics in 2016, entered the Youth Innovation Promotion Association of Chinese Academy of Sciences in 2017, and supported by the NSFC Excellent Young Scientists Fund in 2018. The primary research results are described as following. The first observation of the superposition state of the wave and particle properties of light is realized. This experiment "redefines the concept of wave-particle duality", and "defies the conventional boundaries set by the complementarity principle". The nonlocal quantum simulator is realized, and it is used to investigate the no-signalling problem in the parity-time symmetric theory. The temporal multimode quantum memory of the deterministic single photons emitted from the quantum dot is realized, and the number of the memorized modes is the most to date. The power-recycled weak-value-based metrology is realized, whose precision surpasses the precision limit of the classical protocol. Two direct measurement methods of quantum coherence have been developed in the framework of resource theory, which provide more tools for the studies of quantum resource. His researches were reported by scientific medias like Nature Photonics, Nature Physics, New Scientist, Nature China and Phys.org, etc., and several works were cited in the review papers of Review of Modern Physics.

Light Conference 2019

Symposium 1

Aspheres and freeforms: design, fabrication, inspection and application

Co-Chairs :

Wolfgang Osten

Xuejun Zhang

Optical metrology in times of digital transition

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Digitization and digital transition are frequently used terms in modern communication. We are far from underrating these global phenomenons that are strongly connected with the worldwide networking between all domains of the public, private, commercial, and industrial life. Facts as the transition of the classical Data-Internet to the Internet of Things IoT, and Industrial Internet, respectively, are more and more influencing all technologies and thus it is quite appropriate to think about the future of metrology in such a changing environment. But it should be noticed that at least since the widespread introduction of computer technology in the 80ths and 90ths, optical imaging and metrology have already implemented the transition to digital technologies. Methods such as digital image processing, digital holography, digital microscopy, and digital image correlation are state of the art by now. Manifold worldwide installations like digital/virtual/remote labs and robotic telescopes/microscopes support the position, that not only the simple transition from analog to digital but even more the total networking between complex physical entities and a new quality of data acquisition, processing and evaluation are characteristic features for the new quality of imaging and metrology. In this paper we discuss the state of the art, the challenges, and the perspectives of optical metrology in times of digital transition.

Keywords: optical metrology, digital technologies, digital holography, remote metrology, remote laboratories, networking, big data, computational imaging, autonomous driving

Short Bio:

Wolfgang Osten was from September 2002 till October 2018 a full professor at the University of Stuttgart and director of the Institute for Applied Optics. From 2006 to 2010 he was the vice rector for research and technology transfer of the Stuttgart University, from 2015 to 2018 the vice chair of the University Council, and member of the Board of Directors of The International Society for Optics and Photonics SPIE. His research work is focused on new concepts for industrial inspection and metrology by combining modern principles of optical metrology, sensor technology and digital image processing. Special attention is directed to the development of resolution enhanced technologies for the investigation of micro and nano structures. Wolfgang Osten is fellow of OSA, SPIE, EOS, SEM, and senior member of IEEE. He is a Honorary Professor of the Shenzhen University, China, a Honorary Doctor of the University of Technology of Ilmenau, Germany, the 2011 recipient of the Dennis Gabor Award of the SPIE, the 2018 recipient of the Rudolf Kingslake Medal of the SPIE, the 2019 recipient of the Chandra S. Vikram Award of the SPIE, and the 2019 recipient of the Emmett N. Leith Medal of The Optical Society of America OSA.

Unification of system calibration and optical design

Baer – Optical Engineering, Germany

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In the field of software tools for the computation and simulation of optical systems, currently there exist two completely separate areas. On the one hand software tools for the design and simulation of optical systems and components - on the other hand software solutions for the calibration of measuring instruments and sensors. Both areas are indispensable. Without the simulation and optimization capabilities of modern optical design software, it would not be possible to design systems that meet the rising demands in respect to the system performance. However, for real systems these high demands can only be reached if the fabrication of the optical elements can be carried out with the required precision.

Since surfaces can only be fabricated with the accuracy they can be measured, metrology is one of the key enabling technologies for industries like the semiconductor production or precision engineering. Besides the extremely high accuracy also other parameters like flexibility in respect to surface shape or measurement time play an important role. In many cases these parameters can only be reached by a sophisticated calibration of the metrological system. By taking a closer look on optical design and system aberration calibration software we can see that there is a huge overlap in the functionality. For example, both need the ability to trace rays through an optical system. Also the ability to optimize the system in respect to the design specification or - in case of a calibration - in respect to the calibration data plays an important role in both fields.

We present a novel software solution which represents a unification of the world of optical design and calibration. By combining the separate fields in one software package it is possible to achieve a wide range of benefits.

A first advantage is, that the whole development of a measurement device - from the first design sketch to the machine software used within the final product - can be realized using just a single tool and data format. Further through the high flexibility of the approach, it is easy to adapt the calibration to a wide range of measurement devices such as interferometers, deflectometric as well as fringe projection systems. This leads to large savings in time and money when developing such devices.

The main difficulty with the development is the high complexity of the project. We manage to deal with this challenge by lying a strong focus on a highly modular implementation as well as object oriented representation of the optical systems. The gain from this philosophy is a user friendly, intuitive handling of the software even with complex systems. This is especially an advantage with folded systems like EUV-lithography setups or off-axis telescopes, as well as multi-pass systems like interferometers. Furthermore, typical applications in the area of optical design such as scattering- and ghost analyses or the calculation and optimization of system tolerances can be carried out much more efficiently. We will present the main design concepts behind the software as well as first application examples that show the benefits of our novel approach.

Short Bio:

Goran Bastian Baer studied engineering at the university of Darmstadt and Stuttgart. After his diploma he worked as a research associate at the Institute of Applied Optics (ITO) at the University of Stuttgart in the field of interferometry. The focus of his work was the calibration of non-null interferometers for the measurement of aspheres and freeform surfaces, especially the Tilted-Wave-Interferometer. Since 2016 he is working as an independent engineering consultant. In 2017 he started to work on software based solutions that combine the design and calibration process of optical systems.

Non-contact three-dimensional profiler with sub-nanometer precision using normal vector method

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Optical instruments ranging from telescopes that are used to observe large objects such as the galaxies to microscopes that are used to examine small targets including cells are indispensable for the development of fundamental science and advanced industries. The performance of cutting-edge optical instruments is determined by optical components, such as lenses and mirrors, which have a freeform and precision that can closely approach atom-scale precision. The innovation of such advanced optical components, whose function is increased up to its physical limit, requires the development of absolute metrology. To innovate advanced freeform optical components, the form error from the ideal shape is measured by absolute metrology. Such innovation of advanced optical components allows for the observation of new physical phenomena, opens up new avenues in science, and furthers the development of advanced industries globally. For innovative optical elements, the repeatability of shape measurement is required to be sub-nanometer. In the future, optical elements (lenses, mirrors) whose surface shapes are determined by nanoscale uncertainty while being free-form will be developed. In order to manufacture such a high-accuracy optical element, a shape measurement method with guaranteed accuracy and sufficient repeatability is necessary. In this talk, we will propose a noncontact sub-nanometer shape measurement system for tracking the normal vector of the sample surface based on light straightness. When several shapes of optical surface were three-dimensionally measured. This experiment proved that measurement repeatability of sub-nanometer can be obtained.

Short Bio:

Katsuyoshi Endo is the Director of Ultra Precision Science Research Center, Graduate School of Engineering, Osaka University. He completed Master Degree in Precision Engineering, Graduate School of Engineering, Osaka University at 1982. From 1982 to 1986, he was an assistant professor at Department of Precision Engineering, Faculty of Engineering, Kanazawa University. He was a professor in Osaka University at 2001. He is the vice-president of Japan Society of Precision Engineering.

Manufacturing III: atomic and/or close-to-atomic scale manufacturing

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Manufacturing is the foundation of a nation's economy. It is the primary industry to promote economic and social development. To upgrade the manufacturing technology from "precision manufacturing", "high performance manufacturing" to next generation of manufacturing, i.e, Manufacturing III, a new breakthrough should be made in terms of achieving a "leap-frog development". Different to conventional manufacturing, the fundamental of "Manufacturing III" is beyond the scope of conventional theory. It is based on new principles and theories at the atomic and/ or close-to-atomic scale, called ACSM. This keynote speech will address the key issues in ACSM from concept to main characterizations.

Short Bio:

Fengzhou Fang has over 30 years' experience in working in manufacturing science and technology. He was responsible for setting up the Centre of Micro/nano Manufacturing Technology (MNMT) at Tianjin University in 2005. MNMT has been recognised as a leading manufacturing research organization in the world. He has managed a large number of national, international, and industry funded research projects. His specialist areas of interest include micro/nano manufacturing, optical freeform manufacturing, bio-medical manufacturing, ultra-precision machining and metrology. He is a fellow of the International Academy for Production Engineering (CIRP), the International Society for Nanomanufacturing (ISNM), and the Society of Manufacturing Engineers (SME). He served as a council member of CIRP, the chairman of the CIRP Manufacturing Curriculum Committee, and a board member of the Asian Society for Precision Engineering & Nanotechnology (ASPEN). He is the founding president of ISNM and the editor-in-chief of the Nanomanufacturing and Metrology (N&M).

Absolute calibration of smooth surface and cylindrical surface measurement

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[2]*Suzhou H&L Instruments LLC, China*
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Digital interferometer is widely used for evaluating optical surfaces due to its outstanding sub-nanometer accuracy and precision. In this paper, we will summarize its advantages and then describe its applications in industry, especially in both absolute flat and cylindrical surface and measurements. Inner surfaces measurement of cylindrical ring can be achieved without map stitching, by a Fizeau interferometer with a special cone. The alignment of this arrangement, however, is very crucial to the accomplishment. Any small misplacement of the cone or hollow cylinder from their ideal settings may result in large measurement errors. These errors are not intuitive and hard to be removed if their origins are not well understood. In other words, it is very important to know how these measurement errors are generated from the optical misalignment in order to eliminate them. Transmission flat has normally 1/20 wavelength 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 1/100 wavelength PV. We have dedicated our efforts to do so. The theoretical analysis, computer simulations, and experimental validation are presented in the paper.

Keywords: absolute flat measurement, inner surface measurement of cylindrical ring.

Short Bio:

Sen Han obtained his BE and ME from Changchun Institute of Optics and Mechanics, China and Ph.D. from University of Stuttgart, Germany. Dr. Han is the Professor of University of Shanghai for Science and Technology, China, the adjunct professor of University of Arizona and a SPIE Fellow. Dr. Han won R&D 100 Awards twice in USA. Dr. Han is a co-founder for H&L Instruments.

Infrastructure for freeform surface characterization

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Freeform surfaces have become increasingly important and are appearing more and more in new generations of optical surfaces. With a complex nature and containing points that have non-zero Gaussian curvatures by design, we have treated such surfaces as non-Euclidean Geometries and work on the basis that they can no longer be represented using height values over planar lattices, as is the case with current areal surface measurement. This talk focuses on the development of infrastructure for freeform surface characterization, including: discrete/continuous surface metrology representations for non-Euclidean geometries using mesh-based apex normal representations, finding that decomposition (an inverse problem) can be used to solve the non-uniqueness problem of freeform shape; Filtration based on Diffusion Equations (PDEs) and Morphology (alpha-shape) and numeric characterization for parametric surface.

Short Bio:

Xiangqian Jane Jiang holds a UK Royal Academy of Engineering/Renishaw Chair in Precision Metrology and is the Director of the EPSRC Future Metrology Hub. She obtained her PhD in measurement science in 1995, a Professorial Chair in 2003, a DSc for precision engineering in 2007. She received aDamehood in the 2017 Queen's Birthday Honours for services to manufacturing and engineering.

Jane's research involves advanced metrology with two major aspects: i) mathematical models and algorithms for surface texture analysis, filtration and parametric characterisation and ii) optical measurement technologies for embedded sensors/instrumentsapplying to autonomous manufacturing.

Jane is a Fellow of the Royal Academy of Engineering (FREng), a Fellow of the International Academy of Production Research (FCIRP), the Institute of Engineering Technology (FIET). She has published more than 400 journal papers; was awarded a Royal Society Wolfson Research Merit Award in 2006 and the Sir Harold Hartley Medal and IET Innovation Awards in 2014.

Symposium 1

Developments in the field of asphere and freeform measurement

Mahr GmbH Göttingen, Germany

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The significance of aspheres and freeform surfacesis increasing for modern optical systems. Especially for the production of complex optics, metrology is crucial not only for quality assurance, but to enable the production process itself and as a feedback for the optical design. Therefore the capabilities of the measurement equipment have Aspheric to progress together with the capabilities of the manufacturing process. Mahr aims to provide measurement equipment which is specially tailored to the specific production steps and customer needs such as a MarForm LD Aspheric and MarForm MFU 200 Aspheric as highly flexible point scanning measurement machines, and the area-measuring Tilted Wave Interferometer MarOpto TWI 60 with its unique measurement principle.

The Tilted Wave Interferometer MarOpto TWI 60 is based on non-null interferometric principle in order to directly measure aspheres. In contrast to common interferometric measurement of aspheres, the outstanding TWI principle does not need a cost-intensive computer generated hologram (CGH) or stitching. Thus, the measurement time is optimized and a maximum of flexibility is given. Additionally, even the interferometric measurement of optics produced in low numbers becomes economical.

By optimizing mathematics algorithms the capabilities of MarOpto TWI 60 will be enhanced further in order to measure complex optical surfaces with highest measurement precision. The adoption of the algorithms to enable free form measurement will be one of the next steps in the development of the Tilted Wave Interferometer. The talk will show the principle and the latest enhancements of the MarOpto TWI 60 and give an outlook to the adoption to free form measurement.

Highest flexibility for measuring optical elements or molds with multiple functional interfaces is given by the optical probe sensor of the MFU 200 aspheric in combination with the option of combination with a referenced conventional tactile measurement. Current limitations in the surface slope will be overcome by improvement of the acceptance angle of the high-numerical-aperture (HNA) probe and multiple angle measurement. The measurement precision of the machine is improved by the implementation of an athermal compensation and a calibration frame to enhance the measurement volume for 3D measurement.

Mainly software adoptions will enable the measurement of freeform optics with fiducials or integrated, monolithic optics consisting of optical surfaces on multiple, molds with optical surfaces and kinematic guidance faces.

Mahr is strongly focused to develop measuring equipment based on future demand of the optical industry.

Short Bio:

Andreas Lange is head of R&D at Mahr GmbH in Göttingen with locations also in Jena and Tucson/AZ. USA. He studied electrical engineering at the University of Braunschweig/Germany and joined Voith AG in 1990. He worked in the field of electric vehicles and hybrids for more than 20 years with special focus on field theory problems, new control algorithms and high power density electrical storage devices. He joined Mahr in 2012. Mahr GmbH is a leading supplier of metrology for the automotive and optical industry and is also providing ultra high precision instruments to support the PTB in their strive to redefine units like Kilogramm and Meter and constants like Avogardo and Boltzman.

High-precision micro-machining of optical functional surfaces

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High tech and consumer products nowadays include very often components with highly precise functional surfaces for optical key purposes. For mass production of glass or polymer optics dedicated replication processes are usually applied and therefor particular precision molds are required. High-precision micro-machining processes like diamond turning and milling processes are established manufacturing technologies to deliver those kinds of optical and mechanical high precision components and structured surfaces. This presentation will introduce and discuss the relevant machining processes from the fieldof ultra-precision manufacturing with respect to achievable surface finish, figure accuracy and surface integrity as well as the flexibility regarding the geometrical spectrum of forms and structures. Depending on the process kinematicsapplied, various geometries, including freeform and structured surfaces, can be generated; for brittle materials abrasive processes like precision grinding and polishing processes are applied.

Short Bio:

Oltmann Riemer is a mechanical engineer and he graduated from the Technical University Braunschweig. Since 1993 he is working as a research engineer and teaching assistant at the Laboratory for Precision Machining LFM at the University of Bremen (since 2018 Leibniz Institute for Materials Engineering, Bremen). He received his Dr.-Ing. degree from Bremen University in 2001. The focus of his research work is in the area of ultra-precison and micro-machining processes, i.e. specifically diamond turning and milling processes, cutting mechanics, micro machining technologies, and characterization of the surface integrity. Since 2005 he is the responsible head of the Laboratory for Precision Machining and has experience from managing national and international projects; he is principal investigator of national and European funded projects.

From aspheres to non-circular cylindrical optical surfaces – manufacturing and testing

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[2]*Herbert Kubatz GmbH & Co., Berlin, Germany*

Rainer Schuhmann

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Non-spherical surfaces became more and more important in optical systems since manufacturing processes and metrology are available for generating highly sophisticated surface quality. Years ago, different descriptions of aspherical surfaces have been proposed and became part of the optical design process. The main forms of describing aspherical surfaces have been standardized as part of the ISO 10110 series as well as the analysis of measured form deviations within the ISO 14999 series. The application of these basics hadbeen expanded to other forms of surfaces as cylindrical or toric surfaces. Especially non-circular cylindrical surfaces can play an important role in laser line systems or anamorphic systems as aspheres do in rotationally invariant systems. Surfaces with very low or no symmetry can then be described and designed as general surfaces, so-called free form surfaces, as considered by an additional part of the 10110 series. In the talk an overview about actual enhancements of the corresponding ISO standards will be discussed. Furthermore, selected process items, technicalities and results of manufacturing and testing of aspherical and non-circular cylindrical surfaces will be presented.

Short Bio:

Rainer Schuhmann is currently Manager of Metrology and Software Department at Berliner Glas in Berlin. Afterreceipt of Diploma and PhD (Dr.-Ing.) in Physics at the Technical University Berlin in the field of Technical Optics and Optical Design here worked with Schneider Kreuznach as Head of Optical Design Department, with LINOS, former Spindler&Hoyer, in Göttingen as Director R&D and Head of Quality Management and finally as Vice President and Head of Business Division Industrial Manufacturing, withAcritec in Hennigsdorf near Berlin as Managing Director in the sector of Ophthalmic Implants (intra-ocular lenses), and he joined Berliner Glas in 2006. Since 1985 he is member of the German Society of Applied Optics (Deutsche Gesellschaft für angewandteOptik (DGaO), the German Branch of the European Optical Society, from 1998 - 2012 board member of DGaO, first as representative to the EOS Advisory Board, from 2004 - 2008 as President of DGaO, in 2001 he directed the 102nd Annual Meeting of the DGaO in Göttingen. Furthermore he is a longtime member of the European Optical Society (EOS) and of the Optical Society of America (OSA), here today as Senior member. Besides activities in various working groups for standardization at DIN (German Institute for Standardization) he was chairman of Subcommittee SC1 "Fundamental Standards" within Technical Committee TC 172 "Optics and Photonics" of the International Organization for Standardization (ISO)from 2009 – 2017.

Fourier fringe analysis applied to metrology of extreme physical phenomena: A review

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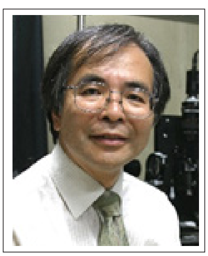
How to extract the desired object information, with highest possible precision and speed, from a temporally and/or spatially modulated quasi-periodic fringe signal has been a critical issue common to all kinds of sensing and metrology that make use of physical waves, such as light waves, acoustic waves, electromagnetic waves, and material waves associated with electrons or atoms. A technique for fringe analysis, today known as Fourier fringe analysis or the Fourier transform method (FTM), was proposed and demonstrated in 1982. Since then, throughworldwide participation of great many scientists and engineers, FTM has been critically analyzed, continuously improved and refined, and has created new areas of cross-disciplinary applications beyond its early applications to traditional optical interferometry and profilometry. This talk presents an overview on yet other applications of FTM to the measurements of extreme physical phenomena including ultrafast/short optical pulses, extremely small atomic displacements, and unconventional electron wave, X-ray and EUV interferometry, and shows how the advantages of FTM are exploited in these cutting-edge application areas.

Short Bio:



Mitsuo Takeda is Adjunct Professor of Center for Optical Research and Education (CORE) at Utsunomiya University, and Professor Emeritus of the University of Electro-Communications (UEC), Tokyo Japan. He received the BE degree in EE from UEC in 1969, and the ME and PhD degrees in Applied Physics from the University of Tokyo, respectively, in 1971 and 1974. After working for Canon Inc., he joined the faculty of UEC in 1977. During 1985 he was a visiting scholar of Prof. J. W. Goodman's Group at Stanford University, and, for the years 2013-2014, an Alexander von Humboldt Guest Professor of ITO at Universität Stuttgart, Germany. He is Fellow of SPIE, OSA, and JSAP, and received Dennis Gabor Award (SPIE), Humboldt Research Award (AvH), Optics and Quantum Electronics Achievement Award (JSAP), and Chandra S. Vikram Award (SPIE).

Ulra-precision ion beam figuring machine and its application

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Very precisely figured plane, spherical and aspherical surfaces with accuracies in depth down to the sub-nanometer level over the entire spatial wavelength range are very important for advanced optics. Large progress for the final optical surface figuring and polishing using sub-aperture processes has been made by different techniques developed during the last years. They are all characterized by a high degree of determinism and CNC process control. Besides different other material removal principles ion beam figuring (IBF) is a favorable technology used in high performance optics fabrication. The talk mainly introduces the principle of ion beam ultra-precision figuring, the key technologies of ion beam processing system, and the application of IBF.

Short Bio:

Chunyan Shi is currently General Manager of Suzhou perfect optics L. td. His PhD graduated from the Chinese Academy of Sciences. From 2010 to 2015, He worked in The Institute of Optics and Electronics, the Chinese Academy of Sciences (IOE), and mainly engaged in ultra-precision optical processing and testing technology research. In 2015, he left IOE to start a business, and was successively awarded some honors such as "Zhangjiagang entrepreneurship talents", "Gusu entrepreneurship talents" and "Jiangsu double entrepreneurship talents".

Light Conference 2019

Symposium 2

High power density white light fluorescent LED

Co-Chairs :

Andries Meijerink

Xiaojun Wang

Luminescent materials for high power density light sources

Utrecht University, Netherlands

Andries Meijerink

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There is an increasing need for high power density light sources, e.g. for the next generation of car headlights, diode laser pumped white light sources and projection devices. However, saturation and droop at high excitation densities limit the light output in high power devices. Excited state absorption and long excited state lifetimes play a role, but the relation between light output and excitation power is a poorly understood and is complex interplay of quenching processes including reabsorption and (transient) color center formation. The development of superior materials is crucial and relies on a better understanding of droop processes and the relation with the nature and processing condition of light conversion materials.

In this presentation，a basic (and hopefully insightful) overview of known luminescence quenching processes will be followed by a discussion on how we can increase our understanding of luminescence quenching with a focus on high power applications. A variety of quenching mechanisms will be evaluated and illustrated for known and new luminescent materials. New experimental and theoretical capabilities will be discussed that may help to acquire new insights in what limits the light output in current and future light sources.

Short Bio:

Andries Meijerink received his MSc and PhD degree in Chemistry at Utrecht University. After a post-doc in Madison (University of Wisconsin) he returned to Utrecht in 1991. In 1996, at the age of 32, he was appointed at the chair of Solid State Chemistry in the Debye Institute of Utrecht University where he leads an active group in the field of luminescence spectroscopy of quantum dots and lanthanide ions. In the field of lanthanide ions his work involves fundamental research on the energy level structure of both $4f^n$ and $4f^{n-1}5d$ states and finding new concepts related to applications in solar cells, LEDs and scintillators, including the discovery of down conversion. Andries Meijerink received several awards, including the Shell Incentive Award (1995), the Gold Medal of the Royal Dutch Chemical Society (1999) and the Centennial Award for Luminescence and Display Materials from the Electrochemical Society (2002). In 2009 he was elected into the Royal Dutch Academy of Sciences.

Functional optical materials and their spectroscopies

Georgia Southern University, USA, China

Xiaojun Wang

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Optically functional materials have attracted great interests from commercial applications to fundamental research, such as phosphor-converted LEDs for illumination, bio-imaging and labeling, photothermic effects, optical anti-counterfeiting, and agri-photonics. We have focus our research on the spectroscopic properties of the functional materials, from ultra-violet to infrared as well as electron paramagnetic resonance, and the dynamical processes during the excitation, spectral conversion, and persistent emission.

Short Bio:

Xiaojun Wang received his PhD degree in Solid State Physics from The University of Georgia, USA. Currently, he is a Professor of Physics at Georgia Southern University, USA.

Narrow emission band phosphors for the application in LEDs

National Taiwan Univeristy, China

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Light-emitting diodes (LEDs) are widely used around the world. Scientists are attempting to develop LED devices that do not only have high brightness but also have a high color rendering index (CRI). Phosphor materials play important roles in tuning and optimizing the final luminescent spectrum. Narrow-band emission phosphors must be incorporated into LED chips to achieve high CRI and efficacy. From this perspective, we introduce and discuss key points in the narrow-band emission spectrum. Three sets of phosphor examples, namely, Eu^{2+}-doped (Ba,Sr)$Si_2O_2N_2$, UCr_4C_4-type structures, and β-SiAlON systems, are used to explain these points. First, we discuss the highly symmetrical local coordination environment of activators, which include cuboid and nine-coordinate structures. Second, we reveal the second shell effect of the substituted cation channel. Third, we discuss the interaction between the electron from the activator and the vibration from the host lattice (electron-lattice interaction). These model systems help establish and design rules for narrow-band emission phosphors and may guide future studies in discovering potential phosphor candidates for practical applications.

Short Bio:

Rushi Liu is currently a Distinguished Professor at the National Taiwan University. University of Minnesota. He received his Bachelor degree in Chemistry from Soochow University (Taiwan) in 1981. He got his Master Degree in nuclear science from the National Tsing Hua University (Taiwan) in 1983. He obtained two Ph.D. degrees in Chemistry from National Tsing Hua University in 1990 and from the University of Cambridge in 1992. He joined Materials Research Laboratories at Industrial Technology Research Institute as an Associate Researcher, Research Scientist, Senior Research Scientist and Research Manager from 1983 to 1995. Then he became an Associate Professor at the Department of Chemistry of the National Taiwan University from 1995 to 1999. Then he promoted as a Professor in 1999. In July 2016, he became the Distinguished Professor. He got the Excellent Young Person Prize in 1989, Excellent Inventor Award (Argentine Medal) in 1995 and Excellent Young Chemist Award in 1998. He got the 9th Y. Z. Hsu scientific paper award due to the excellent energy saving research in 2011. He received the Ministry of Science and Technology award for distinguished research in 2013 and 2018. In 2015, he received the distinguished award for Novel and Synthesis by IUPAC & NMS. In 2017, he got the Chung-Shang Academic paper award. In 2018 he received the highly cited researchers by Clarivate Analytics and Hou Chin-Tui Award. His research is concerning in the Materials Chemistry. He is the author and co-author of more than 560 publications in scientific international journals with total citations > 14,838, h-index: 63. He has also granted more than 200 patents.

$Gd_3Al_4GaO_{12}$: Ce^{3+} Transparent ceramics for high-power LEDs and LDs with warm white light

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Transparent ceramics (TCs) are promising for high-power (hp) white light-emitting diodes (WLEDs) and laser diodes (LDs) lighting. However, comfortable warm white light has not been achieved only using a single TC in hp-WLEDs/LDs. Herein, the highly transparent $Gd_3Al_4GaO_{12}$: Ce^{3+} (GAGG: Ce^{3+}) TCs were prepared via a solid state reaction. Microstructures were investigated by SEM and the cathodo luminescence (CL) system. For blue hp-LEDs or LDs, warm white light with a low correlated color temperature (CCT) from 2800 to 3000 K were achieved by the single GAGG: Ce^{3+} TC, benefiting from its broad emission band (full width at half maximum, FWHM = 133-137 nm) and abundant red components (peaking at about 568-574 nm). These results are much better than the performance of the traditional $Y_3Al_5O_{12}$: Ce^{3+} (YAG: Ce^{3+}) TC, indicating that GAGG: Ce^{3+} TCs are promising color converters for hp-WLEDs/LDs with a comfortable warm white light.

Short Bio:

Yongfu Liu received his Bachelor degree in Physics from Jiangsu Normal University in 2007. He obtained his Ph.D. degrees in Condensed Matter Physics from Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS) in 2012. He became an engineer at Xi'an Institute of Microelectronic Technology from 2012 to 2014. Then he joined Opto-Electronic Materials and Devices Research Laboratories at Ningbo Institute of Materials Technology and Engineering (NIMTE), CAS as an Assistant Researcher and Associate Researcher from 2014 to now. He got the Meiso Yokoyama Outstanding Doctor Scholarship, the Outstanding Graduate, and Excellence Award of President Scholarship of CAS in 2012. He became a member of Youth Innovation Promotion Association of NIMTE, CAS in 2016. He received one of the 20 best articles from Chinese scientists from IOP Science in 2011. He received three cover papers in 2015 and 2017. He got one of the Ten Scientific News of Rare Earths of China in 2017 due to the excellent luminescent material research for healthy lighting. His research is concerning in the Luminescent Materials and Transparent Ceramics. He is the author and co-author of more than 50 publications in scientific international journals with total citations > 850, h-index: 16. He has 13 granted patents.

Composite ceramic phosphors for high-powerwhite LED applications

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[2]University of ChineseAcademy of Sciences,China

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In order to meet the increasing demand of high-power light-emitting-diode (LED) lighting, state-of-the-art white light-emitting diode technology needs phosphors with high thermal conductivity and high luminous efficacy as color converters. In this work, we developed different composite ceramic color converters of yellow-emitting phosphor Ce: GdYAG with high color rendering index combined with the thermally stable Al_2O_3 or $MgAl_2O_4$, using the solid-state reaction method under vacuum sintering. These evenly distributed secondary particles can not only improve the thermal conductivity of the ceramics, but also promote the blue light absorption and extraction efficacies.The composite ceramics exhibit high reliability after high temperature and high humidity, thermal cycling and xenon lamp aging tests. After being packaged with blue light-emitting diode (LED), the high luminous efficacy values of 112.6 lm/W and 108.4 lm/W are achieved by the Al_2O_3-Ce: GdYAG and $MgAl_2O_4$-Ce: GdYAG composite ceramic phosphors, respectively, as well as the color rendering index (CRI) values higher than 70. The scattering nature of these composite ceramic phosphors makes them ideal and promising candidates for high-brightness white LEDs.

Short Bio:

Jiang Li is a professor of Key Laboratory of Transparent Opto-functional Inorganic Materials, Chinese Academy of Sciences, Shanghai. Professor Li holds the PhD degree from Shanghai Institute of Ceramics, Chinese Academy of Sciences. Now he is the deputy director of the transparent ceramics research centre in Shanghai Institute of Ceramics, Chinese Academy of Sciences. Prof. Li's research focuses on laser ceramics, scintillation ceramics, magneto-optical ceramics, and fluorescent ceramics for white LED. He is the coordinator and participant in about 20 domestic and 5 international collaborative projects so far in the field of transparent and opto-functional ceramics. He produced more than 280 original papers (more than 160 for the first author and the corresponding author) in refereed international and domestic journals, 3 co-authored textbooks and one co-authored book chapter.

Our recent progresses in perovskite solar cells and perovskite quantum dots

Jilin University, China

Hongwei Song

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Recently, halide perovskite materials have attracted extensive attentions because of their unique physical properties and great application potentials in the fields of solar cells, light emission diodes and photoelectric detectors. Here, we present some of our recent results on improving the photoelectric properties of perovskite solar cells and expanding photoluminescent properties of perovskite quantum dots through rare earth doping or insulating various rare earth doped nanophosphors. By introducing down-conversion or up-conversion phosphors, the power conversion efficiency of the perovskite solar cells are highly enhanced, and the light stability and long-time stability of the cells are considerably modified. In addition, the solar cells with storage function are developed. It should be also highlighted that through doping rare earth ions into lattices of the perovskite quantum dots, a novel type of quantum cutting phosphors with quantum yield close to 200% are discovered, which can largely improve the power conversion efficiency of c-Si and thin solid film solar cells.

Short Bio:

Hongwei Song received his Bachelor degree in Physics from Jilin University in 1989. He got his Ph.D. Degree in Condensed Material Physics from Changchun Institute of Physics, Chinese Academy of Science (CAS) in 1996. From 1996. to 2000, he worked as a post-doctoral researcher in Institute of Physics, CAS; Nagoya Institute of Technology, University of California at Berkeley, in turn. In 2000, he was nominated as the member of One Hundred Talent Project of CAS, and joined Laboratory of Excited State Physics, CIOMP as a professor. He has been working as a professor of physical electronics in Jilin University since 2007. He obtained the financial support of National Talent Youth Foundation in 2009. He received Second Award,Natural Science Award of Education Ministry in 2008; First Award, Science and Technology Award of Jilin Province in 2010; Second Award, the National Award for Natural Sciences in 2011. He was nominated as one of Leading Talents in Science and Technology,Ten Thousand Talent Project in 2019. From 2014 to 2018, he was ranked in List of Highly Cited Scholars in China. He is the author and co-author of more than 320 publications in scientific international journals with total citations > 8500, h-index: 53. He has more than ten granted patents.

Performance of light sources based on laser excited phosphor conversion

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Matthias Sabathil

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Light-generating devices based on phosphor conversion have significantly evolved on a scale of output flux and white light luminance and extend to the range where competition with the brightest arc discharge-based sources is ongoing. Solid state light sources are unique in that they can provide both an expanded emission spectrum and high luminance. The efficiency of high luminance semiconductor pumped phosphor sources depends not only on efficient generation of primary radiation from the semiconductor (LEDs or laser diode), but also strongly on the conversion material which is being pushed to optical and thermal limits. The rationale and basic principles behind such sources based on luminescence conversion of laser pump sources are reviewed, along with main applications and market need considerations for such devices. Critical materials characteristics and physical mechanisms that control overall source performance will be discussed, also the expected interplay of material characteristics and laser conversion performance. We have separated contributions from thermal and non-thermal quenching mechanisms, and point out the distinction between the true loss mechanisms (e.g. Auger-like or excited state absorption related) and the decline in converted light output due to increased transparency for the pump light (due to activator ground state depletion). The main challenges and outlook on future will be briefly discussed: where is the laser based lighting expected to continue from here?

Short Bio:

Matthias Sabathil is currently the Global Head of Product Development General Lighting in OSRAM Opto Semiconductors (Malaysia) Sdn. Bhd. He has been working in OSRAM for 14 years and 4 months. His journey with OSRAM started in 2004 as a development engineer in OSRAM Regensburg, Germany. After 5 years, he was promoted to become the Senior Manager in Modeling, who was the leader for a team to support projects with multi-physics simulations. In year 2012, Dr. Matthias became the Director for Predevelopment. He was the Head of Advanced Concepts and Engineering Department, heading a department of five groups from epitaxy, chip technology, phosphors to packages and modeling with the mission to create, research and advance novel concepts for future products. At present, Dr. Matthias is responsible for the product development within the OSRAM segment general lighting.

Chromaticity-tunable phosphor-in-glass for long-lifetime high-power warm w-LEDs

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Owing to the merits of high luminous efficiency, low power consumption, and good reliability, white light-emitting diodes (w-LEDs), made of InGaN blue-emitting chip and YAG: Ce^{3+} yellow phosphor, have found wide spread applications in the fields of lightings and displays. Despite these advantages, the current main stream w-LED products suffer from tough issues of red deficiency and poor thermal stability in high-power condition. Aiming to solve these problems, we are engaged in developing chromaticity-tunable phosphor-in-glass (PiG) color converters by incorporating the commercial CASN: Eu^{2+} or the synthesized Mn^{4+} activated red phosphor (e.g., $CaMg_2Al_{16}O_{27}$: Mn^{4+} and $BaMgAl_{10}O_{17}$: Mn^{4+}, Mg^{2+}), accompanied with the YAG: Ce^{3+} yellow phosphor, into low-melting inorganic glass matrix. Benefiting from supplement of the red-emissive component in electroluminescent spectrum, CRI and CCT ofthe fabricated w-LED are greatly improved. Thanks to the excellent thermal/chemical stability of inorganic glass, the long-term heat-radiation induced yellowing and aging of high-power w-LED using the conventional organic encapsulant can be well overcome.

Short Bio:

Yuansheng Wang received his BS from University of Science and Technology of China (USTC), MS from Institute of Solid State Physics, Chinese Academy of Sciences (CAS), and Ph.D in Condensed Matter Physics from USTC (1989). He was appointed Professor of Chemistry in Fuzhou University, China in 1999. He has joined Fujian Institute of Research on the Structure of Matter (FJIRSM), CAS since 2002, leading a group conducting researches on advanced optical materials. Since then, he has published over 180 papers in peer-reviewed academic journals, and received more than 7000 citations, with h-index of 50.

New strategy, luminescence properties and the mechanism of high-efficiency moisture-resistant micro-nano narrow-band luminescent materials for wide color gamut display

Sun Yat-Sen University, China

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Micro-nano narrow-band emitting luminescent materials, especially fluoride red phosphors and all inorganic perovskite nano- crystals, are the key and core materials in the frontier hotspots such as advanced display devices. Unfortunately, they have poor moisture resistance, which is one of the main technical bottlenecks that greatly limit their potential application in the future. Here we introduce several new strategies for improving moisture resistance proposed by our group in recent years, including the organic compound coating or organic framework compound nesting and homogenous inorganic compound core-shell coating. The water erosion mechanisms of the above micro-nano narrow-band luminescent materials with excellent moisture resistance properties, are deeply and reasonably discussed. Finally, we successfully demonstrate the fabrication of the white LEDs with Wide Color Gamut using the above mentioned micro-/nano- narrow-band emitting luminescent materials with improved moisture resistance.

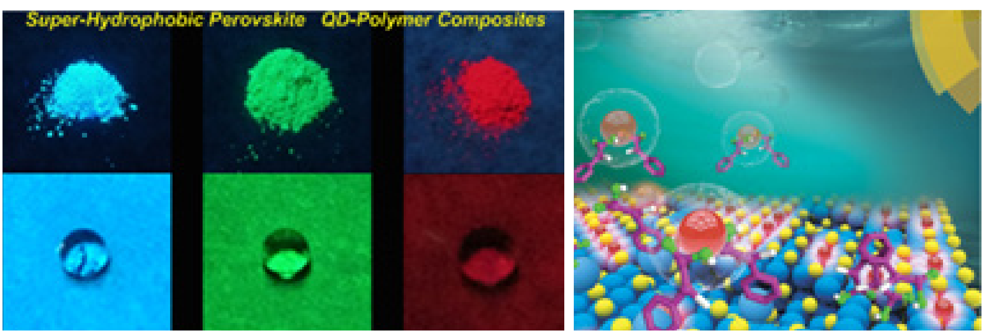

Fig. 1 (Left) Pictures of blue, green and red emitting super-hydrophobic perovskite QD polymer composites and (Right) a novel reductive DL-mandelic acid loading approach for moisture-stable Mn^{4+} doped fluorides

Short Bio:

Jing Wang received his Bachelor degree in Chemistry from Northwest University (China) in 1999. He got his Master Degree and Ph.D. degrees in Chemistry from Changchun Institute of Applied Chemistry, Chinese academy of sciences (China) in 2001 and 2004. He joined School of Chemistry of the Sun Yat-Sen University as an Lecturer from 2004 to 2005. Then he became an Associate Professor at the School of Chemistry of the Sun Yat-Sen University from 2006 to 2013. Then he promoted as a Professor in 2014. He got the Outstanding Talents Award (Sun Yat-Sen University) in 2010, Guangdong Province Science and Technology Award in 2014, Foshan Science and Technology Award in 2015 and Guangzhou Science and Technology Award in 2016. His research is concerning in the Nanoscience and Optical Functional Materials. He is the author and co-author of more than 100 peer-reviewed publications in scientific international journals with total citations > 3600, h-index: 38. He also has more than 15 international and national granted patents.

Design of luminescent materials for laser-driven solid state lighting

Xiamen University, China

Rongjun Xie

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Laser-driven solid state lighting is now attracting great attention due to its super-high brightness, directionality, compactness and high luminous efficacy, therefore is potentially used in high-beam headlamps of vehicles, sports stadium, airport, cinema projectors, and etc. As the primary blue laser diodes (LDs) have a much higher powder density than blue LEDs, traditional down-conversion luminescent materials used for w-LEDs usually show serious luminance saturation under high-power blue LD irradiations. Although the mechanism of luminance saturation is not fully understood, the temperature-induced luminescence quenching is considered as one of major reasons. To reduce the thermal quenching, the luminescence materials used in laser-driven solid state lighting must have the high capability of heat dissipation. The common phosphor-in-silicone cannot be used as it is carbonized under high-power laser irradiation. In this work, we design and investigate three types of luminescent materials for laser lighting: phosphor-in-glass bulks, phosphor ceramics and phosphor-in-glass films. The luminance saturation and optical properties (luminance and luminous efficacy) of these luminescent materials will be presented and discussed. The laser-driven white light will be also demonstrated in the presentation.

Short Bio:

Rongjun Xie is currently a Professor in College of Materials at Xiamen University. He worked as a post-doc at National Institute for Research in Inorganic Materials (Japan) from 1998–2000, at National Institute of Advanced Science and Technology (Japan) from 2001–2002, and as an Alexander von Humboldt Fellow at Darmstadt University of Technology (Germany) from 2002–2003. He joined National Institute for Materials Science (NIMS, Japan) as a Senior Researcher since 2003 and was promoted to Chief Researcher in 2014. Since 2018, he is a full professor at Xiamen University (China). He was a visiting professor at Eindhoven University of Technology in 2011. He is an Editor for Journal of the American Ceramic Society.

Symposium 2

Structural design and emerging LED applications of the UCr_4C^4-type phosphors with narrow-band emission

South China University of Technology, China

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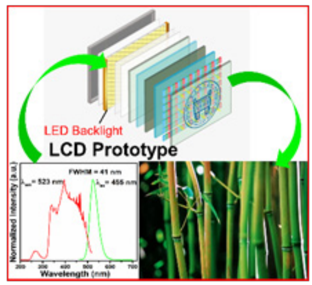

Fig.1

Phosphor-converted white LED strategy relies on combining a single blue-emitting InGaN chip with one or more luminescent materials that emit in the remaining part of the visible spectrum. The discovery of high efficiency narrow-band green-emitting phosphors is a major challenge in backlighting LEDs, while the cyan-emitting (470−500 nm) phosphor is a challenge to realize the full-spectrum white LED lighting. UCr_4C_4-type crystal structure plays an important role in the discovery of the narrow band phosphors, and Schnick's group firstly discovered the novel nitride phosphors in this system. Very recently, our group reported oxide-based UCr_4C_4-type phosphors, $RbLi(Li_3SiO_4)_2$: Eu^{2+} (FWHM = 42 nm, λ_{em}= 530 nm) and $RbNa3(Li_3SiO_4)_4$: Eu^{2+} (FWHM = 22.4 nm, λ_{em}= 471 nm), with excellent thermal stability.

Short Bio:

Zhiguo Xia received his PhD degree (Inorganic Chemistry) from Tsinghua University (Beijing, China) in 2008. He is now a professor in South China University of Technology, and also a member in the State Key Laboratory of Luminescent Materials and Devices. He is a committee member in the Rare Earth Phosphor and Luminescence branch of The Chinese Society of Rare Earths. His research interests covers the inorganic solid state chemistry and spectroscopic study of the rare earth doped luminescence materials. He has more than 160 papers on phosphors in international journals, such as, J. Am. Chem. Soc. (4), Adv. Mater. (1), Adv. Funct. Mater. (3), Chem. Mater. (7), and several review papers in Prog. Mater. Sci., Chem. Soc. Rev., and Acc. Chem. Res., and has more than 4500 citations with H-index 46.

Perovskite light-emitting diodes based on spontaneously formed submicrometre-scale structures

Nanjing Tech University, China

Yu Cao

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Light-emitting diodes (LEDs), which convert electricity to light, are widely used in modern society—for example, in lighting, flat-panel displays, medical devices and many other situations. Generally, the efficiency of LEDs is limited by nonradiative recombination (whereby charge carriers recombine without releasing photons) and light trapping. In planar LEDs, such as organic LEDs, around 70 to 80 per cent of the light generated from the emitters is trapped in the device, leaving considerable opportunity for improvements in efficiency. Many methods, including the use of diffraction gratings, low-index grids and buckling patterns, have been used to extract the light trapped in LEDs 6–9. However, these methods usually involve complicated fabrication processes and can distort the light-output spectrum and directionality. Here we demonstrate efficient and high-brightness electroluminescence from solution-processed perovskites that spontaneously form submicrometre-scale structures, which can efficiently extract light from the device and retain wavelength- and viewing-angle-independent electroluminescence. These perovskites are formed simply by introducing amino-acid additives into the perovskite precursor solutions. Moreover, the additives can effectively passivate perovskite surface defects and reduce nonradiative recombination. Perovskite LEDs with a peak external quantum efficiency of 20.7 per cent (at a current density of 18 milliamperes per square centimetre) and an energy-conversion efficiency of 12 per cent (at a high current density of 100 milliamperes per square centimetre) can be achieved—values that approach those of the best-performing organic LEDs.

Short Bio:

Yu Cao is a PhD candidate in Nanjing Tech University, engaged in the research on perovskite light-emitting diodes (LED). He achieved high performance perovskite LED with a record efficiency of more than 20% in 2018. This work was published in Nature. Until now, he has published more than 10 papers as co-authors. He has won the National Scholarship in 2018.

Symposium 2

Light Conference 2019

Symposium 3

Intelligent optical imaging system and application (in Chinese)

Chair :

Jianli Wang

Light Conference 2019

Symposium 4

Terahertz technology and applications

Chair :

Yan Zhang

Nonlinear terahertz spectroscopy of III-V semiconductor quantum wires and quantum wells using a free-electron laser

Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Germany

Harald Schneider

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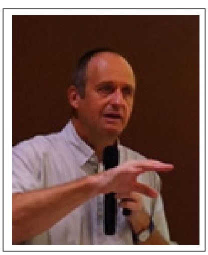
This talk reviews some recent experiments using intense narrow-band terahertz (THz) fields from a free-electron laser for exploring electronic properties in semiconductor nanostructures. In n-type III-V semiconductor nanowires (NW), intense THz excitation causes a nonlinear plasmonic response, which manifests itself by a strong red shift of the plasma resonance. This nonlinearity is investigated by scattering-type scanning near-field infrared microscopy. For the NW sunder study, a spectrally sharp plasma resonance, located at a photon energy of 125 meV for weak excitation, undergoes a power-dependent redshift to about 95 meV. We attribute this nonlinearity to an increase of the effective mass caused by transient carrier heating. In another experiment, we use strong narrowband THz excitation to dress the 2-3 intersubband transition in a 40 nm wide GaAs quantum well (QW). The resulting nonlinearities are explored by THz time-domain spectroscopy using synchronous broadband THz probe pulses and electro-optic sampling. Tuning the THz pump beam into resonance with the 2-3 intersubband transition, we have investigated the induced coherent signatures in the vicinity of the 1-2 intersubband transition and found evidence for mixed light-matter states in the QW giving rise to a THz Autler-Townes effect.

The presented work was conducted in collaboration with D. Lang and J. Schmidt (HZDR) who did most experiments, L. Balaghi, E. Dimakis, M. Helm, R. Hübner, D. Lang, A. Pashkin, S. Winnerl (HZDR), and S.C. Kehr, L.M. Eng (TU Dresden, Germany).



Short Bio:

Harald Schneider is the head of the Spectroscopy Department at the Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Germany, since 2005, and faculty member at the University of Freiburg, Germany, since 2003. From 1989 to 2005 he was with the Fraunhofer-Institute for Solid State Physics, Freiburg, Germany. He completed his Ph. D. degree in physics at the Max-Planck Institute for Solid-State Research, Stuttgart, Germany, in 1988 and his Habilitation at the University of Freiburg, Germany, in 2003. His research interests include optoelectronic properties of semiconductor nanostructures and 2D materials, ultrafast and terahertz spectroscopy, and infrared detectors and lasers. His department is also the main user of the free-electron laser FELBE at HZDR.

All-dielectric terahertz metasurfaces and meta-devices

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[2]*School of Electrical and Computer Engineering, Oklahoma State University, Stillwater, Oklahoma, United States*

Weili Zhang

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Recent advances in plasmonics and metamaterials have opened up a pathway toward integrated functional terahertz devices. Composite materials comprised of subwavelength-sized resonators arranged in a periodic array may be designed to interact with the terahertz field of propagating or surface waves in ways not observed in natural materials. However, meta-systems made from thin metallic films are subject to strong ohmic losses inherently decreasing the efficiency. We study all-dielectric metasurfaces using the state-of-the-art terahertz time-domain spectroscopy and terahertz near-field spectroscopy in both fee space and near-field with an ultimate goal of developing high-efficiency next-generation integrated devices and components functioning at terahertz frequencies.

Short Bio:

Weili Zhang joined the faculty of Tianjin University in 1992 and Oklahoma State University in 2002. He is currently professor of Electrical Engineering at Oklahoma State University and visiting professor of the Center for Terahertz Waves at Tianjin University. His research interests include terahertz optoelectronics, nano- and micro-structured materials optics, and ultrafast phenomena. He serves as Associate Editor of PhotoniX, Topical Editor of Chinese Optics Letters, and Editorial Board Member of a number of peer-reviewed journals. He is a Fellow of the Optical Society (OSA).

Symposium 4

Metasurfaces and original design for terahertz microscopy

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Tahsin Akalin

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Metasurfaces are becoming one growing field of research in the domain of controlling electromagnetic waves in different frequency ranges from visible and infrared to terahertz waves. In this talk, I will focus on their design and applications at terahertz frequencies. Among the applications, the state of the art for terahertz near field microscopy will be particularly described and original terahertz probes will be presented.

Short Bio:

Tahsin Akalin is currently Associate Professor at IUT A Lille, France. His main research activities concern the control of Terahertz waves. He works on periodic structures including metamaterials and metasurfaces for propagating, filtering, absorbing and radiating structures and the development of a new kind of probes for near field microscopy. He is co-author of more than 150 international communications and one book chapter with more than 30 invited and keynote talks for major conferences. He serves as a reviewer for several journals including Nature Publishing Group. He serves also as a TPC member for several international conferences: IEEE-APMC, IEEE-MMS, Meta' conferences, Photonics Global Conference, IEEE-IRMMW-THz, Surface Plasmon Photonics, OTST, Metamaterials etc. He has organized and chaired several special sessions on THz Plasmonics and Metamaterials for international conferences. He has also given seminars and invited lectures in different Universities around the world (UCLA in USA, Osaka Univ in Japan, UESTC and HKUST in China, Ecole Polytechnique de Montreal in Canada, UPNA in Spain, NTU in Singapore). He is also a co-editor of a Focus issue for the New Journal of Physics on "Terahertz Plasmonics". He is a guest-editor of a special issue on "THz Metamaterials and Applications" for the IEEE-Terahertz Science and Technology journal. He is a co-guest-editor for IOP-Journal of Optics of a special issue on "THz Photonics" and for a special issue on "Terahertz Near Field Microscopy" for IEEE-TST journal.

He is an Editorial Board Member of Scientific Reports (Nature Publishing Group) and Editorial Board member of Applied Metamaterials for EJP. He is an Associate Editor for IET-Electronics Letters. Since 2011, he is a European Microwave Lecturer (EML) for the European Microwave Association (EuMA). He has served as a member of the IEEE French Bureau for MTT and TAP societies. He is Vice President of URSI-France and also Vice-President of commissions B for URSI-France. He serves as an expert for research agencies in different countries.

Wireless THz-to-optical conversion with an electro-optic plasmonic modulator

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Wolfgang Freude

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High-speed wireless last-mile access is a promising pathway for service providers to scale up existing photonic networks without the trenching of optical fibres. A seamless connec-tion of the wireless and the optical domains would be highly desirable. Recently, line rates of 10 Gbit/s were transmitted over wireless distances of 5 mata carrier frequency of 60 GHz. The data became directly converted to photonic signals with a plasmonic modulator. However, for supporting the envisaged data rates up to 100 Gbit/s, carrier frequencies in the terahertz range are required. Therefore, and because the frequency spectrum beyond 0.275 THz is not yet regulated, interest in wireless THz communications has tremendously increased. Optoelectronic signal processing is the preferred technology for optical-to-terahertz conversion. In this talk we present a solution for a direct tera-hertz-to-optical conversion. A 0.2885 THz carrier is modulated with QPSK data at 50 Gbit/s, received over a 16 m long wireless link, and controls the input of an electro-optic plasmonic-organic hybrid (POH) modulator ($U_\pi L$ = 240 V μm). The modulator has a bandwidth beyond 0.360 THz and directly transfers the received THz signal to an optical carrier with a wavelength of 1.55 μm.

Symposium 4

Short Bio:

Wolfgang Freude is a professor at the Institute of Photonics and Quantum Electronics, Karlsruhe Institute of Technology (KIT), Germany, a Distinguished Senior Fellow at KIT, and an Honorary Doctor of the Kharkov National University of Radio electronics, Kharkov, Ukraine. His research activities are in the area of optical and wireless high-data rate transmission using high-density integrated optics with a focus on silicon photonics. He has authored and co-authored more than 300 papers, a book and 5 book chapters. Among other engagements, he serves in the Steering Committee of the "Conference on Integrated Optics (ECIO)" since 2018 and in the Technical Programme Committee "Photonic Networks and Devices" (OSA Advanced Photonics Congress) since 2013. He is an Editorial Board Member of Light: Science & Applications since 2016.

Holography from thermal infrared to terahertz in view of applications in metrology and nondestructive testing

Liège Université Centre Spatial de Liège - STAR Unit, Belgium

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Phase is a physical quantity of optical waves which is important for imaging, sensing and measurement purposes. Holography allows capturing phase of an object or a scene from which many information can be retrieved, unlike traditional imaging. Holography is used in many applications, from artistic display to microscopic imaging in the biomedical field. Also through interferometric phase comparison, one can observe any change in the object. This is an important field of research in engineering, where movements or deformation of object can be followed during an evolving stress, for instance. In this talk we will show the possibilities offered by long wavelengths (from thermal infrared to Terahertz waves), in holography and some engineering applications, such as metrology of large space structures and nondestructive testing of aerospace materials.

Short Bio:

Marc P. Georges was graduated in physics at the Université catholique de Louvain (Belgium) in 1989. He received a joint master diploma in Instrumentation and Measurement from the same university and Imperial College of London in 1990. Then he joined the Centre Spatial de Liege (CSL, a Centre of Excellence in Optics of the European Space Agency) at the Liege University (Belgium), where he worked on several projects related to development of holographic metrology methods and devices for aerospace structures. He received his PhD in 1998 from the same university. Since 2006 he is responsible of the laser and nondestructive testing laboratory of the CSL. He leads researches and developments in optical metrology by various coherent and uncoherent imaging methods for assessing the behavior of space structures under space simulated environments. Also he develops innovative nondestructive testing methods of aerospace composites (visible and thermal infrared holography, thermography, laser ultrasonics, Terahertz wave imaging and holography). He is SPIE Senior member, OSA and EOS member. He is author and co-author of scientific papers, invited journal papers and conferences, keynote speeches and book chapters. He is Chair of the Unconventional Optical Imaging SPIE conference (Strasbourg 2018, 2020), program chair of the Digital Holography and 3D Imaging OSA conference (Bordeaux 2019), Symposium chair of the SPIE Optical Metrology (Munich 2019) and in the Steering Committee of World of Photonics Congress (Munich 2019). He also serves as Topical Editor of Applied Optics journal and is guest editor of various SPIE and OSA journals devoted to holography and coherent imaging.

Efficient manipulations of circularly polarized terahertz waves with transmissive metasurfaces

Fudan university, China

Qiong He

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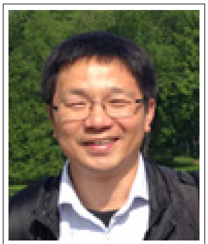
The unrestricted control of circularly polarized (CP) terahertz (THz) waves is important in science and applications, but conventional THz devices suffer from issues of bulky size and low efficiency. While Pancharatnam-Berry (PB) metasurfaces have shown strong capabilities to control CP waves, transmission-mode PB devices realized in the THz regime are less efficient, limiting their applications in practice. Here, based on Jones matrix analysis, we design a tri-layer structure (thickness of~ λ/5) and experimentally demonstrate that the structure can serve as a highly efficient transmissive meta-atom (relative efficiency of ~ 90%) to build PB metadevices for manipulating CP THz waves. Two ultrathin THz metadevices are fabricated and experimentally characterized with az-scan THz imaging system. The first device can realize a photonic spin Hall effect with an experimentally demonstrated relative efficiency of ~90%, while the second device can generate a high-quality background-free CP Bessel beam with measured longitudinal and transverse field patterns that exhibit the nondiffracting characteristics of a Bessel beam. All the experimental results are in excellent agreement with full-wave simulations. Our results pave the way to freely manipulate CP THz beams, laying a solid basis for future applications such as biomolecular control and THz signal transportation.



Short Bio:

Qiong He received his PhD degree in Physics from Paris Institute of Optics in Paris-Sud University (Orsay, France) in 2008. From 2009 to 2013, he was postdoctoral fellow in Physics Department of Fudan University. He is currently an associate professor at Physics Department of Fudan University (Shanghai, China). His research interests focus on metamaterials and plasmonics. He has coauthored more than 50 publications in scientific journals.

Spectral phase tuning for high energy narrowband terahertz pulses

Center for Free-Electron Laser Science and Universität Hamburg, Germany
LIDYL, CEA, CNRS, Université Paris-Saclay, CEA Saclay, France

Spencer Windhorst Jolly

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Highly-efficient optical generation of narrowband terahertz (THz) radiation could enable unexplored technologies and sciences from compact electron acceleration to charge manipulation in solids. State-of-the-art conversion efficiencies are currently achieved using difference-frequency generation (DFG) driven by temporal beating of chirped pulses, but remain far lower than desired or predicted. We show that third-order spectral phase fundamentally limits the efficiency of narrowband DFG using chirped-pulse beating and resolve this limitation with a novel technique based on tuning the relative spectral phase of the pump pulses. We measure a 13-fold enhancement in conversion efficiency for 1%-bandwidth, 0.361 THz pulses, yielding a record total energy of 0.6 mJ, exceeding previous optically-generated energies by over an order of magnitude. Our results prove the feasibility of demanding applications and provide a framework for more flexible use of chirp-pulse beating via knowledge and control of the higher-order spectral phase of the pump.

Short Bio:

Spencer Windhorst Jolly is currently a postdoctoral researcher at the French Commissariat à l'énergie atomique et aux énergies alternatives (CEA) – Saclay, studying spatio-temporal couplings in ultrafast and high-intensity laser pulses, and formerly at the Center for Free-Electron Laser Science (CFEL) and Universität Hamburg in Hamburg, Germany, working on high energy narrowband terahertz generation and laser-plasma acceleration. His broad interests include temporally and spatially structured ultrafast pulses for use in Terahertz generation, high-harmonic generation, particle manipulation and acceleration, among many other applications, along with more fundamental ultrafast laser physics and nonlinear optics phenomena.

Terahertz multiheterodyne dual-comb spectroscopy based on quantum cascade lasers

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Hua Li

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We demonstrate the most compact terahertz multiheterodyne dual-comb spectroscopy using two quantum cascade lasers (QCLs) emitting around 4.2 THz without a need of additional fast detectors and moving parts in the system. With only ~270 nW terahertz power coupled into a terahertz QCL detector comb (no optics for alignment), the down-converted dual-comb spectra are successfully obtained in real-time at different carrier frequencies. To prove the spectroscopic ability, we further demonstrate that the compact dual-comb system can be used to calibrate the relative humidity in the air and to measure the transmission of samples. Due to the small optical coupling aperture (150 μm), it is also potential to use the dual-comb technique for terahertz imaging.

Short Bio:

Hua Li received the Ph.D. degree in microelectronics and solid state electronics from the Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences (CAS), Shanghai, China, in 2009. From 2009 to 2012, he was with the Walter Schottky Institute, Technical University of Munich, Germany, as an Alexander von Humboldt research fellow. In Germany, his work was focused on injectorless quantum cascade lasers emitting in the mid-infrared wavelength range. From 2012 to 2013, he was with the Institute of Industrial Science, The University of Tokyo, Japan, where he was involved with the electrical domain investigation of terahertz quantum cascade lasers as a JSPS postdoctoral research fellow. From 2013 to 2015, he was with the Laboratoire Matériaux et Phénomènes Quantiques, University Paris Diderot (Paris 7), France, where he was involved with mode locking of terahertz quantum cascade lasers as a postdoctoral associate. Since 2015, he has been appointed as a "Hundred-Talent" professor at SIMIT, CAS. His research interests include quantum cascade lasers based frequency combs, fast terahertz detection, laser mode-locking, and applications of inter-subband semiconductor devices. He has authored or coauthored more than 50 peer-reviewed publications.

Terahertz radiation generated by multi-color laser filaments in air: The role of pump power ratio and relative phase

National Tsing Hua University, Taiwan, China

Ciling Pan

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We have experimentally and theoretically clarified the roles of the multi-color power ratios, the total pump energy, and the relative phase in the mechanism of terahertz (THz) generation by laser-induced filament in air. The optimal multi-color power ratio tends to require a larger amount of fundamental field with the increment of total pump energy. By applying optimal relative phases, the THz intensity can be enhanced by three and four orders in two- and three-color pumping schemes, respectively. This implies the relative-phase control is more critical in 3-color pumping scheme. On the other hand, the optimal relative phases are independent with the power in both schemes. In 2-color pumping scheme, the optimal relative phase of 2^{nd} harmonic field is 0.5π. In 3-color pumping scheme, there will be two optimal relative phasesfor the 2^{nd} harmonic field, 0.5π and 1.5π, while the 3^{rd} harmonic stays at π. The optimal relative phasesare 0.5π, π and 1.5π, respectively. However, the enhancement in 3-color scheme decreases as total pump energy increases. Furthermore, after comparing the simulation results based on transient photocurrent model to four-wave rectification(FWR) model, it is possible to distinguish the contribution for the emitted terahertz radiation according to the relationship between total pump energy and its optimal power ratio experimentally.

Short Bio:

Ciling Pan is a Tsing Hua Chair professor, National Tsing Hua University, Hsinchu, Taiwan. Prof. Pan received his Ph.D. degree in physics from Colorado State University, Ft. Collins, Colorado, USA in 1979. His main research interests are laser science, ultrafast and THz photonics, fiber photonics and liquid crystal photonics. Prof. is a Fellow of SPIE, OSA, IEEE and APS; a member of the Asia Pacific Academy of Materials and corresponding member of the International Academy of Engineering. He served on the editorial board of AAPPS Bulletin (2011-2013) and currently serves as a member of Commission C17 (Quantum Electronic) of IUPAP (2012-2014, 2018-2020) and Commission D (Electronics and Photonics) of URSI (2013 to date). Prof. Pan has published more than 260 refereed journal papers to date. He also holds 21 Taiwan patents and 14 US patents. More information are available at the web site: http://www.phys.nthu.edu.tw/e_teacher/clpan.html.

Towards high speed imaging with pulsed terahertz quantum cascade lasers

University of Queensland, Australia

Aleksandar D. Rakić

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The terahertz (THz) quantum cascade laser (QCL) is a compact high-power source of narrowband radiation and is an attractive device for a large variety of sensing and imaging applications. Terahertz QCL's have been demonstrated with peak output power exceeding 1 W and operating temperatures as high as 200 K in pulsed mode. Laser feedback interferometry (LFI) is a coherent sensing technique that has been successfully demonstrated previously in the THz for high-resolution imaging, materials analysis, and measuring QCL emission spectrum. However, LFI has been predominantly demonstrated with the THz QCL operating in cw mode, enforcing reliance on cryogenic cooling, which is bulky, expensive, and impractical for real-world deployment. To overcome this limitation, we have recently demonstrated a novel LFI scheme based on a THz QCL operating in pulsed mode which enables a marked reduction in the heat generated within the laser, thereby permitting higher operating temperatures. In this way, the required cooling power is significantly reduced allowing for a cryogen-free cooling solution. A practical benefit of LFI in pulsed operation is that this sensing mode is inherently less sensitive to environmental noise, including mechanical vibrations.

Short Bio:

Aleksandar D. Rakić leads the Photonics and Microwave Engineering group at The University of Queensland focusing on the development of technologies for sensing and imaging across the electromagnetic spectrum including microwave, terahertz wave and optical systems. Rakić's group pioneered the development of several world's first laser-feedback interferometric sensors including systems based on monolithic vertical-cavity surface-emitting laser arrays (VCSELs), blue-green lasers, terahertz quantum cascade lasers and mid-infrared interband cascade lasers.His current focus is on the development of sensing and imaging systems exploiting the THz spectrum for applications from security and defence to in vivo biomedical imaging. He is currently Professor of Photonics within the School of IT and Electrical Engineering, The University of Queensland and the Associate Dean (External Engagement) in Faculty of Engineering Architecture and Information Technology.

Berry curvature enhanced nonlinear photo response of type-II Weyl semimetals

Peking University, China

Dong Sun

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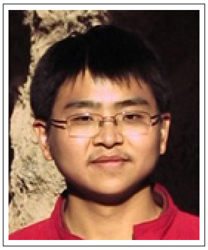
The experimental manifestation of topological effects in bulk materials under ambient conditions, especially those with practical applications, has attracted enormous research interest. Recent discovery of Weyl semimetal provides an ideal material platform for such endeavors. The Berry curvature in a Weyl semimetal becomes singular at the Weyl node, creating an effective magnetic monopole in the k-space. In this talk, signatures of the singular topology in a type-II Weyl semimetal $TaIrTe_4$ is revealed in the photo responses, which are shown to be directly related to the divergence of Berry curvature. As a result of the divergence of Berry curvature at the Weyl nodes, $TaIrTe_4$ exhibits unusually large photo responsivity of 130.2 mA/W^{-1} with 4-μm excitation in an unbiased field effect transistor at room temperature arising from the third-order nonlinear optical response. Furthermore, the circularly polarized galvanic response is also enhanced at 4-μm, possibly due to the same Berry curvature singularity enhancement with the shift current. Considering the optical selection rule of Weyl cones with opposite chirality, it may open new experimental possibilities for studying and controlling the chiral polarization of Weyl Fermions through an in-plane DC electric field in addition to the optical helicities.

Short Bio:



Dong Sun associate professor in International Center of Quantum Materials of Peking University, China. He obtained his bachelor degree in physics from University of Science and Technology of China in 2004 and Ph.D in physics from University of Michigan in 2009 with Professor Theodore Norris. After that he works as postdoc research fellow in Center for Ultrafast Optics Science of University of Michigan and research scientist in University of Washington. In 2012, he started to work in internationalcenterfor quantum materialsof Peking University and got tenured in 2017. His research mainly focusing on using various ultrafast spectroscopy method, including pump probe spectroscopy, scanning photocurrent spectroscopy and THz spectroscopy to study various quantum materials and functional optoelectronics devices.

THz components made from 2D materials and structures

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The wide adoption of terahertz (THz) technology would require high performance and compact THz sources, detectors and various components. The strong capabilities of 2D metamaterials, or metasurfaces, in EM wave manipulation provide a powerful tool for compact and versatile THz component development, while the unique exciton behavior in 2D semiconductors renders a new dimension for the exploration of THz source and detector. In this talk, I will introduce our work on sub-THz detector using AlGaN/GaN two dimensional electron gas (2DEG) HEMT with nano-antennas for low noise and high temperature operation, active electrical and thermal tuning of THz response including complete suppression of THz reflection from Si surface by an atomic scale flat metasurface produced by CMOS compatible process, and the potential mid to far-IR and THz detection at high responsivity and room temperature using transition metal dichalcogenide heterostructures.

Short Bio:

Jinghua Teng is Principal Scientist in the Institute of Materials Research and Engineering (IMRE), Agency for Science, Technology and Research (A*STAR), Singapore. He received his B. Sc. in Physics and M. Sc. in Optics from Nankai University, and Ph.D. degree in Optoelectronics from the National University of Singapore. He has extensive experiences in both academic research and technology development through industry collaboration. He has edited/authored 5 book/book chapters, filed 24 primary patents and published over 210 journal papers. He has been chair/co-chair as well as sitting in the Technical/Program Committee in many international conferences and also given many invited/keynote talks. He is the associate editor of the Journal of Molecular and Engineering Materials published by World Scientific, editor board member of the Journal of Optics published by IOP and the Opto-Electronic Advances published by CAS, IOE. His research interests include nano-optics & photonics, metamaterials & metasurfaces, 2D materials and 2D optoelectronics, THz technology, plasmonics, semiconductor materials and devices.

Strong terahertz wave generation from liquid water

Capital Normal University, China

Liangliang Zhang

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Generating terahertz radiation from liquid water has long been considered to be impossible due to strong absorption. Two recent works reported terahertz generation from water, but the mechanism is not clear and the efficiency demands to be enhanced. We show experimentally that strong terahertz radiation is generated from a water line/column irradiated by a mJ laser beam. The strength is 100-fold higher than that produced from air with efficiency approaching 10^{-4}. We attribute the mechanism to the laser-ponderomotive-force-induced current with the symmetry broken around the column interface. This mechanism can explain our following observations: the radiation can be generated only when the laser propagation axis deviates from the column center; the deviation determines its field strength and polarity; it is always p-polarized whether the laser is p- or s-polarized. This study presents a possible terahertz generation mechanism in water and also provides a simple and efficient scheme of table-top terahertz sources.

Short Bio:

Liangliang Zhang is currently a professor at the Department of Physics, Capital Normal University, Beijing China. She received her Ph.D. degree in instruments science and technology from the Beijing Institute of Technology in 2008. She was a visiting scholar at Rensselaer Polytechnic Institute and University of Rochester in USA. Her research field is terahertz spectroscopy and imaging. She is a topical editor for Journal of the Optical Society of America B (JOSA B).

Light Conference 2019

Symposium 5

Young scientists forum Aspheric and free-form surface: technology and application

Co-Chairs:

Donglin Xue

Dong Liu

Symposium 5

Versatile CGHs for interferometric test of freeform surfaces

National University of Defense Technology, PR China

Shanyong Chen

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Freeform surface plays a very active role in modern optical system design as it provides much more degrees of freedom for optimization. It features a loss of rotational symmetry, which challenges the optical machining and testing. Conventional null lenses or reflectors based on rotationally symmetrical spheres are no longer applicable to balancing the asymmetrical aberrations. Computer generated hologram (CGH) has been a preferred solution to interferometric test of freeform surfaces. This talk presents versatile CGHs in freeform surface test practices. After a short introduction to the CGH design, the advantage of CGH for measuring multiple surfaces sharing a single substrate is demonstrated. Generally a CGH is ad hoc designed for null test of a particular surface. To make a versatile null optics, a pair of CGHs with complementary phase functions are combined and counter-rotated, capable of generating variable coma and astigmatism. Such a near-null optics is then applicable to testing various off-axis aspheres. Furthermore to deal with the unknown surface error during the lapping process, a spatial light modulator (SLM) is proposed to serve as dynamic CGH. By iteratively updating the uploaded holographic pattern, the SLM enables fringe reduction and makes the unknown surface error resolvable with a standard interferometer.

Short Bio:

Shanyong Chen is currently a professor in Mechanical Engineering at the National University of Defense Technology (NUDT), China. His current research interests focus on optical testing and ultra-precision machining. He has published over 30 papers in learned international journals and referred conferences, and contributed one SPIE Spotlight Series ebook as well as 4 book chapters. He was invited as international symposium chair and speakers in a couple of SPIE conferences. He holds one US patent and over 10 China patents in the field of optical testing.

Advances in the ultra-precision machining and measurement of optical freeform and structured surfaces and applications

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Benny C.F. Cheung

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Optical freeform and structured surfaces are complex surfaces that possess non-rotational symmetry and are widely used in advanced optics applications such as freeform prism for AR/VR head mask, multi-scale structured surfaces for multi-focus myopia controlling spectacle lenses, Head up display (HUD) for automotive, compound eyes for 3D imaging, V-grooves for fibre optic connectors and F-theta lenses for high end scanning device, etc. These surfaces can be fabricated to a high degree of accuracy by various ultra-precision machining technologies such as raster milling, tool servo machining, computer controlled ultra-precision polishing. Due to the geometrical complexity of optical freeform and structured surfaces, high-precision measurement and characterization of these surfaces have become cutting-edge problems which measure micrometre to sub-micrometre form accuracy of different scales of surface features and surface finish in nanometre range. In this presentation, the state-of-the-art research results on ultra-precision machining and measurement of optical freeform and structured surfaces is discussed. The presentation attempts to shed some light on the future development of machining and measurement technologies for optical freeform and structured surfaces which will help spur the growth in the application and manufacturing of these surfaces.

Short Bio:

Benny C.F. Cheung is a Professor and the Head of the State Key Laboratory of Ultra-precision Machining Technology at the Department of Industrial and Systems Engineering (ISE) of The Hong Kong Polytechnic University. He holds various honorary positions in other universities and professional bodies including Adjunct Professor of Changchun University of Science and Technology, Board Membership of the Asian Society for Precision Engineering and Nanotechnology (ASPEN), associate member of the IntCIRP, etc. His research interests include ultra-precision machining, precision metrology, advanced optics manufacturing, knowledge and technology management, etc. Up to present, he has authored and co-authored two Research Monographs, three Edited Books, five Book Chapter, 260 refereed journal papers including more than 160 Science Citation Indexed (SCI)/Social Science Citation Indexed (SSCI) refereed journal papers. Prof. Cheung has received many research prizes and awards such as the 2008 ASAIHL-Scopus Young Scientist Awards–First Runner Up Prize in the category of "Engineering and Technology", Joseph Whitworth Prize 2010 and A M Strickland Prize 2017 by the Manufacturing Industrial Division of The Institution of Mechanical Engineers (IMechE), UK, Winner of the IET Innovation Award–Manufacturing Technology, The Institution of Engineering and Technology (IET), UK (2017), etc.

Design and evaluation of near eye display with freeform optics

Beijing Institute of Technology, China

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Freeform optics, mixed with other new technologies, continue to push the frontier of head-worn displays for virtual reality and augmented reality, and deliver systems with high optical performance, better user experience, and low production cost.

Due to the excellent aberration correction ability of freeform surface, the extremely simple, single-mirror HWD is feasible. An FOV as large as 90° is achieved in commercial HWDs of this form. By making the freeform element thin and half mirror, optical see-through (OST) for AR can be realized. Another compact form of HWD is the freeform prism (FFP). This single-piece HWD developed in BIT has a FOV of 53°, an exit-pupil diameter of 8mm, and a weight of 6 grams, whereas a conventional HWD with comparative parameters may need 6 elements and weigh more than 50 grams. Besides the advantages of lightweight and compactness, FFP can be easily used as an AR HWD with an additional compensation lens.

Short Bio:

Dewen Cheng received his B.S. degree in optics from Beijing Institute of Technology, China in 2004, and the Ph.D degree from Beijing Institute of Technology and University of Arizona in 2011. He is currently a Professor at School of Optics and Photonics, Beijing Institute of Technology. He received the Outstanding Young funding from Natural Science Foundation of China (NSFC) in 2018. His research interests include optical design, 3D display, virtual reality (VR) and augmented reality technologies and applications, especially on near-eye display and freeform optics, light field display.

Partial compensation interferometry for freeform measurement: progress and challenge

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Freeform surface has been adopted in AR/VR glasses, projector with ultra-shot distance and other innovative imaging systems which require excellent performance with limited volume and weight. The optimization of these imaging system has benefited from the design degree of freedom, while the testing of freeform surface has suffered from its arbitrary shape commonly without rotational symmetry. Interferometry has always been an accurate and fast testing method for optical surfaces after polishing. Partial compensation interferometry (PCI) as a kind of non-null methods has the profit of lower requirement on the compensator design and fabrication, and good versatility to freeform with different parameters. We summarize the progress in compensator design, system alignment and phase retrieval from dense interferograms for PCI, and analyze the challenges for further application of this technique in freeform measurement.

Symposium 5

Short Bio:

Qun Hao is currently a Distinguished Professor of Beijing University of Technology, Dean of School of Optics and Photonics, Managing Director of China Optical Society (COS) and Chairman of Photoelectric Professional Committee of COS, Director of China Instrument and Control Society (CIS) and Standing Vice-Chairman of Optical-Mechanical Technology and Systems Integration Branch of CIS, Director of Chinese Society for Measurement, Special Expert of Expert Committee of China Information and Electronic Engineering Science and Technology Development Strategy Research Center, and deputy editor of Defence Technology journal. From 1999 to 2001, she was also a visiting researcher at Tokyo University in Japan, and from January to July 2011 a visiting Professor at Case Western Reserve University in the United States. Her main research fields include photoelectric sensing and intelligent imaging. She has published more than 120 papers both at home and abroad, including 70 papers indexed by SCI. She has been invited to give talks at international conferences and authorized 50 patents for inventions in China.

High-precision thin spherical surface lens manufacturing

Shanghai modern advanced Ultra Precision Manufacturing Center Co., Ltd, China

Guogan Liu

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In some high-precision imaging optical systems, ultra-thin optical lenses are needed, and the ultra-thin optical lenses are more difficult to process and metrology due to their own easy deformation. This paper introduces an ultra-thin lens with large radius of curvature manufacturing and metrology method. The metrology is mainly divided into two parts, one is the wavefront aberration measurement of the transmitted wavefront, and the other is the transmission curvature radius testing. For the test content of these two parts, two test systems were built, it uses the phase shift interferometer and position detection interferometer. Optical polishing combine MRF and traditional small grinding methods, ultimately achieving high precision optical lens processing.

Short Bio:

Guogan Liu graduated from CIOMP, is currently the general manager of Shanghai modern advanced Ultra Precision Manufacturing Center Co., Ltd., (UPEC) and processed Shanghai Micro electronics equipment Co., Ltdin 2004. He has been engaged in optical system design, integration and manufacturing related work in lithography tools. He has many years of experience in the design and manufacture of exposure systems, specializing in the design, inspection and integration of high-precision illumination and imaging systems. In 2017, he joined UPEC engaged in high-precision optical manufacturing.

Interferometric measurement of freeform surface using irregular subaperture stitching

Zhejiang University, China

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Irregular subaperture stitching interferometry (ISSI) is proposed for non-null optical freeform surface testing. With irregular subapertures, locally resolvable fringes of an interferogram are matched more easily than with circular or annular ones. The total number of the subapertures is therefore reduced at the same time. The irregular subapertures are partitioned according to specific principles and the subaperture wavefront is uniquely expressed using polynomials which are orthogonal in concerned zones. With a modified multi-aperture simultaneous reverse optimization reconstruction (MSROR) algorithm, full aperture figure error of the test surface could be acquired from subaperture wavefront coefficients based on a multi-configuration system modeling. Particularly, overlaps and complementary requirement of the subapertures are not necessary with ISSI. However, it should be emphasized that the system model demands careful calibration and its accuracy has a great influence on the final measurement result, the misalignment calibration method is also given in the talk. Experimental results show consistency with the results of coordinate measurement machine (PRISMO 9/12/7 ultra, Carl Zeiss IMT GmbH), in which the peak-to-valley (PV)value error is better than 0.05λ.

Short Bio:

Dong Liu is currently a Professor at Zhejiang University, China. He is now the Assistant Dean of the College of Optical Science and Engineering, the Duputy Director of the State Key Laboratory of Modern Optical Instrumentation. He received his Bechelor degree and PhD degree both from Dept. of Optical Engineering, Zhejiang University in 2005 and 2010, respectively. Then he worked as a postdoctor at National Aeronautics and Space Administration (NASA) in the United States for two years. In Sep. 2012, he became a faculty of the Dept. of Optical Engineering at Zhejiang University. He is now the PIs of 1 National Key Research and Development Program of China, 3 National Science Foundation of China programs, and also the Excellent Young Scientist Program of Zhejiang Provincial Natural Science Foundation of China. Prof. Dong Liu and his group hosted the International Workshop on Ocean Optical Remote Sensing (OORS) in 2018, and the 6th International Symposium on Atmospheric Light Scattering and Remote Sensing (ISALSaRS'19) in 2019.

Construct freeform surface quickly for off-axis multiple-mirror system by seed curve extension and Genetic Algorithm

Jiangnan University, China

Zhouping Su

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In this report, we present a method about constructing freeform surface directly and quickly. The method is performed by combining the seed curve extension and Genetic Algorithm. The method can obtain all the sample points on freeform surface based on curve by curve. After obtaining all the sample points, the continuity of the freeform surface is evaluated. Then the sample points are fitted to an extended polynomial by Genetic Algorithm. The method can be employed to design the initial layout of Multiple-mirror system including freeform surfaces.

Short Bio:

Zhouping Su currently is an Associate Professor in Applied Physics Department, Jiangnan University. He received the Ph.D. degree from Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences in 2008. He was a visiting scholar in Institute of Optics, University of Rochester. His research interests include optics design, optimization algorithm development for freeform optics design, LED illumination, laser diode technology. Currently, he is also a topic editor for Acta Optica Sinica.

Nodal aberration theory in non-rotationally symmetric freeform optical system design

Institute of Space Optoelectronics Technology, Changchun University of Science and Technology, China.

Haodong Shi

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Freeform surfaces have advantages on balancing non-rationally symmetric aberrations of the unobscured mirror system. However, since the conventional paraxial aberration theory is no longer appropriate for the freeform system design, as a result of lacking insights on the imaging quality from the freeform aberration distribution for optical designers. Based on the framework of nodal aberration theory (NAT), the wave aberration expressions of three kinds of off-axis optical system, such as field of view (FOV) decentered, pupil off-set and axis tilted, containing with Zernike polynomial freeform surfaces are derived, respectively. The relationship between the off-axis configuration and the Zernike freeform surface shape acting on the aberration node locations of the third-order spherical aberration, astigmatism, and coma are revealed, respectively. The nodal aberration properties of the off-axis freeform system are analyzed and validated by using full-field displays (FFDs). Those three kinds of off-axis freeform optical systems are designed according to the field aberration distribution properties. The design results show that some of the aberration node locations of the system are controlled in the real-FOV area by optimizing Zernike coefficients pointedly. Thus, the imaging quality, evaluated by modulation transform function (MTF) or point spread function (PSF), is improved comparing with the initial configuration. By using this design method, the efficiency of designing non-rotationally asymmetric optical system with freeform surfaces can be increased. This research will support the next generation space telescope for increasing the survey sky FOV and improving the imaging quality in the future. Freeform surfaces have advantages on balancing non-rationally symmetric aberrations of the unobscured mirror system. However, since the conventional paraxial aberration theory is no longer appropriate for the freeform system design, as a result of lacking insights on the imaging quality from the freeform aberration distribution for optical designers. Based on the framework of nodal aberration theory (NAT), the wave aberration expressions of three kinds of off-axis optical system, such as field of view (FOV) decentered, pupil off-set and axis tilted, containing with Zernike polynomial freeform surfaces are derived, respectively. The relationship between the off-axis configuration and the Zernike freeform surface shape acting on the aberration node locations of the third-order spherical aberration, astigmatism, and coma are revealed, respectively. The nodal aberration properties of the off-axis freeform system are analyzed and validated by using full-field displays (FFDs). Those three kinds of off-axis freeform optical systems are designed according to the field aberration distribution properties. The design results show that some of the aberration node locations of the system are controlled in the real-FOV area by optimizing Zernike coefficients pointedly. Thus, the imaging quality, evaluated by modulation transform function (MTF) or point spread function (PSF), is improved comparing with the initial configuration. By using this design method, the efficiency of designing non-rotationally asymmetric optical system with freeform surfaces can be increased. This research will support the next generation space telescope for increasing the survey sky FOV and improving the imaging quality in the future.

Short Bio:

Haodong Shi was born in Changchun, China, in 1989. He received the B.E. degree in opt-electrical engineering from the Changchun University of Science and Technology (CUST), China, in 2012, and completed the Ph.D. degrees in optical engineering with the Academician of Chinese Academy of Engineering Prof. Huilin Jiang at CUST in 2017. He joined Institute of Space Optoelectronics Technology at CUST as an assistant research fellow in November 2017. His current research is focused on the optical system design, freeform aberration theory and polarization aberration.

Tilted carrier non-null common-path interferometry

Nanjing University of Science and Technology, China

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Complex surface optical elements can correct aberrations of optical system, modulate special light field, and meet the requirements of lightweight and miniaturization of system structure. Therefore, it is widely used in optical systems in aerospace, civil electronic products and biomedical fields. However, it is still difficult to measure the surface shape of complex surface optical elements with high efficiency, high precision and high versatility.

The tilted-wave method has the characteristics of high efficiency and large dynamic range of surface measurement, so it is considered as one of the effective methods to solve the surface measurement of complex surface optical elements. For the problem of large system error and insufficient measurement generality in tilted-wave method, a common-path tilted carrier non-null interferometry is proposed. The measurement results of standard spherical mirror show that the measurement error of proposed method is only several hundredth of that of non-common path system without calibrating the system error. A paraboloid surface is measured by using the method presented in this paper and the aberration-free method respectively. The deviation between the two measurement results is about 0.01 λ (RMS value, λ=632.8nm), which proves that the proposed method has high measurement accuracy while realizing full-aperture measurement. The cylindrical, parabolic and off-axis ellipsoid surfaces are measured with this system, which proves the validity of the dynamic generation of point source array and the good universality of the measurement system.

Short Bio:

Hua Shen is an associate professor of optical engineering at NUST. He is the director of Fiber Laser and Optical Fiber Sensor Department, MIIT Key Laboratory of Advanced Solid Laser, China. Besides, he was elected as the secretary-general of the Optical Testing Committee of Chinese Optical Society in 2010. Dr. Shen was honored as one of the Young and Middle-Aged Academic Leaders in the Blue Project, Jiangsu Province, in 2017. He was also supported by the 333 Talent Project, Jiangsu Province, in 2016. Now he mainly focuses on laser technology, optical fiber sensor and optical measurement. In the past five years, as the person in charge, his research has been sponsored by the National Natural Science Foundation (China), the National Key Research and Development Program (China), the National Major Scientific Instruments and Equipment Development Project (China) etal. He has published more than 50 academic SCI/EI papers. And 25 invention patents were authorized. In 2013, he won the second-class prize of Science and Technology Invention of the Ministry of Education, China. He is currently a member of the Youth Editorial Board of the Chinese Laser Press and the topic-editor of the Chinese Optics Letters and the Acta Optica Sinica.

Intelligent manufacturing equipment and process for complex shape nano-precision optical components

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National major optical projects, such as microelectronics manufacturing, space telescope, inertial confinement fusion project, and four-generation light source have put forward higher requirements for advanced optical manufacturing equipment and processes. Nano-precision control for complex optical components has become the frontier of optical fabrication. This report focuses on the research of controllable intelligent manufacturing equipment like magnetorheological and ion beam, and its processes, including: theory and method for nano-precision control of complex shape optical components; mechanism of nano-scaledamage precursors optical surface under high power laser irradiation and its control method during fabrication; controllable intelligent manufacturing equipment design, and examples for combined process optimization strategy and processing.

Short Bio:

Feng Shi is currently a Professor and the Director of the Laboratory of Precision Engineering at the National University of Defense Technology. He got his Ph.D. degree in mechanical engineering in 2009. During his graduate studies, he also visited the LFM Laboratory at the University of Bremen in Germany, from 2007 to 2008. His major research interests include ultra-precision, high damage resistance, and special materials fabrication; intelligent manufacturing of complex shape optical components; magnetorheological, ion beam, and jet polishing equipment development. He was selected into the youth talent support program, and the standing committee of optical manufacturing committee of China optical society. Now he is the Principle Investigator of over 15 national-level projects, such as National Science and Technology Major Project, 863, and National Natural Science Foundation. He teaches 5 undergraduate and postgraduate courses, published more than 40 papers indexed by SCI and obtained more than 30 national invention patents. He received National Second Prize for Technological Invention, First Prize for Military Science and Technology Progress and First Prize for Scientific and Technological Progress in Hunan Province.

Testing large convex asphere by subaperture stitching interferometry

CIOMP, CAS, China

Xiaokun Wang

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On the basis of summing up conventional testing methods for convex aspheric surfaces, a novel method for testing large convex asphere by subaperture stitching interferometry(SSI) is proposed, the basic principle and theory of SSI are researched, the synthetical optimization stitching model and effective algorithm are established based on triangulation algorithm, homogeneous coordinates transformation, simultaneous least-squares method and Zernike polynomial fitting, and a hybrid testing technique merging CGH and SSI for large departure convex asphere is proposed. The subaperture stitching measurements are carried out on a number of aspheric surfaces, and the surface error is consistent to the null testing. This technique broads the dynamic range of the interferometer, makes use of the small interferometer to realize measurement of large convex asphere without auxiliary optics, and provides an efficient, fast, low-cost, high-precision and universal method to test aspheric surfaces and even freeform surfaces.

Short Bio:

Xiaokun Wang is currently a Professor at CIOMP. He received his doctor's degree from CIOMP in 2008, he has been researching on ultra-precise fabrication and measurement of optics, especially on testing of large aspherical surfaces by subaperture stitching interferometry (SSI). As the project leader and technical backbone, he was responsible for or participated in more than 10 national defense and major national projects. As the first author, he has published more than 40 academic papers and 8 authorized invention patents. He has won the special award of DaHeng optics, outstanding science and technology achievement prize of the Chinese academy of sciences, Changbai youth science and technology award, 3 times FrontRunner 5000(F5000), Jilin province patent gold award, China patent excellence award and Jilin province technology invention first prize, etc.

Aberration correction technology for aspheric window optical system

Changchun University of Science and Technology, China

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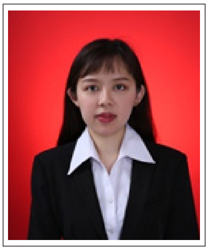
In order to realize the optimal aerodynamic outer shape, the traditional hemispheric and plane shape is frequently replaced by the streamline aspheric shape in the design of the optical window on aircraft. Due to the serious decenter and tilt performance of the aspheric window optical system, the classical optical aberration theory and wavefront aberration theory cannot be used in the analysis of this system, and traditional optical structures are failed to correct the dynamic aberrations of this system, which brings a great challenge for the optical design. This presentation concentrated on the analysis of aberration characteristics and the research of aberration correcting theory for the aspheric window optical system. The main innovate productions are: focus on the ellipsoidal window, three novel aberration correcting theory and methods are proposed. And two novel aspheric window shapes which have good aerodynamic performance and induce less aberration are put forward.



Short Bio:

Chao Wang is currently an associate professor in Academician Huilin Jiang's group at Changchun University of Science and Technology. She obtained her B.S. Degree at Harbin Engineering University in China in 2009, and completed her Ph.D. with Prof. Xin Zhang at Changchun Institute of Optics and Fine Mechanics and Physics, Chinese Academy of Science in China in July 2014. Until now, she has published 30+ papers and 4 patent applications. She is the reviewer of multiple SCI journals. Her current research is focused on the design of unconventional complex optical system and the high resolution/super-resolution imaging technology.

Distortion optimization design of free-form large field camera

CIOMP, CAS, China

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Distortion is an important index of space camera. It represents the deformation of real image and theoretical image. It will not only bring differences between image shape and resolution and theoretical image, but also decrease the registration accuracy of multi-spectral image and the MTF of TDI imaging system. In this paper, the optimal design method of free-form surface optical system distortion is introduced, and the distortion characteristics, full-field resolution, distortion correction function fitting accuracy and multi-spectral registration accuracy of free-form surface wide-field space camera are described in detail. In this paper, we analyze the effects of the optical axis tilt and the curvature of the earth on the distortion of in-orbit imaging, and use the trapezoid distortion of the optical axis tilt to optimize the distortion of free-form space camera.

Short Bio:

Lingjie Wang Associate professor Lingjie Wang obtained his B.S. Degree at Tianjin University in China in 2002, and completed his Master Degree with Prof. Xin Zhang at Changchun Institute of Optics and Fine Mechanics and Physics, Chinese Academy of Science in China in July 2007. Now he is an associate professor in Changchun Institute of Optics, Fine Mechanics and Physics Chinese Academy of Sciences. Until now, he has published 30+ papers and 6 patent applications. His current research is focused on the design of unconventional complex optical system and free-form optical system.

Partial null interferometry for a freeform Zernike mirror

Nanjing University of Science and Technology, China

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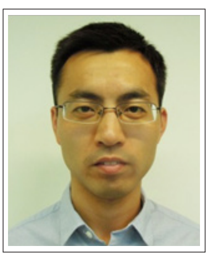
Astigmatism-dominated freeform is a common freeform surface in off-axis reflection systems. Partial null interferometry without using any null optics is proposed to measure the freeform Zernike mirror, and oblique incidence on the freeform mirror is used to compensate for astigmatism as the main component in its figure. The phase demodulated from the partial nulled interferograms is divided into low-frequency phase and high-frequency phase by Zernike polynomial fitting. The low-frequency and high-frequency surface figure errors of the freeform mirrorare retrieved from low-frequency phase and high-frequency phase respectively, with the corresponding method elaborated. Simulations verified that this method is capable of testing a wide variety of astigmatism-dominated freeform mirrors due to the high dynamic range. The experimental result using our proposed method for a concave freeform Zernike mirror is consistent with the null test result employing the computer-generated hologram.



Short Bio:

Qun Yuan is currently an associate professor in Optical Engineering at Nanjing University of Science of Technology. He received his BS degree and PhD in 2008 and 2014 from the same university. He was a visiting scholar at the Institute of Optics, University of Rochester. His main research interests include optical design, laser interferometry and white light interference microscopy.

Applications of the point-by-point method in designing nonsymmetric imaging systems

Beijing Institute of Technology, China

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Freeform optical surfaces are nonsymmetric optical surfaces and they can introduce much more degree of freedom into optical design. This kind of optical surface can be seen as a revolution in the optical design and plays an important role in future high-performance optical systems. Another trend in the optical design field is to use phase element in the imaging systems. Typical phase elements include diffractive element and metasurface. These elements can be made ultrathin and are capable of controlling the wavefront arbitrarily. In this talk, we will present the design method of nonsymmetric imaging systems containing freeform surfaces and/or flat phase elements. Both the geometric freeform surfaces and the phase profiles or functions are generated point-by-point. The whole design process starts from an initial system using simple geometric planes. The dependence on existing starting points is significantly reduced and advanced design skills are not required.

Short Bio:

Tong Yang obtained his PhD degree in optical engineering from Tsinghua University. He is currently an assistant professor in Beijing Institute of Technology. His research interests include optical system design, freeform optics and diffractive optics. He has coauthored 20 journal papers (including several top journal papers in Light: Science & Applications and Optics Express) and has been authorized more than 20 patents, including more than 10 U.S. patents. He is a member of OSA, SPIE and EOS.

High efficiency and precision machining of RB-SiC with fluid jet

Shandong University, China

Peng Yao

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Fluid jet machining has been increasingly applied for treating hard-to-machine and multi-layered materials, and as an alternative tool for milling, turning and polishing. A hybrid fluid jet machining was applied to promote processing efficiency, reduce machining cost and realize ultra-precision polishing of RB-SiC mirror blank for a space telescope. A hybrid process for RB-SiC manufacturing is performed, by successive application of four non-traditional processes: selective abrasive water jet (AWJ) milling of sintering residues on RB-SiC surface, abrasive waterjet milling of RB-SiC, abrasive waterjet assisted grinding (AWJAG) of RB-SiC and ultra-precision abrasive flow polishing (AFP) of amorphous silicon coating on RB-SiC.With application of different fluid jet technologies, a high material removal rate was obtained in the milling and grinding process, and an ultra-smooth surface was gained in the polishing process.

Short Bio:

Peng Yao is currently an Associate Dean and Associate Professor. in School of Mechanical engineering of Shandong University in China. He joined the faculty of the Shandong University in 2012. From 2005 to 2007, he held research or faculty positions at Northeastern University in China. In 2011, He got his PH.D. from Department of Nanomechanics, Graduate School of Engineering of Tohoku University in Japan. He was a visiting professor at University of Rochester. The research interest is the theory and technology of multi-energy assisted ultra-precision and high-efficiency machining of difficult-to-machine optical materials. He is the principal investigator of nine national-level and ministerial-level scientific research projects, published more than 30 papers, holds 8 authorized patents, one translation book and one textbook.

Enhanced tool servo diamond turning of complex optical surfaces

Nanjing University of Science and Technology, China

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Optical surfaces with complex shapes have attracted extensive attention in both academia and industry, and the fast-/slow tool servo (F-/STS) diamond turning is widely regarded as very promising for the generation of such surfaces. Strongly restricted by the working principle of the current F-/STS, it is still challenging to generate the complex optical surfaces in terms of the satisfactory machining efficiency, machining accuracy, and machined surface quality. In this talk, several powerful strategies for enhancing the cutting performance of F-/STS will be presented through extending its motion capability in the time domain or/and spatial domain. The basic concept, system realization, and practical application of the enhanced multi-axial and trans-scale tool servos will be introduced, and the superiority of the enhanced tool servos will be demonstrated through generating both freeform and micro-structured surfaces in ductile and brittle materials. The enhanced tool servo brings a new insight into extending the manufacturing capability of complex optical surfaces.

Short Bio:

Zhiwei Zhu is currently a Professor with School of Mechanical Engineering, Nanjing University of Science and Technology (NJUST), China. He received the B.E. and M.S. degrees in mechanical engineering from Jilin University, China, and the Ph.D. degree in industrial and systems engineering from the Hong Kong Polytechnic University, Hong Kong SAR, China. He then joined the faculty of NJUST through the recruitment program for young professionals in China. He has authored and co-authored more than 40 peer-reviewed papers in the field of advanced optical manufacturing in the last 5 years, and his current research interests include smart micro/nano manufacturing for advanced optics, and design, modeling, and control of precision mechatronic systems for mechanical manufacturing.

Symposium 5

Design of freeform illumination optics: a nonlinear boundary problem for the elliptic Monge-Ampère equation

Zhejiang University, China

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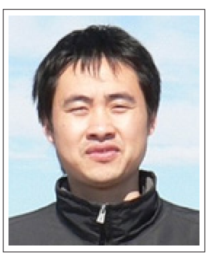
Regulating the spatial energy distribution of a light source with high efficiency is the territory of illumination design, which is a classical and challenging issue in the field of nonimaging optics. The purpose of illumination design is to produce a prescribed illuminance/intensity distribution by a means of some elaborately designed optical surfaces. Freeform surfaces are optical surfaces without linear or rotational symmetry, transcending rotational or linear restrictions on surface geometry. Their freeform nature offers high degrees of freedom, which can be used to avoid restrictions on surface geometry and create compact yet efficient designs with better performance. More importantly, the use of freeform surfaces can produce new designs that cannot be achieved by the use of spherical or aspherical surfaces. However, the design of freeform illumination optics is a challenging inverse problem. This talk will give detailed physical insight into the design of freeform illumination optics and present a general formulation for designing freeform illumination optics.



Short Bio:

Zhenrong Zheng received his PhD in Optical Engineering in 1999 from College of Optical Science and Engineering, Zhejiang University. He worked as a visiting researcher at College of Optical Science, University of Arizona in 2009. Currently he is the Professor of Optical Engineering at Zhejiang University. His research interests include freeform imaging optics, display, and optical system design.

Model of radial basis functions with slope-based shape factor and distribution for optical freeform surface

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To get satisfied performance in characterizing optical freeform surface with local feature, we proposed a model of Radial Basis Function with Slope-based Shape factor and Distribution (RBF-SSD). Compared to previous RBF-slope model with only slope-based shape factor, RBF-SSD model relates both shape factor and distribution with surface slope, leading to stronger fitting ability for freeform surfaces with local feature. Fitting experiments for two different surfaces demonstrated the fitting performance of RBF-SSD model. An off-axis three-mirror system with 3°×3.6° FOV was designed as an example to show the optical design application of the proposed model.

Short Bio:

Xing Zhao received his PhD degree in Optics Engineering from the Institute of Modern Optics, Nankai University in 2007. After that, he joint Nankai University as lecture, associate professor and professor. He visited and worked in Advanced Optics Manufacturing Center, the Hong Kong Polytechnic University in 2014. His current research interests are concerned with freeform optics, three-dimensional imaging and computing imaging. In the field of freeform optics, he concentrated on the research of modeling, designing and optimization of freeform surfaces, and also cooperated with colleagues on some topics of fabrications. In last decade, he published more than 40 peer-reviewed journal articles and had 3 authorized patents.

Symposium 5

Design method for freeform optical systems containing diffraction gratings

Tsinghua University, China

Jun Zhu

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Freeform surfaces can increase the overall performance of imaging spectrometers, which is a typical kind of optical system containing diffraction gratings, in the aspects of compactness, spectral and spatial bandwidth. There exists a "field-pupil-wavelength" (FPW) problem in the design of dispersion systems. For an ideal optical system, light rays incident on one point on the optical surface have multiple pupil coordinates and are from multiple fields with multiple wavelengths. The FPW problem is about solving for every point in the system that deflects these light rays towards their corresponding target points in the image space that satisfies the object-image relationship. A design method for freeform optical systems containing diffraction gratings is proposed, which gives an approximated solution for the FPW problem. This method is based on Fermat's principle and Ludwig's grating ray-tracing equation and can be modified to design freeform systems with other dispersive elements. Three-mirror reflective systems are chosen as examples to demonstrate the design approach, but the method is also feasible for systems containing fewer or more surfaces. Near-diffraction-limited freeform imaging spectrometers can be achieved directly within a reasonable time.

Short Bio:

Jun Zhu is currently a Tenured Associate Professor at Tsinghua University. He joined the faculty of Department of Precision Instrument, Tsinghua University in 2001 after he got his Ph. D degree in the College of Optical Science and Engineering at Zhejiang University. From 2015 to 2016, he was a visitor scholar in the Institute of Optics at the University of Rochester. His current research interests include the design and characterization of freeform optical systems, automated design of optical freeform systems, and infrared remote technology. He is now teaching two undergraduate courses: Fundamental of Optical Engineering (I) and Modern Optical Design. In recent five years, he has published more than 24 SCI journal papers and is now holding 36 China patents and 6 US patents.

Light Conference 2019

Symposium 6

Solar&Terrestrial radiation, measurement, modeling and applications

Co-Chairs:

Gerard Thuillier

Peng Zhang

Wolfgang Finsterle

Ping Zhu

The joint total solar irradiance monitor for FY-3E satellite

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The Joint Total Solar Irradiance Monitor (JTSIM) for Feng Yun-3E (FY-3E) satellite is a space-based total solar irradiance (TSI) measuring experiment. JTSIM/FY-3E mainly consists of pointing system, the thermal control system, the electronics, Digital Absolute Radiometer (DARA) developed by Physical Meteorological Observatory in Davos (PMOD) and Solar Irradiance Absolute Radiometer (SIAR) developed by Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP). With these two radiometers, JTSIM/FY-3E will get long-term stability of space-based TSI measurement, which is similar to ground-based World Standard Group (WSG). Compared to the previous generation of SIAR on TSIM/FY-3C, SIAR on JTSIM/FY-3E has a faster response time, which gives it the rapid measuring ability. And it also uses a three-channel structure to improve its calibration ability for on-orbit degradation of the cavity detector. A general description of the JTSIM, including the instrument modules, uncertainty evaluation, and its operation mode, is given in this presentation.

Short Bio:

Wei Fang is the professor in optical engineering at Changchun Institute of Optics, Fine Mechanics and Physics. She received the Ph D. degree in optical engineering from Changchun Institute of Optics, Fine Mechanics and Physics. She has been engaged in related research about absolute radiometric measurement, measurement & calibration of solar irradiance and absolute calibration of space optical remote sensing instrument since 1987. She was the project leader of Solar Irradiance Monitor for FY-3A satellite (launched in 2008), FY-3B satellite (launched in 2010) and FY-3C satellite (launched in 2013). She is currently the project leader of Joint Total Solar Irradiance Monitor for FY-3E satellite.

Solar radiometry at PMOD/WRC – latest developments

Physikalisch-Meteorologisches Observatorium Davos / World Radiation Centre, Switzerland

Wolfgang Finsterle

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The Phyiskalisch-Meteorologisches Observatorium / World Radiation Centre (PMOD/WRC) has been actively developing solar radiometers ever since it was founded in 1907. Since the early 1970s the focus was laid on developing absolute cavity electrical substitution radiometers (ESR).

DARA stands for Digital Absolute Radiometer. Its development started in 2008. Today the DARA is arguably one of the most advanced absolute solar radiometers. The first DARA-type solar radiometer is currently flying on the CLARA experiment as part of the Norwegian NORSAT-1 space mission. Future missions with DARA-type radiometers include the Chinese FY-3E and ESA's PROBA3. A commercial variant of the DARA for ground-based applications in the meteo/climate and solar energy sectors is currently being developed in collaboration with the spin-off company “Davos Instruments”.

We will present the design philosophy, concepts and improvements implemented in the DARA with respect to previous absolute solar radiometers.

Short Bio:

Wolfgang Finsterle is currently leading the Solar Radiometry Section (SRS) at PMOD/WRC. He holds a MSc in experimental physics and a PhD in natural sciences from ETH Zurich. He joined the SRS in 2004. From 2002 to 2004, he was a postdoc researcher with focus on helioseismology at the University of New Mexico's Maui Scientific Research Center in Kihei, USA. He is the PI for SOHO/VIRGO and FY-3E/JTSIM-DARA and an instrument team member for ISS/SOVIM, PICARD/PREMOS and PROBA3/DARA.

Lunar spectral irradiance observation for lunar reference model improvement

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The Moon is a nearby atmosphere-less body that reflects solar radiation and its surface does not change with time (at least within our lifetimes), so it provides an excellent reference standard for space-borne sensors' calibration. But the uncertainty of the absolute lunar spectral irradiance is still too high at present to resolve the differences in the absolute calibration of satellite radiometer instruments to use the Moon as an absolute calibration reference at the level needed for climate monitoring. In the past years, global efforts of developing many facilities are taken including ground-based, aircraft and space-borne lunar observation for improving the Moon radiometric standard for on-orbit instrument calibration. In China, one Lunar Imaging spectrometer and Hyperspectral lunar-photometer were developed and are keeping improvement as well as some ancillary measurements for atmosphere correction (Lidar and sun-photometer). A good observation site nearby Lijiang astronomical observatory is selected with excellent clear sky condition (AOD less than 0.05) and 3200m altitude. CMA with these instrument vendors initiated long term observation of ground-based lunar irradiance with automatic control by remote and local maintenance at Lijiang since November, 2018. The preliminary results of current data processing and comparison with ROLO model show the 5~10% absolute bias and less than 3% deviation of these samples. To realize the prospective Improvement (Uncertainty less than 1%) for current lunar reference model, the instrument improvement and accurate calibration is challenging and kept ongoing and other new instruments will be incorporated into this kind of observation in the new future.

Short Bio:

Xiuqing Hu Deputy Chief Scientist of FY-3 Satellite program ground application system, Satellite Calibration/Validation Chief. Xiuqing Hu currently works at the National Satellite Meteorological Centre, China Meteorological Administration. Xiuqing does research in Satellite sensor Calibration/validation. Their current project is 'Integrated Calibration System of FY sensor' and 'Solar bands calibration technique based on Lunar radiance source.

JTSIM-DARA engineering concept and architecture

PMOD/WRC, Switzerland

Silvio Koller

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PMOD/WRC performed Total Solar Irradiance (TSI) measurements in space for decades with the well-known PMO6-type absolute radiometers. These active cavity radiometers were integrated in the payload experiments of the missions: EURECA, SOHO, SOVIM(ISS), PICARD and delivered an uninterrupted time series of TSI acquisition.

In 2009 a new generation absolute radiometer development was initiated by PMOD/WRC. First feasibility studies, followed by a Phase B1 for the ESA mission PROBA-3 led to a prototype instrument, which was used in terrestrial applications. The instrument has been further improved and finally the Compact Lightweight Absolute Radiometer CLARA was launched in July 2017 aboard the Nano-satellite NORSAT-1. The same instrument concept is applied now for the ESA mission PROBA-3 and the NRSCC mission FY3-E. The Digital Absolute RAdiometer DARA incorporates a unique thermal design, a newly developed receiver configuration and highly integrated electronics with feed-forward PID control loops for the radiometer sensors. The specific technical implementations and solutions are presented on the example of JTSIM-DARA on FY-3E.

Short Bio:

Silvio Koller is Co-head of the Technical Department at the Physikalisch-Meteorologisches Observatorium Davos & World Radiation Center (PMOD/WRC), Switzerland. He is an Electrical Engineer (MSc) with an additional master's degree in business administration. Silvio Koller is a member of the institute management board. He was involved in various instrument developments for space application, starting in 1986 with electronics development and since 1998 frequently as project manager for UV radiometers and Absolute Radiometers for Total Solar Irradiance measurement. Further he was responsible for the Quality Management of the calibration departments of the World Radiation Center for more than 10 years. Currently he is also project manager on the space project JTSIM-DARA, to be flown on the Chinese mission FY-3E.

Total solar irradiance record from FY-3C/SIM-II

NSMC/CMA, China

Jin Qi

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Solar Irradiance Monitor-II (SIM-II) onboard FengYun-3C (FY-3C), the third satellite of the second generation of Chinese meteorological polar orbit series, is aimed to observe incoming solar energy over 0.2–50 um band at top of atmosphere and convert it to total solar irradiance (TSI) at the average sun-earth distance. Based on ground calibration, the results of FY-3C/SIM-II are traceable to world radiometric reference and showed as the level of 1365.37 W/m^2 over nearly 5 years observations. The SIM-II TSI data has been evaluated by comparing with SORCE/TIM and RMIB composite data. The result shows a good consistency. This work shows the new results from recalibrated TSI data record after improvement on background and aging correction, and its capability on monitoring solar activities.

Short Bio:

Jin Qi is an associate researcher with the National Satellite Meteorological Center, China Meteorological Administration, Beijing, China, with background in the field of satellite remote sensing. She has worked on the calibration and validation of Solar Irradiance Monitor onboard FY-3 satellites for over ten years, and currently in the research field of TSI data record building.

Earth radiation measurements on chinese new generation polar orbit satellites

NSMC/CMA, China

Hong Qiu

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Weather and climate on Earth are strongly influenced by the amount and distribution of incoming radiation from the Sun. The outgoing Longwave (LW) radiation from Earth –atmosphere system would balance its absorbed solar Shortwave (SW) radiation. Earth Radiation Budget (ERB) measurement is one of the main missions of Chinese new generation of polar orbiting meteorological satellites ---FengYun-3 (FY-3) series. There are two instruments, the Solar Irradiance Monitor (SIM) and the Earth Radiation Budget (ERB), on board FY-3 satellite to observe the earth incoming and reflected solar radiance and the emitted radiance. The ERMs observes the Earth atmosphere within a narrow scanning field of view (NFOV) and a wide non-scanning field of view (WFOV). For each field of view, the measurements are made from two broadband channels: a total waveband channel covering 0.2 – 50 μm and a Short Wave (SW) band covering 0.2 - 4.3 μm. In this presentation the ERB instrument, its calibration prelaunch and performance in orbit will be showed. The ERM unfiltered radiance for LW and SW broadband produced with spectral correction based on atmospheric transfer modellingwere compared to the data from EOS/Terra and Aqua CERES and a good consistence was showed between the two datasets. With the ERMs on-orbit calibration data and observations from tropical ocean, the radiometric response for two channels was analyzed The SW channels and SW part of total channels have larger changes in gain. This drift is caused by the detector degradation. The worst thing happened that the SW channel of NFOV has stopped working after 20 months for FY-3A and 8 months for FY-3B in orbit. The SW and total channels for FY-3C are in good condition for 5 years in orbit.

Short Bio:

Hong Qiu received the B.S, degree in atmospheric physics and environmental science from the Nanjing University of Information Science & Technology; M.S degree in Chinese Academy of Meteorological Science (CAMS) and Ph.D degree in Peking University, China, in 1991, 1994 and 2007, respectively. She joined the National Satellite Meteorological Center (NSMC), China Meteorological Administration(CMA), Beijing, China in 1994. She has worked on the calibration of the VIRR instruments on Chinese FY-1C/D satellites, remote sensing of tropical cyclone with microwave data. She is currently an AssociateSenior Scientist in the field of calibration of Earth Radiation Measurement (ERM) and products generating from Chinese FY-3 series satellites.

Micro-calorimetry dedicated to radiative transfer monitoring

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It is a documented physical phenomenon that energies in all transfers constantly deteriorate to heat. Especially in the radiative flux monitoring, absorption by a surface induces temperature excursions depending of its parameters. This fact covered in the calorimetry concept, could be exploited for radiometers design. We will deal in this presentation with the means and methods finalized at the Royal Observatory of Belgium (ROB) to address this idea. Thermistors with original electronics allow to introduce monitoring at the level of precision of the µKelvin. This is far below the absolute determination which is announced in term of mili-Kelvin. A series of thermal approaches is introduced that illustrate the abilities of extremely precise thermometry, to improve the understanding of intricacies of radiative signatures from celestial bodies. Different thermometric applications dedicated to geophysics, are described in order to introduce the micro-calorimetry concept and its applicability.

Short Bio:

Michel van Ruymbeke, emirate professor at University Catholique de Louvain. Senior scientist at Royal Observatory of Belgium. He has initiated the EDAS (European Data for Scientist) concept in 80s, under this concept, many education program and field experiments were developed in Europe, Asia and Africa. He is the PI of the BOS experiment on the PICARD microsatellite, the key designer of gravimeters and their calibration platform for steroids and planetary bodies.

Activity of the sun and sun-like stars

MPI, Germany

Alexander Shapiro

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Solar brightness varies on all timescales that have ever been resolved or covered by spaceborn instruments. Driven by the climate community's interest in links between solar variability and climate change, our understanding of solar-brightness variations has dramatically improved over the last decade. Modern models are capable of reproducing available measurements of solar brightness variability with high precision. However, the amplitude of secular solar brightness variability still remains uncertain, hindering the quantitative assessment of the solar role in natural climate change.

Concurrently with solar studies, ground-based photometric measurements of Sun-like stars revealed brightness variations similar to solar variability on the 11-year activity timescale but with much wider variety of patterns. The interest to stellar brightness variations has been further elevated by the unprecedented precision of stellar brightness measurements achieved by the CoRoT and Kepler space missions.

We review a present state-of-the-art in the studies of solar and stellar brightness variability and show how the solar paradigm can help us to explain variability of other stars and vice a versa stellar data can help us to better understand solar activity.

Short Bio:

Alexander Shapiro, Leader of the SOLVe Research Group (http://www2.mps.mpg.de/projects/solve/) funded by an ERC Starting Grant, Max-Planck-Institut für Sonnensystemforschung, Göttingen, Germany. He has received Marie Curie Intra-European Fellowship, Fellowship from the "Dynasty" foundation in theoretical physics, and Soros fellowships. His research interesting is focused on: solar and stellar variability, numerical and analytical radiative transfer, solar and stellar magnetic fields, Sun-Earth connections, and atmospheric physics.

SOLACER – A new auto-calibrating system to record solar spectral irradiance

Fraunhofer Institute for Physical Measurement Techniques IPM | *IPM, Germany*

Gerhard Schmidtke

After about 50 years of solar spectral irradiance measurements from space, the precise measurement of is still challenging as it requires a system to reliably track the instrument degradation over the full mission duration. Based on a systematic re-analysis of the requirements for future SSI measuring systems, the new, compact, and moderate-cost instrument SOLACER is proposed offering the possibility to improve the on-board monitoring of degradation effects to provide SSI data acquisition of significantly increased accuracy. To achieve this, an absolute radiometer along with ionization chambers of proven long-term stability serve as primary detector standards to determine the absolute SSI fluxes passing a series of narrow- and medium-band filters with updated transmission. Consecutively cross-calibrated Bolometers and photomultiplier tubes of high sensitivity are to be used as secondary detector standards. With this design, the new SOLACER instrument covers the spectral range from about 2 nm to 2800 nm with eight planar grating spectrometers.

Short Bio:

Gerhard Schmidtke, born on 3rd March 1937 in Lyck/Germany, Gerhard Schmidtke started academic studies of physics at University of Rostock in 1956 receiving the diplom of physics at university of Freiburg in 1962 and the PhD in 1968. In 1963 to 1964 Gerhard Schmidtke worked on a fellowship with Dr. Hans Hinteregger of AFGL Air Force in Cambridge, Massachussetts, USA in the field of upper atmospheric physics and the measurement of solar extreme ultraviolet radiation. Thereafter, he was employed with the Institute of Physical Measuring Technique of the Fraunhofer Society for Applied Research, investigating solar, auroral, and XUV-EUV-VUV-VIS atmospheric radiations based on 14 rocket and 3 satellite experiments. From 2008 to 2017 the Solar Auto-Calibrating EUV/UV Spectrometer system was working aboard the International Space Station. From 1980 to 1996 he worked also in the fields of tunable IR diode laser spectroscopy for atmospheric and trace gas measurements as well as for industrial applications, of UV derivative spectroscopy, and of contour mapping by laser radar techniques. From 16th September to 8th October 1995 Gerhard Schmidtke followed an invitation by the Bejing University. After his retirement he is still working to develop an auto-calibrating spectrometer system to derive solar spectral irradiance of highest possible accuracy for climate modelling and other applications in the XUV through the IR spectral regions. More than 150 papers have been published primarily in international journals.

Solar spectral irradiance and solar radius for validating solar models used in atmosphere and climate physics

PMOD/WRC, Switzerland

Gérard Thuillier

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For atmosphere and climate models, solar spectral irradiance (SSI) is reconstructed using several proxies when no SSI data exist at the appropriate time. This is especially true for climate studies for the past periods, e.g. the Maunder minimum. Some examples show that the SSI model validation remains an important and difficult task. Using the solar radius open a way to contribute to several objectives: 1) Solar physics: is the solar radius constant or changing with time in particular with solar activity. 2) Its absolute value is a key input for the metrology of the solar system. 3) Solar model validation. There are large uncertainties among solar radius values due to the use of different measurement techniques, instruments calibration, role of the Earth's atmosphere effects for ground-based measurements, role of the space environment for instruments in orbit and their aging when long term studies are foreseen. Basically, the solar radius value depends on the solar atmosphere opacity, which allows solar model validation by comparing model predictions with the observations. We present a new method using an absolute radius reference stable on a time scale much greater than a solar cycle.

Short Bio:

Gérard Thuillier as Principle Investigator (PI) proposed in 1976 to ESA a triple spectrometer named Solar Spectrum (SOLSPEC) for SSI measurements. It was the first investigation aiming to space observations over this large spectral range for solar, atmospheric and climate physics. The SOLSPEC instrument flew on board the Space Shuttle with the SpaceLab I and SpaceLab II mission. SOLSPEC observations were resumed with the ATLAS 1, ATLAS 2, and ATLAS 3 missions. The twin instrument of SOLSPEC was part of the European Retrieval Carrier (EURECA) ESA mission. SOLSPEC was run on board the International Space Station (ISS) allowing an extension of the spectral domain of measurements.

Space absolute radiometry payload and on-orbit traceable radiometric calibration system

CIOMP, CAS, China

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In order to improve the measurement accuracy and stability for space optical remote sensors, the on-orbit traceable radiometric calibration system of solar reflection spectrum is investigated for developing the space absolute radiometry payload. The space cryogenic absolute radiometer (SCAR) operated at 20K is developed to realize the on-orbit traceable high accuracy radiation measurement, and to establish the radiation calibration standard source with the 0.03% uncertainty. The earth-moon imaging spectrometer with high signal-to-noise ratio and ultra-large dynamic range is researched. The wide spectrum coverage and full spectrum high transmittance are achieved through optical design optimization. The high-order aspheric off-axis three-mirror telescope system is designed to optimize the optical layout. The earth-moon imaging spectrometer has the measurement functions for earth and moon. The onboard radiation standard transfer chain of the self-calibration system is established through the components of monochrome source, halogen tungsten lamp, solar and transfer radiometer. The earth-moon imaging spectrometer can be calibrated in orbit, such as the radiance and the response linearity. The absolute observation of the spectral radiance of the earth reflection spectrum and the lunar spectral irradiance can be realized. The observation modes of the satellite scanning, the calibration site, and lunar radiation are designed. The optical remote sensing instruments can be cross-calibrated by the earth-moon imaging spectrometer, pass through observing the calibration site on the earth or the lunar surface simultaneously. Then the radiation scale on the satellite is unified. The research results will provide the key technology basis for the future establishment of the high-precision calibration benchmarks for onboard radiation, significantly improve the comparability and long-term stability of remote sensing data, and have important significance for the study of the climate change, disaster prediction, and monitoring.

Short Bio:

Xin Ye is an associate professor of optical engineering at Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP). He is also the deputy director of space optics department I of CIOMP. His research interests are solar absolute irradiance radiometer, space cryogenic radiometer and on-orbit radiometric calibration. He is the project leader of the Absolute observation technique of solar, earth and lunar spectral radiation based on space cryogenic radiometer (2018YFB0504603) supported by National Key R&D Program of China under grant 2018YFB0504600.

The solar spectral irradiance monitor on FY-3 satellite E

CIOMP, CAS, China

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The Solar Spectral Irradiance Monitor (SSIM) is a new payload on FY-3 satellite E. Like SOLSPEC in various space missions, it designs for long-term monitoring of the continuous solar spectrum for solar physics, climate research, and atmospheric physics etc...

SSIM is made of five main components, two spectrometers for observing, a two-axis platform allowing to point to the Sun, a power control unit for electronic command, data processing and control, and a sun sensor for imaging the Sun. The dimension of SSIM is about 529mm×1070mm×755mm, and the weight is approximately 140kg.

SSIM is a broadband spectral instrument, covering the range 165nm to 2400nm. Considering the spectral range is wide,SSIM has been divided into three bands, the UV band, the VIS band and the NIR band, covering the range 165nm~320nm, 285nm~700nm and 650nm~2400nm. The spectral resolution of each band is less than 1nm, 1nm and 8nm respectively.

The two spectrometers of SSIM are called UV spectrometer and VIS/NIR spectrometer. The VIS band and the NIR band form the VIS/NIR spectrometer, and two same UV bands form the UV one. The two spectrometers adopt the same structures on filter wheels, wavelength scanning mechanisms, and double-monochromators of reductive dispersion. The gratings are concave holographic ones made by JOBIN-YVON. The detectors are photomultipliers from Hamamatsu and InGaAs from Judison. The two-axis platform is mainly made of carbon fibers, which makes the platform lightweight but stable. According to the sun sensor, it can make the sun tracking precision less than 0.1 degree. The power control unit is the whole brain of SSIM, which gives orders, controls the moving mechanisms, communicates and makes data processing.

The SSIM is now on Flight-type stage, and will be launched in 2020 to observe the next solar maximum period for at least 8 years.

Short Bio:

Xiaohu Yang is an associate research fellow at Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences. He got his PhD of optical engineering in 2012. His technical research is mainly about optical testing, instrument adjustment and radiation calibration.

Symposium 6

The earth's energy imbalance and its importance to study climate change

CIOMP, CAS, China

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The solar forcing is the primary driver of the Earth's climate. For a balanced climate system, the incoming solar radiation is required to equal to the sum of the reflected visible and the reemitted thermal radiation at-top-of-the-atmosphere (TOA). The Earths Energy Imbalance (EEI) is the difference between the absorbed solar radiation (the incoming solar minus the reflected solar radiation) and the remitted thermal infrared radiation. However, the absolute level of the TOA EEI is fixed at the range of [0.5-1.0] Wm^{-2} based on the ocean heat content measurements. Considering the atmosphere has a negligible effect on the EEI determination, the surface global EEI is consistent with the values determined from space. How is the EEI linked to the climate change? Why is it a critical indicator of the health of climate? In addition to studying the absolute level of the global EEI, we show that the interannual variation of global net radiation flux, which can be independently derived from the PICARD-BOS experiment, the result is comparable with the NASA-CERES system. In this presentation, we will briefly recall the past and current space missions targeted to track the EEI from TOA and discuss lessons learned from them.

Short Bio:

Ping Zhu he studies the various geophysical phenomena and mainly focuses on solar, terrestrial, and planetary radiation measurement from space. He is nominated as a 100 talent professor of Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science and a senior scientist at Royal Observatory of Belgium. He was the Co-PI of PICARD-BOS experiment, a French-Swiss-Belgian space mission and the PI of TARO a joint Chinese and Belgian space experiment.

Radiation budget measurements from current and future FY-3 satellites

National Meteorological Satellite Center/China Meteorological Administration, China

Peng Zhang

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Fengyun 3 series (FY-3 as brief hereafter) is the second generation of Chinese meteorological polar orbiting satellite. There are 4 satellites have been launched successfully since 2008. The first two of them, FY-3A (2008) and FY-3B (2010) are research and development satellites. As a successor, FY-3C (2013) and FY-3D (2017) satellites are operational satellites. Multiple types of advanced instruments have been mounted on the platform of FY-3 satellites, including multiband optical imaging, atmospheric sounding, microwave imaging, hyperspectral trace gas detecting, and full-bandradiation budget measuring. There are two instruments deployed to measure radiation budget at top of the atmosphere, i.e. Earth Radiation Monitor (ERM) and Solar Irritation Monitor (SIM). This talk will summarize the performance of ERM and SIM. The longterm results since 2008 are also given in this presentation. The future program with the improved instruments for radiation budget measuring has been introduced in the last part.

Short Bio:

Peng Zhang is deputy director–general of National Satellite Meteorological Center, chief director of ground segment for FY-3 meteorological satellites and Chinese TanSat. He was chair of Global Space Inter-Calibration System (GSICS) Executive Panel from 2014 to 2017, chief scientist of the national high technology research and development program of China for the space-based radiometric benchmark onboard calibrators (Grant No. 2015AA123700) from 2015-2017. Now he is chief scientist of national key R&D program of China for the retrospective calibration of the historical Chinese earth observation satellites (Grant No. 2018YFB0504900) from 2018-2022. Dr Zhang got his Ph.D at IAP/CAS (Institute of Atmospheric Physics, Chinese Academy of Sciences) for atmospheric physics in 1998. He worked in EORC/NASDA (Earth Observation Research Center, National Space Development Agency of Japan) with Post Doctor position for GLI/ADEOSII project. Since 2001, he worked in NSMC/CMA with Associate Professor (Nov., 2001 — Nov., 2005) and Professor (Dec., 2005 — Present) position. Dr. Zhang intensively involved in conceiving, developing, and operating FY-3 satellite ground segment. With his leadership, Chinese meteorological polar orbiting satellite FY-3 data have been used worldwide and the radiance calibration accuracy of the instruments mounted on the FY-3 has been improved greatly. His research experience covers the atmospheric remote sensing, satellite calibration and validation, and atmospheric radiative transfer calculation, etc. He has authored and coauthored over 90 papers published in refereed scientific journals to date, in addition to editing 2 Books and many book chapters and technical reports.

Light Conference 2019

Symposium 7

Semiconductor lasers and detectors

Co-Chairs:

Cunzhu Tong

Huiyun Liu

Si based MWIR photodetectors

Shanghai Tech University, China

Baile Chen

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Mid-wavelength infrared photodetectors have many applications in areas such as gas monitoring, chemical sensing and infrared imaging. While III-V infrared photodetectors have been demonstrated on GaAs, InP, InAs and GaSb substrates, the cost of these III-V substrates is still high as compared to Si substrate. Moreover, these technologies aren't compatible with standard silicon CMOS technology. Therefore, direct integration of III-V materials with CMOS technology for MWIR application is highly desirable, which can significantly reduce the cost of the current technologies. In this talk, I will review the performance of III-V photodetectors monolithically grown on Si, such as quantum dot infrared photodetectors, quantum dot quantum cascade photodetectors, and InAs/GaSb type-II superlattice PIN photodetectors.

Short Bio:

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, PI. His research interests include III-V compound semiconductor materials and devices, silicon photonics.

Silicon photonics technologies for advanced information systems

National Institute of Advanced Industrial Science and Technology(AIST), Japan

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Integrated photonics technologies are showing great potential in dealing with the rapidly increased traffic in data communications and telecommunication. Silicon photonics offers a way of low cost, high integration level, and mass productivity to implement photonic integration by leveraging well-established CMOS lines. From a platform point of view, it is very important to establish silicon photonic technologies featuring stable and superior fabrication accuracy, uniformity, and productivity. Meanwhile, it is also indispensable to establish not only the current mainstream fundamental devices, but also devices facing the future applications. In this talk, we will review our high-performance silicon photonic devices developed on state-of-art AIST 300-mm CMOS line which are key devices in constructing future information systems.

Short Bio:

Guangwei Cong is currently a senior researcher of National Insitute of Advanced Industrial Science and Technology (AIST), Japan, who is working on developing silicon photonics technologies based on a 300-mm CMOS line. He obtained the Ph.D. degree from Institute of Semiconductors, Chinese Academy of Sciences in 2006. After that, he joined AIST as a postdoc and studied the high-speed all-optical switches based on II-VI and III-V quantum wells. In 2010, he became the researcher of AIST and started research on silicon photonics technologies. Currently, he is a senior researcher of AIST and is doing research on electronics and photonics monolithic integration, optical switches, high-speed modulators, and novel devices for advanced photonic computing applications.

III-V quantum-dot lasers grown on silicon for silicon photonics

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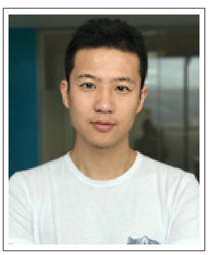
The available of silicon-based light sources is the key technology for the whole Si photonics industry. But the indirect bandgap of silicon is a severe limitation, and, despite recent advances, these devices will not, in the foreseeable future, outperform their III-V counterparts. Much effort has been directed toward hybrid integration of III-V lasers with silicon photonics platforms. Although impressive results have been achieved, on a longer term, large-scale integration of photonics circuits will rely on monolithic integration of III-V light sources on silicon.

In this talk, we discuss our recent progress made in the epitaxial growth of various III-V quantum dot lasers on silicon substrates for silicon photonics.



Short Bio:

Siming Chen obtained his Ph.D. in Electrical Engineering from the University of Sheffield in 2014. He then joined the Dept. of Electronic and Electrical Engineering (EEE) at University College London (UCL) as a Research Associate and was award a Royal Academy of Engineering (RAEng) Research Fellowship in 2017 in recognition of his pioneering work on the development of silicon-based light sources and growing international profile. He is currently a RAEng Research Fellowhosted by Dept. of EEE at UCL and PI on £0.6m of current grant. Dr Chen has published more than 70 papers in internationally-leading journals and conferences, with several high-profile journal papers, including one Nature Photonics, Optica and ACS Photonics and so on. He is a regular speaker at key international conferences (SPIE, ISLC, CLEO, CLEO-PR, ECOC) and workshops related to silicon photonics and semiconductor lasers and has delivered over 10 invited talks/tutorials at conferences, workshops and summer schools. He is a TPC member of CLEO-PR, a Content Management member of the LSA Editorial Office in London and reviewer for many prestigious journals (Light Sci. Appl., Optica, Nano Lett., Sci. Rep., ACS Photonics).

Symposium 7

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

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Optical modulators are at the heart of optical communication links. Ideally, they should feature low loss, low drive voltage, large bandwidth, high linearity, compact footprint and low manufacturing cost. Unfortunately, these criteria have been achieved only on separate occasions. Based on a silicon and lithium niobate hybrid integration platform, we demonstrate Mach–Zehnder modulators that simultaneously fulfil these criteria. The presented device exhibits an insertion loss of 2.5 dB, voltage–length product of 2.2 V cm in single-drive push–pull operation, high linearity, electro-optic bandwidth of at least 70 GHz and modulation rates up to 112 Gbits−1. The high-performance modulator is realized by seamless integration of a high-contrast waveguide based on lithium niobate—a popular modulator material—with compact, low-loss silicon circuitry. The hybrid platform demonstrated here allows for the combination of 'best-in-breed' active and passive components, opening up new avenues for future high-speed, energy-efficient and cost-effective optical communication networks

Short Bio:

Xinlun Cai is currently a full Professor in School of Electronics and Information Technology at the Sun Yat-sen University, and an Affiliate Member of the State Key Laboratory of Optoelectronic Materials and Technologies. He joined the faculty of the Sun Yat-sen University in 2014. He got his Ph.D. in University of Bristol, U.K. for semiconductor ring lasers and silicon photonic optical vortices devices. From 2012 to 2014, he was a post-doc research at University of Bristol.

Recent progress in advanced indoor infrared wireless communications

Eindhoven University of Technology, The Netherlands

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Wireless communication by means of light (a.k.a. 'optical wireless communication', OWC) instead of radio waves can bring a breakthrough in communication capabilities, both in terms of ultra-high capacity per user and in terms of electromagnetic interference-free communication, without requiring spectrum licenses. Since 2012, an ERC advanced grant 'Beam Reconfigurable Optical Wireless System for Energy-efficient communication (BROWSE) is carried out in Eindhoven University of Technology (TU/e). Here we summarize part of our recent progresses on infrared wireless communication (IWC) systems, mainly about how to increase the power utilization by advanced photonic integrated circuits of receiver and a novel transmitter concept.

Short Bio:

Zizheng Cao is currently atenured assistant professor with ECO group at Institute for Photonic Integration (IPI) of Eindhoven University of Technology (TU/e), the Netherlands. In 2015, he was graduated with highest honor PhD degree (cumlaude) in Eindhoven University of Technology. After one-year post-doctoral research, Dr. Cao has been promoted to a tenure track position as an assistant professor and later tenured assistant professor in 2018. Dr. Cao has more than 10-year research experience on optical communication system design, high speed digital signal processing, and the design, fabrication and characterization of photonics integrated circuit in multiple platform including SOI, SiN and InP. His current research interests include, a) indoor optical communications, b) microwave photonics, c) photonic integration.

He is a recipient of IEEE Photonics Society Graduate Student Fellowship 2014. He serves for European Conference on Optical Communication (ECOC) as a member of technical program committee (TPC). He serves as an active reviewer for many IEEE/OSA journals.

Quantum dot cascade laser: from concept to practice

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Quantum dot cascade laser (QDCL) possesses high wallplug efficiency and broad tunability. The QDCL based on three-layer QD active region design combined with two-step strain-compensation growth technique, gives continuous wave operation at room temperature at wavelength of 7.2 μm. In the coupled QD active structure, the upper laser state is quantum well (QW) dominated hybrid state of QW-QD, the lower laser state is QD dominated hybrid state of QW-QD. The QD dominated hybrid state is quasi-separate states, which sustains the "phonon bottle neck effect", consequently reduces the nonradiative decay rate of the lasing transition. In order to enhance the renovated "phonon bottle neck effect", the QD active region should be based on two-layer QD or single-layer QD.

In this talk, the QDCLs based on two-layer QD active region, and single-layer QD active region have been exploited. The QDCL based on two-layer QD active region presents room temperature lasing at wavelength of 6.85μm, while the QDCL based on single-layer QD active region shows lasing at wavelength of 6.5μm at 80K. Considering the structure of QDCLs consist of GaAs layers and the accurate energy levels are difficulty to exact match the injection and extraction levels, the materials quality and electronic design of active regions are not good enough. What is more, the detailed physics of electron scattering and tunneling should be explored in the future. This feasible method paving a route for developing QDCLs.

Short Bio:

Fengqi Liu joined Institute of Semiconductors, Chinese Academy of Sciences, in 1996, where his work has concentrated on the MBE growth and fabrication of high-performance mid-infrared and terahertz quantum cascade lasers (QCLs). He received the National Natural Science Foundation for Distinguished Young Scholars in 2005, and the New Century National Hundred, Thousand and Ten Thousand Talent Project in 2007. He developed a series of room temperature (RT) operated high-performance QCLs with emitting wavelength in the range of 3.5--16microns,innovated the first quantum dot cascade lasers by two-step strain compensation active region design, developed high power terahertz QCLs with emitting frequencies between 2.95--3.3 THz, developed a series of quantum dot cascade detectors with very low dark current and background noises, high operating temperature, and high detectivity.

Epitaxial quantum dot lasers on silicon with high performance and reliability

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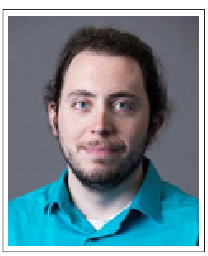
An epitaxially integrated laser on silicon would provide significant economic advantages over heterogeneously integrated devices. Unfortunately, high densities of crystalline defects that arise from the structural mismatch between III-Vs and Si have prevented the realization of a commercially viable laser grown on silicon. Recently, significant progress has been made through optimized GaAs buffers on silicon and the use of InAs quantum dots as a defect-tolerant O-band gain medium. At threading dislocation densities below 107 cm^{-2}, lasers have been demonstrated with threshold current densities as low as 132 A/cm^{2}, continuous wave output over 90°C, and extrapolated device lifetimes of >10,000,000 h at 35°C (>50,000 h at 60°C), all done on industry-standard (001) Si substrates. These devices have also been characterized for their dynamic performance revealing near-zero linewidth enhancement factors for high stability against optical feedback, and the material has been used for mode-locked lasers with 4.1 Tbps transmission from 64 externally modulated comb lines.



Short Bio:

Justin Norman is currently a Postdoctoral Researcher in the Institute for Energy Efficiency at the University of California, Santa Barbara. He obtained his Ph.D. in Materials from the University of California, Santa Barbara in 2018 under Prof. John Bowers and Prof. Arthur Gossard. His research interests are in the epitaxial growth of III-V materials on silicon and the use of quantum dots for optoelectronic devices and silicon photonic integrated circuits.

III-V semiconductor lasers directly grown on silicon by metalorganic chemical vapor deposition

Beijing University of Posts and Telecommunications, China

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The integration of III-V lasers monolithically grown on Si is considered to be a promising solution to obtain efficient light sources on the Si platform in the near future. However, direct epitaxial growth of III-V semiconductors on Si wafers faces several significant difficulties including large mismatches in lattice constant, thermal expansion coefficient, and polar/non-polar surfaces.Due to the tolerance to the crystalline defects, quantum dot (QD) lasers have shown promise for fabricating high performance lasers on Si. To avoid the growth condition conflict between QD active regions and AlGaAs upper cladding layers in metalorganic chemical vapor deposition (MOCVD) technology, we proposed a reasonable resolution to adopt the GaInP upper cladding layers instead. Compared with AlGaAs upper cladding layers, the GaInP counterparts have many advantages. Its growth temperature by MOCVD can be lower to 550 ℃. Hence, it can be relieved to affect the QDs during post-growth of upper cladding layers. In this talk, we will present our research of developing a 1.3μm InAs/GaAs QD laser structure grown on silicon by MOCVD with GaInP upper cladding layers.

Short Bio:

Jun Wang received the M.S. degree in optics from Huazhong University of Science and Technology in 2003, and the Ph.D. degree in microelectronics and solid state electronics from Institute of Semiconductors, Chinese Academy of Sciences (CAS) in 2006. After receiving his PhD, he joined the National Engineering Research Center for Optoelectronic Devices, Institute of Semiconductors, CAS. In 2012, he joined the State Key Laboratory of Information Photonics and Optical Communications, and Institute of Information Photonics and Optical Communications, where he is now an Associate Professor. His current research interests include the nano-scale engineering of low-dimensional semiconductor structures (such as quantum dots and quantum wells) by using metalorganic chemical vapor deposition, and the development of novel optoelectronic devices including lasers on silicon.

III-V microcavity lasers monolithically grown on SOI substrates for silicon photonic integration

Institute of Physics, CAS, China

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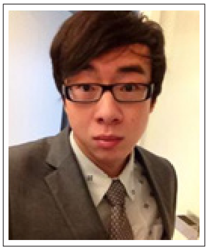
Silicon is one of the most important semiconductor materials. Although it has been the mainstays for modern electronics, it is not widely used for light emitting sources because bulk silicon is an inefficient emitter, a result of indirect bandgap. Direct epitaxial growth of III-V nanostructures on silicon substrates is one of the most promising candidates for realizing photonic devices on a silicon platform. Recent years, the emergence of hyper-scale data centers boosted the research field of integrated silicon photonics. One of the major challenges for compact photonic integrated circuits is silicon based lasers. Here, we have demonstrated optically pumped InAs/GaAs quantum-dot microcavity lasers on exact Si (001) on SOI substrate by (111)-faceted-sawtooth Si hollow structure via IV/III-V hybrid epitaxy. The proposed III-V/Si hybrid platform is a major step towards silicon-based photonics and photonic-electronic integration, and provide a route towards cost-effective monolithic integration of III-V devices on Si platform.

Short Bio:



Ting Wang received his PhD from University College London, where he fabricated the world-first room-temperature InAs QD laser on both Ge and Si substrate for silicon photonic integration. He then joined MIT International Design Centre for nonlinear silicon photonic research in Singapore. In 2014, he was awarded IOP CAS 100 Talent Plan, and started his academic career by taking Associate Professor position in the Nanoscale Physics and Devices Laboratory at Institute of Physics (Chinese Academy of Sciences) with commissioning the first III-V/IV hybrid Molecular Beam Epitaxy reactor for silicon photonics in China. His current research interest concentrates on the nanometre-scale engineering of low-dimensional semiconductor structures (such as quantum dots and nanowires) by using Molecular Beam Epitaxy and the development of novel optoelectronic devices including lasers, detectors, and modulators. He co-authored more than 50 scientific papers (Nature Photonics, Nature Communications, Nano Letters, Laser & Photonics Reviews etc.) and hold on several patents on silicon photonics.

MBE growth of high-performance InAs/GaAs quantum dots and their devices application

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Semiconductor quantum dots (QDs) promise significantly enhanced performances of optoelectronic and electronic devices due to their discrete energy levels and delta-function-like density of states. The continuous progress in the fabrication of the nanostructured QDs and their applications to various optoelectronic and electronic devices has shown the promising, e.g., the QD lasers have shown much lower threshold current densities, much more temperature stability, and much stronger anti-reflection than their quantum well counterparts. This talk will present our recent works on the MBE growth of high-performance InAs/GaAs QDs as well as their devices application including the realization of high-performance QD lasers with ultralow threshold current density and QD intermediate band solar cells (QD-IBSCs) with high conversion efficiency.

Short Bio:

Tao Yang has beena Professor at the Institute of Semiconductors, CAS in Beijing, China since 2006. He has also been a Professor at the University of Chinese Academy of Sciences, Chinasince 2015. Before he joined the Institute of Semiconductors, CAS in 2006, he held research positions at Central Research Lab., Hitachi Ltd., NEDO, and University of Tokyo, Japan from 1997 to 2005, where he had been devoted to the development ofblue nitride semiconductor lasers, ultrafast optical switches based on photonic crystals and quantum dots (QDs), and the growth of high-performance self-assembled InAs/GaAs QDs by MOCVD for lasers operating at 1.3μm. His current research covers the growth and characterization of low-dimensional heterogeneous semiconductor materials (on GaAs, InP and Si) by MBE or MOCVD as well as their applications in the fabrication of high-performance optoelectronic and electronic devices.So far, Prof. Yang has publishedover 120 peer-reviewed scientific papers and applied for 30 patents including 10 issued ones. He has presided 10 national and local government projects containing one National Key Research and Development Program of China. He was awarded the NEDO fellowship in 2000 and the “Hundred Talent Program” of CAS in 2007.

Optically-pumped micro-lasers directly grown on silicon

The Chinese University of Hong Kong, China

Zhaoyu Zhang

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This talk will present the low-threshold lasing in InAs/GaAs quantum dot microdisk and photonic crystal lasers monolithically grown on on-axis Si (001) substrate. The lasing emission of microdisk lasers with a sub-wavelength scale (diameter ~1.1μm) was illustrated, of which an ultra-low threshold ~3μW was obtained. Lasing emission from both the ground state and higher excited states were observed. Besides, the ultra-small photonic crystal membrane lasers monolithically grown on CMOS-compatible Si substrate will be demonstrated. The photonic crystal lasers are continuous-wave optically pumped under room-temperature with a low threshold ~1.2μW and operate up to 70 ℃ , which provide an advanced route of densely integrated laser sources for chip-scale photonic integrated circuits. The promising lasing characteristics of the microdisk and photonic crystal lasers with low lasing threshold and small footprint provide a viable route towards large-scale, low-cost integration of laser sources on a silicon platform.

Short Bio:

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

Growth and optoelectronic properties of intrinsic acceptor-rich ZnO single-crystal microtubes

Beijing University of Technology, China

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ZnO is a representative of the 3rd generation semiconductors, its high-quality n-type doping ZnO is easy to achieve due to its intrinsic n-type conductivity. However, the fabrication of reliable p-type ZnO is a major challenge to realize ZnO-based electronic device applications. Undoubtedly, the stable acceptor is the base of reliable doped p-ZnO. Here, we proposed a novel technique to grow high quality free-standing undoped acceptor-rich ZnO microtubes with dimensions of ~100 μm (in diameter) ×5 mm (in length) by optical vapour supersaturated precipitation. The extraordinary optoelectronic properties of the ZnO microtube are revealed, and several novel applications (e.g.mimetic p-n homojunction, low-threshold UV microlasers, multicolor light source, etc.) are demonstrated.

Short Bio:

Qiang Wang received his PhD in Optical Engineering from the Beijing University of Technology. His work is focused on micro-nano optics and electronic transport regulation in novel structured wide band-gap semiconductors. He proposed the optical vaporization supersaturated precipitation method, for the first time, to realize undoped acceptor-rich ZnO microtubes. He was awarded the China Physics society (CPS) 2016 Outstanding Poster Award and the National Scholarship during postgraduate study. In 2017, he was funded by China Scholarship Council to study at the Johns Hopkins University in the US. He is also the major participant in the research projects funded by the National Natural Science Foundation of China, Beijing Nova Program, and Beijing Municipal Commission of Education.

Light Conference 2019

Symposium 8

Ultrafast laser material processing

Co-Chairs:

Jianjun Yang

Feng Chen

Symposium 8

Periodic ripples on Si surface induced by a single temporal shaped femtosecond laser pulse

East China Normal University, China

Tianqing Jia

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In the fabrication of regular and uniform periodic ripples by femtosecond laser pulses, enhancing periodic energy deposition and reducing the residual heat are two basic factors. This paper reports the formation of subwavelength periodic ripples on silicon surface induced by a single shaped 800 nm femtosecond laser pulse. By using periodic π-phase step modulation, a Gaussian pulse is shaped into a pulse train with temporal interval changing in the range of 0.1-7.2 ps. The shaped pulse is applied to silicon surface to produce subwavelength periodic ripples. The results show that only when the interval between two sub-pulses is longer than 0.9 ps, periodic ripples can be observed on the center of ablation area. By using the two temperature mode and Drude mode (TTM-Drude mode), the evolution of electron density, electron temperature, lattice temperature after the irradiation with a single shaped pulse are studied. The results show that temporal shaped femtosecond laser pulse can be used to enhance the excitation of surface plasmon polaritons (SPPs) and periodic energy deposition, and to reduce the residual thermal effects on silicon surface, eventually leaving periodic ripples on the center of ablation area.

Short Bio:

Tianqing Jia is a full professor at State Key Laboratory of Precision Spectroscopy, East China Normal University, China. His main research focuses in the ultrafast optics and laser micro/nanofabrication.

MEMSbased swept laser source

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Diaa Khalil

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High Speed tunable laser source is currently an essential element for many applications like laser spectroscopy, optical communication systems, telemetry and Optical Coherence Tomography OCT. The required specifications depend on the target applications, however, the compactness, high speed and signal purity are usually common requirements. To achieve such challenging target, the MEMS technology is a strong candidate that allows the integration of both moving and fixed optical elements like mirrors and lenses on the same substrate. These components are all self-aligned with the lithographic accuracy and fabricated within the same process steps. Starting from swept MM laser source going to tunable random laser, the talk will address the current status as well as the potential of the MEMS technology in this domain. The basic theory as well as the main features of this technology will be addressed emphasizing on their effects on the source performance in the NIR range.

Short Bio:

Diaa Khalil has over 34 years of experience in micro photonics systems, including integrated optoelectronics and optical MEMS technology. He is a Professor of photonics in the Faculty of Eng., Ain Shams University, and currently the Vice dean of post graduate and research affairs. He is also the CTO of the Optical MEMS Division in Si-Ware Systems company, leading a group of talented engineers developing an innovative FTIR MEMS spectrometer, a unique product that gained the Prism award in the Photonics West conference 2014 in SF USA. He is a holder of the Egyptian state incentive prize in engineering sciences in 1998 and a member in the editorial board of the Nature journal, “Light: Science and Applications”. He is inventor of 16 granted international patents and 10 patent applications, author of 250 publications, 2 book chapters and 1 ebook produced by SPIE.

Femtosecond laser 3D microfabrication with single exposure and 1D scan

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Femtosecond laser direct writing is a versatile tool to create almost arbitrary 3D nano/microstructures at high spatial resolution by strongly focusing the pulses into a transparent material. However, the dot by dot writing procedure is usually time-consuming. By the 3D focal field engineering with the 2D wavefront modulation of the conventional Gaussian beam using a spatial light modulator, we engineer the focal field intensity distribution into the arbitrary 3D configurations to fabricate a whole microstructure with only single exposure. A microstructure with larger volume can be formed by the 1D scan of the slices of the structure. Because the single exposure technique and the single scan method are realized by the same experimental system, these two approaches can be switched freely.

Short Bio:

Yan Li is currently a Professor at School of Physics, Peking University,Vice director of the State Key Laboratory for Artificial Microstructures and Mesoscopic Physics, Deputy Secretary General of The Chinese Optical Society. He received B.S. in Physics, M.S in Optics and Ph.D in Optics from Harbin Institute of Technology, China in 1989, 1994 and 1997. His professional experiences: 1989.07-2003.09, Assistant, Lecturer, Associate Professor, Harbin Institute of Technology, China;2000.09-2003.03, Research Fellow, Osaka University, Japan;2003.10-current,Associate Professor,Full Professor, School of Physics, Peking University, China.His current research interests include the 3D micromachining and nanofabrication with femtosecond laser pulses, light wavefront shaping and focal field engineering with spatial light modulators and metasurfaces, and spin Hall effect of light.

3D nanofabrication of functional structures using blended resins

University of Nebraska-Lincoln, Lincoln, USA

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Direct laser writing by two-photon polymerization (TPP) has been established as one of the most promising methods for achieving 3D fabrication in micro/nanoscales, due to its ability to produce arbitrary and complex 3D structures with subwavelength resolution. However, the lack of TPP-compatible and functional materials represents a significant barrier to realize functionalities of the fabricated structures devices, such as high electrical conductivity, high environmental sensitivity, high mechanical strength, and fast writing speed. In order to overcome these barriers, we have investigated the TPP 3D nanofabrication based on blended precursors. We introduced thiol-acrylate chemistry into TPP to improve structural stability, high fabrication throughput and fine linewidth. We also investigated a thiol grafting method in functionalizing multiwalled carbon nanotubes (MWNTs) to develop TPP-compatible MWNT-thiol-acrylate (MTA) composite resins. Similarly, we also realized metallic 3D micro/nanostructures with silver-thiol-acrylate composites via TPP followed by femtosecond laser nanojoining.

Short Bio:

Yongfeng Lu is currently the Lott Distinguished Professor of Engineering at the University of Nebraska-Lincoln (UNL). He received his bachelor degree from Tsinghua University (China) in 1984 and M.Sc. and Ph.D. degrees from Osaka University (Japan) in 1988 and 1991, all in electrical engineering. He is currently the president of International Academy of Photonics and Laser Engineering (IAPLE, UK). He served as the President of the Laser Institute of America (LIA, USA) in 2014. He has been elected to SPIE fellow, LIA fellow, OSA fellow, and IAPLE fellow. He has also served as chair and general chair for major international conferences in the field. He is also the recipient of the Schawlow Award of LIA in 2016.

Influence of oxygen adsorption on the ultrafast carrier dynamics in monolayer graphene and MoS_2 viewed by transient THz spectroscopy

Shanghai University, China

Guohong Ma

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By employing ultrafast optical pump and THz probe spectroscopy, we investigated the influence of oxygen adsorption on the THz photoconductivity of graphene and MoS_2 laminate. The graphene on fused silica and MoS_2 on sapphire substrate were fabricated by CVD method. The monolayer graphene on silica substrate shows p-type semiconductor, the oxygen adsorption leads to the shift of Fermi level apart from the Dirac point comparing with the case in pure N_2 environment, as a result, oxygen adsorption is equivalence with the condition of the sample under high optical pumping. For the case of MoS_2 laminate, a negative optical induced THz photoconductivity was observed in N_2 environment, and the THz photoconductivity becomes positive one in air and O_2 environment. Moreover, the photoexcitation of MoS_2 in different atmospheres can form different quasi-particles, such as exciton and trion, which is manifested as the very different relaxation of the atmospheres dependent photoconductivity. Our present study highlights the role of oxygen on the photoconductivity in graphene and MoS_2, and may have important applications for the design of future two-dimensional materials-based electronic devices.

Short Bio:

Guohong Ma obtained his Ph.D degree in Optics from Fudan University in 2001. He had been a research fellow in National University of Singapore during 2001-2005. He became a full professor at Shanghai University since 2005. Dr. Ma was awarded as "Pujiang Scholar" in 2006, and "Eastern Scholar" in 2008. Dr. Ma is the member of Optical Society of America (OSA) as well as the member of Singapore Materials Research (SMR).

Prof. Ma's research interests cover ultrafast photonics, terahertz photonics and terahertz spintronics, he also pays attention on the control and optical manipulation of electronic spin in semiconductor and ordered magnetic system. Dr. Ma published more than 150 peer-reviewed papers, and he gave more than 40 oral presentations including 20 invited talks in international conferences.

Fs laser induced periodic microstructures and their applications

Zhejiang University, China

Jianrong Qiu

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Fs laser is a powerful tool for micro-processing since various precise microstructures can be induced both on surface and inside of materials. Periodic microstructures exhibit special optical characteristics due to various optical effects. They are usually prepared by laser scanning and interference field of lasers. In this talk, I will introduce some new observations about fs laser induced periodic microstructures induced by single fs laser beam. I will also introduce the promising applications of such periodic microstructures for optical memory, optical attenuator, computer generated hologram and other embedded optical devices.

Short Bio:

Jianrong Qiu is currently a Professor at Zhejiang University. He worked at Japan Science and Technology Agency, Cornell University, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences and South China University of Technology before joining the College of Optical Science and Engineering, Zhejiang University in 2015. He was visiting professor of Kyoto University, Japan and Aalborg University, Denmark. He received Otto-Schott Research Award from the Ernst Abbe Fund, Germany in 2005, Academic Award from the Japanese Ceramic Society in 2007 and G. W. Morey Award from the American Ceramic Society in 2015. He is Fellow of the American Ceramic Society.

Symposium 8

Femtosecond laser manufacturingof high-performance optical components from diamonds and sapphires

Tsinghua University,China

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Diamond and sapphire are ideal optical materials of devices that work on extreme environmental conditions that glass components cannot endure, including high and low-temperature, high humidity, strong cosmic irradiations. However, an open problem is how to shape such hard-processing materials into desired geometries that perform functions as conventional optical devices do. Here we demonstrate our solution based on fs laser nanoprocessing that is assisted by dry and wet etching technologies. Devices like artificial compound eyes, small eyes siting on curved bases, are readily created. More details on the lens design and fabrication will be introduced .

[1] Liu XQ, Yang SN, Yu L, Chen QD, Zhang YL, and Sun HB, Adv. Funct. Mater. 190037 (2019).

[2] LiuXQ, Yu L, Yang SN, Chen QD, Wang L, Juodkazis S, and Sun HB, Laser Photon. Rev. 1800272 (2019).

[3] Cui T, Bai BF, and Sun HB, Adv. Funct. Mater. 1806692 (2019).

Short Bio:

Hongbo Sun received B.S. and Ph.D degrees in electronics from Jilin University, China, in 1992 and 1996, respectively. He worked as a postdoctoral researcher in the University of Tokushima, Japan, from 1996 to 2000, and then as an assistant professor in Osaka University. In 2004, he was promoted as a full professor (Changjiang Scholar) in Jilin University, and since 2017 he has been working in Tsinghua University, China. His research has been focused on laser nanofabrication, on which he has so far published over 400 scientific papers.They are cited for nearly 16000 times, giving him a personal H factor of 62, according to ISI search report. He is the executive editor-in-chief of Light: Science and Applications (Nature Publishing Group), and topical editor of Optics Letters. He is IEEE, OSA, SPIE and COS fellow.

Solids in ultrafast strong laser fields: topological phenomena

Georgia State University, Atlanta, USA

Mark I. Stockman

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A strong optical field, ~0.1-1 V/Å, changes solids on the attosecond time scale, i.e., within an optical cycle. Such fields drive ampere-scale currents in dielectrics and adiabatically controls their properties, including optical absorption and reflection, extreme UV absorption, and generation of high harmonics in a non-perturbative manner.

We will concentrate on ultrafast phenomena defined by nontrivial topological properties of solids in the reciprocal space, which are described by non-zero Berry (topological) curvature and Berry flux, which to a significant degree define their behavior in strong optical fields. In particular, these are graphene, silicene and surfaces of topological insulators (TI's) (semimetals), monolayer transitional metal dichalcogenides (TMDC's), black phosphorus and phosphorene (direct bandgap semiconductors), and hexagonal boron nitride (h-BN) (dielectric).

For two-dimensional semiconductors such a TMDC's, we predict a new attosecond phenomenon in a strong chiral optical fields – topological resonance. This manifests itself in the establishment of a strong valley polarization during just a single optical cycle, i.e., in the fundamentally fastest way possible. It structures the reciprocal space into topologically distinct areas.

Another distinct class of two-dimensional systems in a strong pulse field that we consider are surfaces of TI's. These are crystals characterized a non-zero topological invariant Z_2=1 where bulk is semiconducting but surfaces are Dirac semimetals. In the surface reciprocal space, they contain a single Dirac point with a Berry -phase of ±π at the Γ-point. Subjected to circularly-polarized ultrashort strong pulses they exhibit chiral textures in the reciprocal space and topologically-protected currents. We will also present our latest results on Weyl semimetals in ultrafast strong chiral fields. Such fields induce topological resonances and ultrafast bulk currents on femtosecond time scales.

Finally, we will discuss or latest results on anomalous ultrafast all-optical Hall-effect in two dimensional semiconductors such as TMDC's.

Short Bio:

Mark I. Stockman received his PhD and DSc degrees from institutes of the Russian Academy of Sciences. He is a Regents Professor of Physics and the Director of the Center for Nanooptics (CeNO) at Georgia State University, Atlanta, GA, USA. He is a Fellow of the American Physical Society, Fellow of Optical Society of America, and Fellow of SPIE – The International Society for Optoelectronic Engineering. He has served as a Distinguished Visiting Professor at Ecole Normale Supérieure de Cachan (France) and as a Visiting Professor at Ecole Supérieure de Physique and de Chimie Industrielle (Paris, France), and also as a Guest Professor at University of Stuttgart (Germany), Max Plank Institute for Quantum Optics (Garching, Germany), Changchun Institute of Optics, Fine Mechanics and Physics (China), and Ludwig Maximilian University (Munich, Germany). A major direction of his research is theoretical nanoplasmonics and strong-field ultrafast optics. He is an author of over 200 major research papers and has presented numerous plenary, keynote, and invited talks at major international conferences. He gave lectures and taught courses on nanoplasmonics and ultrafast optics at many major international meetings, schools, and scientific institutions in US, Canada, Europe, Asia, and Australia. He has received over 16,000 citations; on average his work is cited over 1,800 times per year, and his H-factor is 60. He currently has five research grants totaling over $10 million from Department of Energy, Department of Defense, and National Science Foundation.

Among his major achievements is invention of a spaser (plasmonic nanolaser), which is a laser of 21 Century: the smallest laser whose size is comparable with biological molecules. Spaser is a source of light on the nanoscale with unprecedented brightness and concentration. Another field of major achievement is ultrafast physics in strong laser fields where he published articles in such leading journals as Nature, Nature Physics, Physical Review Letters, etc. In particular, he has predicted and participated in observation of such a new phenomenon as femtosecond semi-metallization of dielectrics. He has recently been pioneering topological optics of high-field attosecond phenomena in two-dimensional solids.

THz quantum cascade lasers with novel active regions and resonators

Technische Universität Wien, Vienna, Austria

Karl Unterrainer

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Quantum cascade lasers (QCLs) are very successful quantum devices which cover a broad spectral range from the infrared to the THz. By investigating new materials system and active regions designs the output power and operating temperature is increased. New material systems based on InGaAs or InAs are promising for high temperature operation due to their lower effective electron mass and thus higher optical gain. We have achieved record operating temperatures and output powers despite the large interface roughness asymmetries in this material. We have studied the influence of different barrier heights for an active region design based on the GaAs/$Al_xGa_{1-x}As$ material system and have observed an increased operating temperature for increasing harrier height. The unique properties of QCLs allow the realization of novel resonator structures. Photonic crystal and micro pillar arrays have been demonstrated but are limited to single mode emission given by the resonator resonance. Random lasing on the other hand does not rely on such cavity resonances and is therefore inherently broadband. We have realized monolithic Random THz Quantum Cascade lasers with a spectral emission range only limited by the intrinsic gain bandwidth which exceeds one octave. These devices also provide collimated surface emission which is in demand by imaging applications.

Short Bio:

Karl Unterrainer received the MS degree in Physics and his Ph.D. degree from the University of Innsbruck, Austria.In 1994 and 1995 he worked as a visiting researcher at the Quantum Institute, University of California, Santa Barbara. From 1997 till 2003 he was associate professor, since 2004 he his full professor at the Photonics Institute, Technische Universität Wien. Since 2006 he is coordinating the FWF research cluster “Infrared Optical Nanostructures IR-ON”. His main research areas are THz spectroscopy of semiconductor nanostructures and the development of THz devices. He is author or coauthor of more than 300 scientific articles and winner of several awards among them is the START award from the Austrian FWF.

Femtosecond laser hyperdoping crystal: principle and applications

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Qiang Wu

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

Short Bio:

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

Development of high average power ultrafast lasersand applications

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[2]*University of Chinese Academy of Sciences, China*

Zhiyi Wei

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In recent years the ultrafast laser with high average power has become an important topics because of the wide applications. In particular, this kind lasers with bulk materials or fiber as the gain media promise the advantages of high efficiency, compact size and low cost. In this presentation, we will review the recent progresses and introduce our research works on diode pumped all solid state and fiber femtosecond lasers, report the new results of 15W and 100W femtosecond laser pulses of generating from the thin disk Yb:YAG laser and fiber laser respectively. Finally, the potential applications on precision fabrication and biology will be prospected.

Short Bio:

Zhiyi Wei accepted Ph.D from Xi'an Institute of Optics and Fine Mechanics,CAS in 1991. From 1991 to 1997, he was a postdoctoral researcher and associate professor in Sun Yat-Sen University. He joined in the Institute of Physics, CAS since 1997 and promoted as full professor in 1999. During 1993 to 2002, he also worked at RAL in UK, the Chinese University of Hong Kong, the Hong Kong University of Science and Technology, University of Groningen in the Netherland and Advanced Institute of Science and Technology in Japan. Up to now, he has published more than 300 peer review papers and more than 70 invited talks in international conferences. As the first contributor, he won 1 National second award on technology invention and 3 Ministry second awards on science and technology. He also accepted the award for young scientist by CAS in 2001, national talent young scientist fund in 2002, Hu Gangfu award in 2011. Prof Wei is the member of Max-Planck Center for attosecond and X-ray Science and Asian committee on ultrahigh Intensity laser. In view of his major contributions on ultrafast and ultrahigh intensity femtosecond laser community, he was selected as OSA fellow in 2017.

Bio-inspired control of surface wettability by a femtosecond laser

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After millions of years of evolution,the surfaces of many plants and animals are endowed with special wettability, which inspire scientists to design and fabricate bionic surfaces with superwettability. Femtosecond laser microfabrication has been successfully applied in the field of surface science to design and change the surface wettability of solid materials in the past decade. Various micro/nanoscale hierarchical structures and 2D/3D patterns can be easily created on the surfaces of a wide range of materials by using one-step femtosecond laser scanning manner. The laser processing position, the scanning speed and the scanning track can be precisely controlled by computer program. Because surface wettability is mainly determined by both the surface topography and chemical composition, these patterned microstructures usually show various unique wetting properties. Compared to the common methods that are used to prepare different wetting surfaces, the femtosecond laser microfabrication is better at achieving sophisticated and heterogeneous wettability, and this technology can apply to most of the materials.The femtosecond laser-structured superwetting surfaces have a broad potential applications, such as water/oil-repellent coating, self-cleaning coating, anti-ice/fog/snow, manipulation of droplets, oil/water separation, antifouling, anti-corrosion, underwater drag reduction, lab chip, cell engineering, fog collection, microfluidic systems, and so on.

Short Bio:

JialeYong is currently a lecturer of Electronic Science and Technology at Xi'an Jiaotong University. He received his BS degree from Xi'an Jiaotong University in 2011. After that, he joined Prof. Feng Chen's research group and received a PhD in Electronic Science and Technology from Xi'an Jiaotong University in 2016.From 2018 to 2019, he was a visiting scholar in the Institute for Optics at the University of Rochester. His research interests include femtosecond laser microfabrication, controlling wettability of solid surfaces, and bio-inspired design of superhydrophobic and superoleophobic interfaces.

Femtosecond laser induced luminescence in glasses

Shanghai Institute of Optics and Fine Mechanics, CAS, China

Quanzhong Zhao

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Firstly, we will review the ultrashort laser pulses induced luminescence phenomena. Then, we will present several progresses of ultrashort laser pulses induced luminescence in glasses. Finally, the potential applications of induced luminescence will be demonstrated.

Short Bio:

Quanzhong Zhao is currently a Professor at Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. He received his B.S. & M.S. degree from Northwestern Polytechnical University, China in 1997 and 2000. He obtained his Ph.D. (Optical Engineering) from Chinese Academy of Sciences, China in 2003. His research interest includes laser-based micro-/nanoprocessing, structuring of versatile materials, functional photonic materials and devices, physics of ultrashort pulsed laser interaction with matter, and fundamental research with potential commercialization. He has authored and co-authored two book chapters and more than 80 journal papers and 20 conference papers.

Laser fabrication of graphene-based soft robots

Jilin University, China

Yonglai Zhang

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We reported here the engineering of the surface/interface properties of graphene oxides (GO) film by controllable photoreduction treatment. In our recent works, typical photoreduction processes, including femtosecond laser direct writing (FsLDW), laser holographic lithography and controllable UV irradiation have been employed to make conductive reduced GO (RGO) micro-circuits, hierarchical RGO micronanostructures with both superhydrophobicity and structural color, as well as moisture responsive GO/RGO bilayer structures, respectively. 1-4 As compared with other reduction protocols, for instance, chemical reduction and thermal annealing, the photoreduction strategy shows distinct advantages such as mask-free patterning, chemical-free modification, controllable reduction degree and environment-friendly processing. These works indicate that the surface and interface engineering of GO through controllable photoreduction of GO holds great promise for the development of various graphene-based micro-devices.

Short Bio:

Yonglai Zhang received his BSc (2004) and PhD (2009)from Jilin University, China.He joined Jilin University in 2010 and is currently a full professor in the State Key Laboratory of Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University. To date, he has authored more than 100 SCI papers in top journals such as NanoToday, Adv. Mater., Adv. Funct. Mater., and Laser Photon. Rev., which have been cited for more than 3000 times (h-index factor 35). In 2011, he was awarded a “Hong Kong Scholar”postdoctoral fellow. In 2015, he was supported by National Natural Science Foundation-Outstanding Youth Scholar, China. His research interests include smart laser processing, graphene-based microdevices, biomimetic surfaces and Lab-on-a-Chip systems.

The perovskite crystal femtosecond laser processing and its charge transport properties

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Single crystal perovskites are now widely studied in solar cells, photodetectors, and other devices due to their excellent light absorption and carrier transport characteristics. Controlling the surface morphology and the light emitting property of perovskite crystals are critical for a variety of applications. Here, a simple method to achieve top-down fabrication of MBSCs, i.e., femtosecond laser processing MBSC surface by controlling the laser parameters is demonstrated. The femtosecond laser processing technology can achieve two orders of magnitude enhancement under ambient conditions in PL. The femtosecond laser ablation provides a convenient top-down strategy to achieve a range of morphological micro-/nanostructures with enhanced PL on MBSC surface. In addition, we investigated the charge transport property of perovskite crystals in field effect transistors, some interesting results are found and the mechanism lying behind is unveiled.

Short Bio:

Weili Yu is currently anassociate Professor at the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS). He got his PhD degree in Dec. 2009 from Jilin University. He then joined the King Abdullah University of Science and Technology (KAUST) as a postdoctoral researcher. In Dec. 2016, he joined the Guo China-US Joint Photonics Laboratory(GPL) of CIOMP. He is interested in optical, electrical and energy conversion related researches of functional nanomaterial.He is now developing technologies utilizing femtosecond laser as an efficient tool to processing or unveils the fundamental behavior of novel materials.

Observation and optimization of 2-micron all-fiber ultra-fast laser dynamic

Changchun University of Science and Technology, China

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Ultrafast pulses, possessing the characteristic of high peak power, have been extensively investigated in passively mode-locked fiber lasers and have important application values in optical communications, ultrafast spectroscopy and laser surgery. Ultrafast pulses output in all-fiber lasers can increase the peak power of the lasers by several orders of magnitude, which greatly increase the practicability of the laser. This has also been a research hotspot in the field of 1.55μm and 1 μm fiber lasers. However, limited by the dispersion, transmission loss in quartz fibers and mode-locking mechanism at 2 μm band, it is still difficult to achieve ultrafast pulse output with high energy, narrow pulse width, high repetition frequency and high stability in all-fiber lasers.

In this talk, a series of key technologies of 2 μm band all-fiber ultra-fast lasers will be presented, aiming at improving the output characteristics of 2 μm band all-fiber ultra-fast lasers and exploring the dynamic characteristics of 2 μm ultra-fast mode-locked pulses. The main work include four parts:

. Output characteristics and its optimization of conventional soliton.
. Passively mode-locked femtosecond pulse generation and compression.
. Output characteristics of high energy square wave mode-locked pulses.
. 2.05-2.1 um high repetition rate actively mode-locked pulse generation.

The research results are of great significance to the promotion of its application in the cross-cutting fields such as communication and sensing.

Short Bio:

Wanzhuo Ma is currently a doctoral student at Changchun university of science and technology. His research interests include ultrafast fiber laser and its application technologies. He has made a series of breakthroughs in energy enhancement, pulse compression and waveform control of ultrafast fiber laser. He has published 8 papers as first author in Optics Express, IEEE Photonics Technology Letters and other authoritative optical journals. Research results of 2-micron passively mode-locked fiber lasers have been published in the IEEE Journal of Selected Topics in Quantum Electronics as invited paper. He has won four national authorized patents. He has won multiple prizes such as the Wang Daheng's optical prize of the Chinese optical society, the first prize of China Instrument &Control Society and the national scholarships for postgraduates.

Light Conference 2019

Symposium 9

Next generation light science & technologies

Co-Chairs:

Luc Thévenaz

Guilu Long

Ultra-Black Silicon: an ultra broadband light absorber with extraordinary wetting properties

Université Paris-Est, ESIEE Paris, France

Tarik Bourouina

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Black Silicon (BSi) became nowadays a well-established micro-nano-structured silicon surface.It exhibits both wetting and optical fascinating properties. In particular, it is well-known for its excellent absorption of nearly 99% of incident light in the visible range, hence its name Black according to its color to the naked eye. However, only a little is known about such optical properties in mid and far infrared. Due to its specific morphology.

In this talk, we report on the absorption properties of BSi in the infrared spectral range from 1.5 μm until 25 μm. We will explain how Black Silicon can be tailored so that to exhibitan even higher absorption– exceeding 99.9%, in a broad spectral range from 1 to 8 μm. We will also discuss how the spectral range extends to the far-infrared.

In the second part of this talk, we will also revisit the extraordinary wetting properties of black silicon and then conclude with several applications that take benefit of both optical and wetting extraordinary properties.

Short Bio:

Tarik Bourouina holds M.Sc. in Physics, M.Eng. in Optoelectronics, Ph.D. in MEMS (1991), and Habilitation HDR (2000) from Université Paris-Sud, Orsay. His entire career was devoted to the field of MEMS and Lab-On-Chip. He had several contributions in optical MEMS, among which the smallest MEMS-based FTIR Optical Spectrometer, Neospectra, jointly developed with Si-Ware-Systems, awarded the Prism award on photonics innovation in 2014.

Tarik Bourouina took several positions in France and in Japan, at the Université Paris-Sud Orsay, at the French National Center for Scientific Research (CNRS) and at The University of Tokyo. In 2017, he was the recipient of the Chinese Academy of Sciences President's Fellowship, as visiting scientist at the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP).Since 2002 he is full Professor at ESIEE Paris, Université Paris-Est. His current interests include fundamental micro-opto-fluidics, also seeking applications in the areas of Sustainable Environment and Smart-Cities.

Smart metamaterials and metasurfaces

Southeast University, China

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Intelligence in material level is a goal that researchers have been pursuing, which is also a pursuit of digital coding metasurface. From passive to active, digital coding metasurfaces have been developed to programmable. However, the programmable metasurfaces must be controlled by human beings to switch among different functionalities. Here, we propose a smart digital metasurface that has self-adaptively reprogrammable functionalities. Based on but different from the programmable metasurface, the smart metasurface requires a sensing-feedback system that is integrated in the metasurface. We present a motion-sensitive smart digital metasurface integrated with a three-axis gyroscope and feedback software, which can adjust the radiated electromagnetic beams self-adaptively with different rotations of the metasurface.We develop a fast feedback algorithm as control software to make the smart metasurface achieve single-, multi-beam steering and other dynamic reactions adaptively. The presented metasurface is also extensible for other sensors to detect the height, humidity, temperature, and illuminating light, and various reactions based on 2-bit coding metasurface are designed and measured. Good agreements between numerical and experiment results demonstrate the self-adaptively programmable functions of the smart metasurface.

Short Bio:

Tiejun Cui received the B.Sc., M.Sc., and Ph.D. degrees in electrical engineering from Xidian University, Xi'an, China, in 1987, 1990, and 1993, respectively. In March 1993, he became a faculty member at the same university, and was promoted to Associate Professor in November 1993. From 1995 to 1997 he was a Research Fellow with the Institut fur Hochstfrequenztechnik und Elektronik (IHE) at the University of Karlsruhe, Germany. In July 1997, he joined the Center for Computational Electromagnetics, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign,first as a Postdoctoral Research Associate and then a Research Scientist. In September 2001, he became a Cheung-Kong Professor with the Department of Radio Engineering, Southeast University, Nanjing, China.He is now the Chief Professor of Southeast University.

Generating THz pulses from modelocked quantum cascade lasers

Laboratoire de Physique de l'Ecole normale supérieure, ENS, Université PSL, CNRS, Sorbonne Université, Université Paris-Diderot, Sorbonne Paris Cité, France

Sukhdeep Dhillon

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The Quantum Cascade Laser (QCL) is the semiconductor solution to realise laser action over the entire mid-infrared to the terahertz (THz) regions of the electromagnetic spectrum. This has led to a mini-revolution in these spectral domains with novel and new applications, such as highly sensitive spectroscopy and non-destructive imaging. In this work I will present how new and recent functionalities that can be introduced using the inherent properties of THz QCLs. In particular I will show ultrashort pulse generation via modelocking of THz QCLs using time resolved THz spectroscopy, illustrating how the ultrafast dynamics are not a hindrance for the generation of short THz pulses as previously thought. This opens up the possibility of a purely semiconductor system to generate single-cycle THz pulses

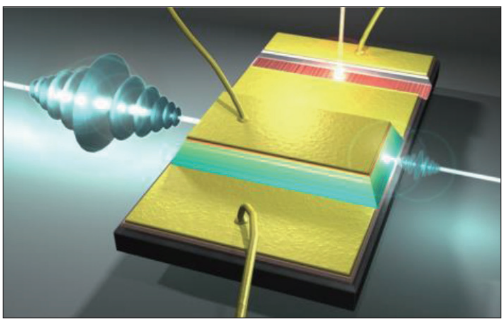

Fig.1

Short Bio:

Sukhdeep Dhillon received his PhD in Physics from the University of Cambridge UK. He is currently a CNRs Research Director at the Ecole Normale Superieure, Paris, France. Dr Dhillon is an expert in ultrafast terahertz (THz) spectroscopy and nonlinearities of nanostructures and, in particular, the transient properties of quantum cascade lasers (QCLs). He has published over 70 research articles, given over 60 invited conference presentations, filed 5 patents, and is currently coordinating a large European H2020 project (FET-Open 'ULTRAQCL') on short pulse generation from QCLs.

Plasmonics for sensors and filters

University of Alabama in Huntsville, USA

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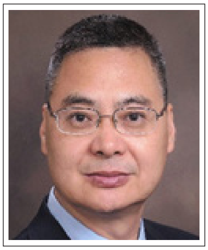
Metallic nanostructures are plasmonic optical resonators which can store and dissipate electromagnetic energy at their localized plasmonic resonance modes. Localized plasmonic resonance modes can be designed by engineering their size and geometry. To utilize localized surface plasmon resonance, various surface plasmon sensors have been investigated. However, these localized surface plasmon sensors rely on optical spectrometers for localized plasmon resonance measurement. In this talk, I will present a transformational new surface plasmon sensing platform using a super-period fine structure metallic nano-grating. The new plasmonic sensor platform can measure localized surface plasmon resonance spectra without using optical spectrometers.Additionally, localized surface plasmon resonance can be utilized for making optical filters. In this talk, I will review recent progresses on narrow linewidth plasmonic optical filters.

Short Bio:



Junpeng Guo educated at the University of Illinois at Urbana-Champaign and Peking University, Prof. Guo started his research career as a research scientist at the former Rockwell International Science Center in Thousand Oaks, California and later moved to the Sandia National Laboratories in Albuquerque, New Mexico as a Member of Technical Staff. He joined the faculty of the University of Alabama in Huntsville in 2005 and has been a Professor of Electrical Engineering and Optics. Prof. Guo received the Alan Berman Research Publication Award in 2013, and was the only recipient of the University Distinguished Faculty Research Award in 2016. Prof. Guo is a Fellow of the SPIE-International Society for Optics and Photonics. Currently he serves as an Associate Editor of Journal of Nanophotonics and as an Associate Editor of Photonics Research.

NIR femtosecond pulses to probe electron-phonon dynamics in condensed matter systems

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Femtosecond pulses of electromagnetic radiation offer many ways to control and also probe the elementary and quasi particle excitations of condensed matter systems around us. Understanding of the underlying physics upon excitation of femtosecond pulse on a semiconductor for example still is very much important in the development of photonics and spintronicsas alternatives to traditional electronics, crossing the boundaries of physics, materials science, and electrical engineering. Here in the talk, I will present some of the recent results from our laboratory demonstrating this capability to understand the effect of carrier density on the electron-phonon coupling in wide band gap semiconductor nanoparticles and single crystals of topological insulator systems .

Short Bio:

Kamaraju Natarajan received his PhD degree in March 2011 on ultrafast experimental condensed matter physics from Department of Physics, IISc Bangalore. After his Ph.D, he worked in the field of terahertz physics in Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin (for two years), and Department of Electrical and Computer Science Engineering, RPI, Troy, NY, USA (for one year). Later he did his final postdoctoral research in Los Alamos National labs, NM, USA on using THz to study two dimensional systems under high magnetic fields. He is now an assistant professor in Dept of Physical Sciences, Indian Institute of Science Education and Research Kolkata, India.

Practical quantum secure direct communication

Tsinghua University, China

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Quantum communication offers provable security of communication. Quantum secure direct communication (QSDC) is one of the important branches of quantum communication. In contrast to other branches of quantum communication, it transmits secret information directly. Recently, remarkable progress has been made in proof-of-principle experimental demonstrations of QSDC. However, it remains a technical feat to bring QSDC into a practical application. Here, we report the recent progress of practical quantum secure communication. First, the security of QSDC has been analyzed in the Wyner wiretap channel theory. The secure and reliable direct communication is achieved by using a specially designed concatenated low-density parity-check (LDPC) code in combination with universal hushing families. A protype set up was completed in 2018 with a repetition rate of 1 MHz at a distance of 1.5 kilometers and achieved secure communication rate is 50 bps. Very recently, a secure communication rate of 4 k bps at a distance of 10 kilometers is achieved. The problem of impractical quantum memory was solved by designing a quantum memory-less QSDC protocol using delayed coding. With these developments, QSDC is ready to go to practical applications.

Short Bio:

Guilu Long is a professor at Tsinghua University, fellow of IoP and fellow of APS, President of Associations of Asian Pacific Physical Societies. He received his B.Sc. from Shandong University in 1982, and Ph.D. from Tsinghua in 1987 respectively. He was a research fellow in the University of Sussex between 1989-93. He is the founder of quantum secure direct communication, and duality quantum computing formalism.

Photophysics of Sn-based metal halide perovskites

University of Groningen, Groningen, The Netherlands

Maria Antonietta Loi

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Thanks to the intensive research efforts of a large scientific community, lead-based metal halide perovskite solar cells have reached impressive power conversion efficiency (24.2%). Despite these outstanding accomplishments, the toxicity of lead causes concerns about the possible large-scale utilization of this new type of solar cell. Among the various alternatives to lead, Sn has been recognized to have a great potential, as the Sn-based hybrid perovskites display excellent optical and electrical properties such as high absorption coefficients, energies and high charge carrier mobilities. In my talk I will show that Sn-based perovskites display evidences of photoluminescence from hot-carriers with unexpectedly long lifetime. The asymmetry of the PL spectrum at the high-energy edge, is accompanied by the unusually large blue shift of the time-integrated photoluminescence with increasing the excitation power. Not only the sample show very long hot-carrier relaxation when excited with a femtosecond laser, but also when excited with continuous-wave light, fact that is highly relevant to think about future applications. Finally, I will discuss the importance of the sample quality to achieve such long hot carrier lifetime.

Short Bio:

Maria Antonietta Loi received her PhD degree in Physics from University of Cagliari, Italy. In 2001 she joined the Linz Institute for Organic Solar cells, of the University of Linz, Austria as a postdoctoral fellow. Later she worked as researcher at the Institute for Nanostructured Materials of the Italian National Research Council in Bologna, Italy. In 2006 she became assistant professor and Rosalind Franklin Fellow at the Zernike Institute for Advanced Materials of the University of Groningen, The Netherlands. She is now full professor in the same institution and chair of the Photophysics and OptoElectronics group. She has published more than 200 peer-reviewed articles on photophysics and optoelectronics of different types of materials. In 2012 she has received an ERC Starting Grant from the European Research Council. She currently serves as associated editor of Applied Physics Letters and she is member of the international advisory board of Advanced Functional Materials, Advanced Electronic Materials and Advanced Materials Interfaces. In 2018 she received the Physicaprijs from the Dutch physics association for her outstanding work on organic-inorganic hybrid materials.

World's fastest distributed Brillouin reflectometry

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We review the recent advances of specially configured Brillouin optical correlation-domain reflectometry (BOCDR) for real-time distributed strain and temperature measurement with intrinsic single-end accessibility. Technical details and the latest findings of this configuration are presented. Specifically, we demonstrate the detection of a shortest-ever hot spot using a "beyond-nominal-resolution" effect, loss-insensitive operation using a trench-index-type fiber, stable operation using a polarization-maintaining fiber, and highly sensitive temperature measurement using a plastic optical fiber. If time permits, we will also present the measurement results using a silica fiber embedded in a composite structure and prove the practical usefulness of this system. Finally, we discuss the future prospects of this technique.

Short Bio:

Yosuke Mizuno received the B.E., M.E., and Dr.Eng. degrees in electronic engineering from the University of Tokyo in 2005, 2007, and 2010, respectively.From 2007 to 2010, he worked on Brillouin optical correlation-domain reflectometry for his Dr.Eng. degree. From 2010 to 2012,as a JSPS Research Fellow (PD), he worked on polymer optics at Tokyo Institute of Technology, Japan, and at BAM Federal Institute for Materials Research and Testing, Germany. Since 2012, he has been an Assistant Professor at Tokyo Institute of Technology, where he is active infiber-optic sensing, polymer optics, and ultrasonics. He has authored >140 refereed journal papers and has given >20 invited talks at international conferences including OFS-23 and OFS-25. He is a senior member of the IEEE Photonics Society, and a member of the Japan Society of Applied Physics (JSAP), the Optical Society of Japan (OSJ), and the Institute of Electronics, Information, and Communication Engineers (IEICE) of Japan.

Atomically thin monolayer metasurface

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Chengwei Qiu

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Interfacial engineering via the artificially constructed structures of ultrathin thickness compared to the wavelength has enabled a plethora of advanced manipulations of light-matter interactions. I will report some of the most recent developments in my group as well as in the field of the interfacial engineering of manipulation of light-matter interactions, via the artificially constructed structures of ultrathin thickness compared to the wavelength, particularly the metasurfaces made of atomically thin monolayers of 2D materials. It will include metasurface-boosted second harmonic generation of 2D materials, hybrid Au-WS_2 nonlinear metasurfaces, and other TMDC monolayer based nano-optical devices.

Short Bio:

Chengwei Qiu received his B.Eng. and Ph. D. degree in 2003 and 2007, respectively. He was a Postdoctoral Fellow at Physics Department in MIT till the end of 2009. Since December 2009, he joined NUS as an Assistant Professor and was promoted to Associate Professor with tenure in Jan 2017. From 1st Jan 2018, he was promoted to Dean's Chair Professor in Faculty of Engineering, NUS. He was the recipient of the SUMMA Graduate Fellowship in Advanced Electromagnetics in 2005, IEEE AP-S Graduate Research Award in 2006, URSI Young Scientist Award in 2008, NUS Young Investigator Award in 2011, MIT TR35@Singapore Award in 2012, Young Scientist Award by Singapore National Academy of Science in 2013, Faculty Young Research Award in NUS 2013, and Young Engineering Research Award 2018 in NUS. His research is known for the structured light for beam manipulation and nanoparticle manipulation. He has published over 200 peer-reviewed journal papers, including Science, Nature Photonics, Nature Materials, Nature Communications, Science Advances, Physical Review Letters, etc.

Efficient coupling and wavefront tailoring of surface plasmons with metasurfaces

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Freely exciting and reshaping surface plasmon polaritons (SPPs) are key goals in photonic researches, but conventional approaches exhibit low efficiencies and/or require bulky devices. In recent years, we not only propose a new concept to excite the SPPs with extremely high efficiency, but also pave a road to reshape the wavefronts of SPPs at desired manner, all based on an ultrathin gradient metasurfaces. We demonstrate the SPP manipulation effects in different frequency domains, including anomalous reflection, focusing and Bessel beam generations of SPPs. Moreover, the two distinct functionalities ofthe SPP excitation and wavefront tailoring can be achieved simultaneously with a single meta-device. Our concept is quite generic for different frequency domains. We perform both microwave and THz measurements to demonstrate our ideas. These findings may inspire many SPP related applications, e.g., near-field imaging, enhanced nonlinear effect, nano-particle trapping, and so on.

Short Bio:

Shulin Sun received his PhD degree in Physics Department of Fudan University in 2009. From 2010 to 2013, he is a Postdoctoral Fellow of physics division of NCTS in National Taiwan University, Taipei, Taiwan. In 2013, he joined Department of Optical Science & Engineering of Fudan University as an associate Professor. His research interests include metamaterials/metasurfaces, plasmonics, and photonic crystals. He has published 50+ papers with 3100+ citations and 5 papers are elected as ESI highly cited papers. He won the prizes of "Important achievements of Chinese Optics in 2012" (1/6) and "The first class of Shanghai natural science award in 2016" (2/4).

Optoacoustics in optical fibres: a powerful tool for smart interactions between light and matter

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Luc Thévenaz

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Coupling 2 lightwaves is only possible through the intercession of matter and acoustic vibrations turn out to offer the further advantage to make this coupling coherent. These material vibrations are stimulated by intensity-modulated lightwaves and their effect is detected through a phase-modulation on a distinct lightwave, so that the system is entirely activated and probed using light. It can be shown that an intense distributed amplification of light can be obtained leading to laser emission with a spectral purity in the Hertz range. Since the acoustic properties are strongly dependent on the nature and the response of the hosting material, sensors based on such interactions can be made distributed and show remarkable and unique performance. Finally, such interactions can be efficiently exploited to make all-optical signal processing and coherent optical memories.

Short Bio:

Luc Thévenaz received the M.Sc. degree and the Ph.D. degree in physics from the University of Geneva, Switzerland. In 1988 he joined the Swiss Federal Institute of Technology of Lausanne (EPFL) where he is currently Professor and leads a research group involved in photonics, namely fibre optics and optical sensing. Research topics include fibre sensors, slow & fast light, nonlinear fibre optics and laser spectroscopy in gases. His expertise covers all applications of stimulated Brillouin scattering in optical fibres and he is known for his innovative concepts related to distributed fibre sensing.

He is member of the Steering Committee of the International Conference on Optical Fiber Sensors and General Chairman of this conference in 2018. He has served in the Technical Committee of several conferences, such as ECOC, CLEO-Europe, APC, etc. and is now co-Executive Editor-in-Chief of Nature: Light Science & Applications. He is author or co-author of some 500 publications and 12 patents,and is Fellow of the IEEE and the Optical Society.

Photo-patterning self-assembled chiral superstructures foroptical vortex processing

Nanjing University, China

Peng Chen

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Cholesteric liquid crystal (CLC) chiral superstructure exhibits unique features of polychromatic and spin-determined phase modulation. In this talk, a concept of digitalized chiral superstructures is proposed, which further enables the arbitrary manipulation of reflective geometric phase and may significantly upgrade existing optical apparatuses. By encoding a specifically designed binary pattern, an innovative CLC optical vortex (OV) processor is demonstrated. Up to 25 different OVs are extracted with equal efficiency over a wavelength range of 116 nm. The multiplexed OVs can be detected simultaneously without mode crosstalk or distortion, permitting a polychromatic, large-capacity and in situ way for parallel OV processing. Such complex but easy-fabrication self-assembled chiral superstructures exhibit versatile functionalities, and provide a satisfactory platform for OV lightened territories.

Short Bio:

Peng Chen is currently a Research Associate in College of Engineering and Applied Sciences at Nanjing University. He obtained his B.S. and Ph.D. in Material Physics and Optical Engineering from Nanjing University in 2014 and 2019, respectively.His research interests focus on nanostructured liquid crystals and corresponding optical applications.He has authored and co-authored over 35 peer-reviewed papers, including Nature Commun .,Adv. Mater., Light Sci. Appl., ACS Photon., Phys. Rev. Appl., Appl. Phys. Lett.and so on. His works have been selected as “ESI highly cited paper” and “China’s Top 10 Optical Breakthroughs” in 2018. He holds 10 issued or pending patents, and is also the recipient of several awards. He has been serving as a reviewer for some journals,such as Opt. Lett. and Opt. Express.

Symposium 9

Energy tailorable multi-functional metasurfaces with full Fourier components

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Wenwei Liu

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Compact integrated multifunctional metasurface that can deal with concurrent tasks is one of the most profound research fields in modern optics. Such integration is expected to have a striking impact on minimized optical systems in applications such as optical communication and computation. However, arbitrary multifunctional spin-selective design with precise energy configuration in each channel is still challenging, and suffers from intrinsic noises and complex designs. We propose a design principle to realize energy tailorable multifunctional metasurfaces, in which the functionalities can be arbitrarily designed if the channels have no or weak interference in k-space. We demonstrate the design strategy with high-efficiency dielectric nanopillars that can modulate full Fourier components of the optical field. The spin-selective behavior of the dielectric metasurfaces is also investigated, which originates from the group effect introduced by numerous nanopillar arrays. Such approach provides straightforward rules to control the functionality channels in the integrated metasurfaces, and paves the way for efficient concurrent optical communication.

Short Bio:

Wenwei Liu, is a post-doctoral research associate at the Key Laboratory of Weak Light Nonlinear Photonics, Nankai University, China. He received his bachelor's degree in theoretical physics from Nankai University in 2013.His current research focuses on optical manipulation with metasurfaces and metalenses. He published several papers in Adv. Mater., Phys. Rev. Appl., Opt. Lett.etc. and published an open access book chapter in Intech. He applied for a United States patent and a Chinese patent. His papers have been cited over 572 times, and the single highest citation reaches 92 times. He was supported by the Postdoctoral innovative Talent Support Program in 2018, and won the second prize in the 2nd National College Physics Experiment Competition.

High-quality multilayer microstructure based upon hybrid SPP mode

Université Paris-Est, ESIEE Paris, France

Xiaoyi Liu

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In common plasmonic structures, field enhancement and energy loss, especially radiation and absorption, are mutually restricted, which can be a serious limitation for plenty of applications. This oral presentation exhibits a novel approach to break this rule based on surface plasmon polariton (SPP) mode hybridization. A multilayer trench grating microstructure is designed to support both Fabry-Perot (FP) and cavity resonances, and the hybridization between these two modes presents interesting properties. The energy loss was obviously reduced, which can be fundamentally ascribed to the mutual energy exchange between FP and cavity modes. Meanwhile, the electric field enhancement was also modulated by controlling the absorption and radiation characters. The maximum total quality factor and strongest field were both obtained under certain conditions, thereby signifying that the structure simultaneously achieved field enhancement and loss inhibition, which is significant to the design of high quality plasmonic devices.

Short Bio:

Xiaoyi Liu is currently a postdoc in Université Paris-Est, ESIEE Paris, which is supported by the Chair Blaise Pascal assistant project of École Normale Supérieure Fondation. He obtained his Bachelor degree from Shandong University in 2013, and obtained his PhD degree from University of the Chinese Academy of Sciences, Changchun Institute of Optics, Fine Mechanics and Physics in 2018. He focuses on the investigations on high quality Si-based structure and device based upon surface plasmon polaritons. During his PhD study, He won a lot of honors such as National Scholarship for Postgraduate Students (2015&2017), Special Prize of Daheng Optical Scholarship (2017), Special Prize of President Scholarship of Chinese Academy of Sciences (2018), Excellent Graduate Student of Beijing & University of the Chinese Academy of Sciences (2018), Wang Daheng Optical Scholarship for students (2018), etc.

An overview of infrared search and tracking system

Nanjing University of Science and Technology, China

Minjie Wan

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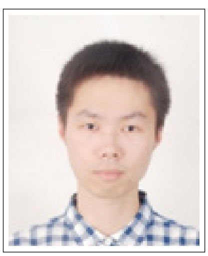
Infrared search and tracking (IRST) system has been more and more important in modern military applications, like early warning, precise guidance and so on. Its main purposeis to locate and capture the long-distance military targets, such as missile, ship and unmanned aerial vehicle, in an automatic way. The core task of investigating IRST is developing intelligent algorithms involving infrared image enhancement, infrared target detection and infrared target tracking. Due to the inherent property of infrared imaging, infrared image always suffers from noise, low contrast and blurred detail. As a pre-processing tool, infrared image enhancement aims at enhancing the local details, especially the edges, and improving the visual contrast simultaneously. Because of the long imaging distance, infrared target always occupies few pixels, leading to lack of image features. To extract infrared target with small size precisely, infrared target detection focuses on suppressing the complex background and highlighting the small target as much as possible. Furthermore, infrared target tracking is designed to capture the object of interest by means of exploiting grayness and motion features. This talk will present the introduction and related research achievements of the afore-mentioned key techniques in IRST system.



Short Bio:

Minjie Wan received his B.S. degree from the School of Electronic and Optical Engineering, Nanjing University of Science and Technology, Nanjing, China, in 2014. He was a visiting Ph.D student with the Department of Electrical and Computing Engineering, Université Laval, Quebec, Canada, from 2017-2018. He is currently pursuing his Ph.D. degree from Nanjing University of Science and Technology. His main research interests include infrared target detection and tracking, infrared image enhancement, multi-source image registration and fusion. He has published 11 research articles indexed by Science Citation Index and 3 conference papers indexed by Engineering Index. He is reviewer of the internal journals: Remote Sensing, Optical Express, Applied Optics, IEEE Geoscience and Remote Sensing Letters and Infrared Physics & Technology.

CMOS-compatible plasmonic hydrogen sensors with a detection limit of 40 ppm

Institute of Microelectronics of Chinese Academy of Sciences, China

Song Yue

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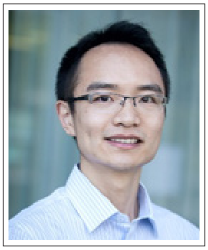
Sensing of leakage at an early stage is crucial for the safe utilization of hydrogen. Optical hydrogen sensors eliminate the potential hazard of ignition caused by electrical sparks, achieving however a detection limit far higher than their electrical counterparts so far. To essentially improve the performance of optical hydrogen sensors in terms of detection limit, I shall show in this work a plasmonic hydrogen sensor based on aluminum-palladium (Al-Pd) hybrid nanorods. Arranged into high-density regular arrays, the hybrid nanorods are capable of sensing hydrogen at a concentration down to 40 ppm, i.e., one thousandth of the lower flammability limit of hydrogen in air (4%). Different sensing behaviors are found for two sensor configurations, where Pd-Al nanorods provide larger spectral shift while Al-Pd ones exhibit shorter response time. In addition, the plasmonic hydrogen sensors demonstrated here utilize exclusively CMOS-compatible materials, holding the potential for real world large-scale applications.

Short Bio:



Song Yue is currently an Associate Professor at Microelectronics Instruments and Equipment R&D Center, Institute of Microelectronics of Chinese Academy of Sciences. He joined his present group of Integrated System for Laser Applications in June 2017. From 2013 to 2016, he worked as a postdoctoral researcher with Prof. Laura Na Liu at Max Planck Institute for Intelligent Systems in Stuttgart, under the support by a fellowship from Alexander von Humboldt Foundation. He obtained his doctor's degree from the Institute of Modern Optics, School of Physics, Peking Univeristy, under the guidance from Prof. Qihuang Gong. His current research interests include plasmonics, dielectric metasurface and CMOS compatible nanophotonics, and he holds solid expertise in numerical simulation (COMSOL), nanofabrication (EBL & FIB) as well as various optical microscopy and spectroscopy.

Light Conference 2019

Symposium 10

The application of optics in life sciences

Co-Chairs:

Martin J Booth

Bei Li

Twenty years of Doppler OCT and OCT angiography: translation of functional OCT technology from bench to bedside

Beckmann Laser Institute, University of California, Irvine, CA

Zhongping Chen

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Optical coherence tomography (OCT) is one of the fastest growing areas of biomedical optics. Many of the functional extensions of OCT technology that were developed in the last decade, such as Doppler OCT, polarization sensitivity OCT, phase resolved OCT, and optical coherence elastography, started to generate clinically important information. I will review the development of D-OCT and report several on-going research projects in my laboratory that focus on technology development and translation of functional OCT technology to solve specific clinical problems, including diagnosis and management of ocular diseases, sleep apnea, and cardiovascular diseases. The challenges and opportunities in translational research will be discussed.

Short Bio:

Zhongping Chen is a Professor of Biomedical Engineering and Director of the OCT Laboratory at the University of California, Irvine. He is a Co-founder and Chairman of OCT Medical Imaging Inc. Dr. Chen received his B.S. degree in Applied Physics from Shanghai Jiao Tong University in 1982, his M. S. degree in Electrical Engineering in 1987, and his Ph.D. degree in Applied Physics from Cornell University in 1993.

Dr. Chen's research group has pioneered the development of functional optical coherence tomography (OCT), including Doppler OCT, phase resolved OCT, and optical coherence elastography. In addition, his group has developed a number of endoscopic and intravascular OCT and MPM imaging and translated this technology to clinical applications. He has led numerous major research projects funded by NIH, NSF, DOD, and DARPA, including several interdisciplinary research projects such as the NIH Biomedical Research Partnership (BRP) grant and NSF Biophotonics Partnership Initiative grant. He has published more than 280 peer-reviewed papers and review articles and holds a number of patents in the fields of biomaterials, biosensors, and biomedical imaging.

Dr. Chen is a Fellow of the American Institute of Medical and Biological Engineering (AIMBE), a Fellow of SPIE, and a Fellow of the Optical Society of America.

Imaging deeper and faster: watching the brain in action with ultrafast lasers

Cornell University, USA

Chris Xu

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Brain research is a multi-disciplinary endeavor, and inspires the development of innovative measurement tools. Multiphoton microscopy is the go-to technique for high spatial resolution, deep imaging in scattering biological tissue, and relies heavily on the new development of ultrafast lasers that deliver high pulse energy, flexible repetition rate, and wide wavelength coverage. By pushing the boundaries of imaging depth and speed, multiphoton microscopy enables large-scale, non-invasive monitoring of brain activity in live animals, and is poised to play a major role in understanding how brains work.

Short Bio:

Chris Xu is the founding co-director of Cornell Neurotech, and the director of Cornell NeuroNex Hub, an NSF funded center for developing and disseminating neurotechnology. Prior to Cornell, he was a member of technical staff at Bell Laboratories, and pioneered breakthrough development of fiber optic communication systems. He received his Ph.D. in Applied Physics from Cornell University, and contributed to the early development of 2-photon microscopy. His current research areas are biomedical imaging and fiber optics, with major thrusts in multiphoton microscopy for deep brain imaging, multiphoton microendoscopy for clinical applications, and fiber-based devices and systems for telecommunications and optical imaging. His research is supported by major grants from NIH, NSF, DARPA, and IARPA. Dr. Xu has chaired or served on numerous conference organization committees and NSF/NIH review panels. In addition to hundreds of journal and conference papers, he has 32 patents granted or pending. He has won the NSF CAREER award, Bell Labs team research award, the Tau Beta Pi Professor of the Year Award, and two teaching excellence awards from Cornell Engineering College. He received the 2017 Cornell Engineering Research Excellence Award. He is a fellow of the Optical Society of America, and a fellow of the National Academy of Inventors.

Advances in dynamic optics for microscopy

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[2]*Universität Erlangen-Nürnberg, Germany*

Martin J Booth

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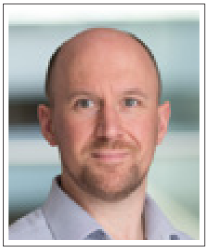
Dynamic optical elements, such as deformable mirrors and spatial light modulators, are used in microscopes to enhance imaging capabilities. One of the most common dynamic methods, adaptive optics (AO), has been introduced into microscopes in order to overcome the problems caused by specimen-induced wavefront aberrations, restoring image quality. This is particularly important when focusing deep into tissue where the cumulative effect of focusing through the refractive index structure of the specimen causes significant wavefront distortion. Adaptive optics has been demonstrated in a range of microscope modalities including conventional widefield microscopes as well as laser scanning systems with various applications in biomedical imaging and other areas. Adaptive microscopy has most recently been developed for super-resolution microscopes – or nanoscopes – which enable resolutions smaller than the diffraction limit of light. Other applications of dynamic optics include the control of illumination patterns or even the spatiotemporal profile of ultrashort pulses for non-linear microscopy. We will review a range of recent advances in this field, including applications in cell biology, neuroscience and other areas. We will also discuss the future of AO in microscopy.



Short Bio:

Martin J Booth is Professor of Engineering Science at the University of Oxford. His research involves the development and application of adaptive optical methods in microscopy, and laser fabrication. In 2012 he was awarded the "Young Researcher Award in Optical Technologies" from the School of Advanced Optical Technologies, Erlangen, Germany, where is a Visiting Professor. In 2014 he was awarded the International Commission for Optics Prize and in 2017 he was elected a Fellow of the Optical Society. He has over 110 publications in peer-reviewed journals. He is Editor-in-Chief of the journal Optics Communications. He is co-founder of two spin-off companies, Aurox Ltd. and Opsydia Ltd.

Shrink polymer biosensors: manufacturing from micro to nano

University of Minnesota, USA

Tianhong Cui

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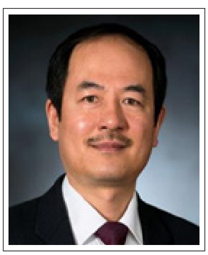
Polymer shrinkage becomes a new approach to do lithography and generate smaller structures by reforming larger pre-patterned structures. The facile polymer fabrication approach by embossing and thermoplastic shrinkage aims to do lithography in a nanoscale or reduce the feature size and dramatically increase the aspect ratio of imprinted microstructures. The shrinkage capability of embossed microstructures is obtained by molding at low temperatures for less cycle time. Embossed patterns are activated for shrinkage by removing projected structures and heating at higher temperatures. The final structures are defined with the shape of removed materials before shrinking polymer materials. Both two- and three-dimensional embossed structures were successfully shrunk into much smaller scale. This polymer-shrinking process brings a new way to extend the fabrication capability of polymer embossing process towards MEMS-based biosensors. This talk will present shrink polymer for nanolithography, high-aspect-ratio microstructures, and biosensors for medical applications.

Short Bio:



Tianhong Cui is a Distinguished McKnight University Professor at the University of Minnesota. He is a Professor in Mechanical Engineering, and an Affiliate Senior Member in Department of Electrical Engineering and Department of Biomedical Engineering at the University of Minnesota. He is an Adjunct Professor at Mayo Clinic, a Visiting Fellow at the University of Cambridge, a Distinguished Visiting Fellow at the Royal Academy of Engineering, and a Distinguished Visiting Professor at University of Paris East. He is a Fellow of American Society of Mechanical Engineering (ASME).He is the founding Executive Editor-in-Chief for two Nature journals, Light: Science & Applications and Microsystems & Nano engineering. He is also serving as the founding Editor-in-Chief for the first AAAS/Science Partner Journal titled Research.

New perspectives in biomedical sciences: single cell analysis through continuous in-flow phase-contrast tomography

Institute of Applied Sciences & Intelligent Systems, Italy

Pietro Ferraro

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High-throughput single-cell analysis is a challenging task. I will be shown that Label-free tomographic phase microscopy is an excellent candidate to perform this task. We demonstrate that by exploiting the random rolling of cells while they are flowing along a microfluidic channel, it is possible to obtain in-line phase-contrast tomography, if smart strategies for wavefront analysis are adopted. Without a priori knowledge of the three-dimensional position and orientation of rotating cells 3D tomography can be completely retrieved through digital holography and intelligent wavefront numerical analysis.

The intriguing and challenging result is that by our approach a continuous-flow cytotomography is possible thus opening the route for practical operation in real-world, single-cell analysis. A demonstration is given for three completely different classes of biosamples, i.e. red blood cells and diatom algae, and cancer cells. Future emerging exploitations in detecting circulating tumor cells (CTC) will be discussed.

Short Bio:

Pietro Ferraro is currently director of research at CNR Institute of Applied Sciences and Intelligent Systems, Napoli Italy. Previously, he was Chief Research Scientist at Istituto Nazionale di Ottica del CNR, Pozzuoli, NA, Italy. He also worked as Principal Investigator with Alenia Aeronautics. He has published 12 book chapters, 300 papers in journals, more than 250 papers at International Conferences. He edited two books with Springer. He holds 14 patents. Among his current scientific interests are: holography, interferometry, microscopy, fabrication of nanostructures, ferroelectric crystals, optical fiber sensors, fiber bragg gratings, nano-microfluidics, optofluidics. Dr. Ferraro has chaired many International Conferences. He is in the Editorial Board of Optics and Lasers in Engineering (Elsevier), is Topical Editor of Biomedical Optics Express. He is Fellow of SPIE and Fellow of OSA. According to Google Scholar he has more 11.000 citations and H-index of 56.

He has puvbished his research in many high-ranked journals among which are: Nature Nanotechnology, Science, PNAS, Advanced Materials, Nature Communications and Light & Science Applications.

Applications of Raman spectroscopy in disease diagnosis

[1]CIOMP, CAS, Changchun, China
[2]HOOKE Instruments Ltd, Changchun, China

Bei Li

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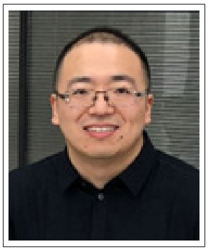
Raman spectroscopy is emerging as a promising and practical tool for rapid, real-time clinical diagnosis. As a label-free and non-invasive technique based on inelastic light scattering due to rotational and vibrational modes of molecular bonds, Raman spectra provides chemical signatures of changes in cells, tissues or biofluids related with various pathologic conditions. Abnormal status can be detected by analyzing the differences in relative intensity or shift of the same fingerprint peaks between normal and diseased tissues. Furthermore, associated with multivariate calibration and classification algorithms developed on large training datasets, Raman spectroscopy provides a novel, objective and quantitative approach in a wild range of medical applications, including disease screening and diagnosis, molecular characterization *in vivo* or *in vitro* for biopsy, intraoperative margin assessment, pathogens and antimicrobial-resistant bacteria identification. This talk will present our recent progress in the diagnos is of several disease using Raman spectroscopy, including glioblastoma, skin carcinoma, diabetes and infectious diseases.



Short Bio:

Bei Li is the professor at Changchun Institute of Optics, Fine Mechanics and Physics, CAS and the general manager of HOOKE Instruments Ltd. He obtained a Ph. D in photonics from University of Bristol, UK in 2009. From 2010 to 2014, he was engaged in the research and development of complex optical instruments in the Cardiff University and British NDS company. As a senior researcher at University of Oxford, he worked on the research and application of optical microscopy in the research group on dynamic optics and photonicsled by Professor Martin Booth during 2014-2017. He joined Changchun Institute of Optics, Fine Mechanics and Physics in 2017. He specializes in developing complex optical microscopy and its application in biological imaging. His main research fields include optics, optical engineering, biological science, etc.

Development of super-resolution microscopy for special biological target

Fudan University, China

Jiong Ma

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Since the development of the super-resolution microscopy win the 2014 Noble prize, it comes to the age of optical microscopy 2.0. These technologies promote a new round of biomedical research. However, there are still many limitations in applications, how to study and develop suitable new principles and methods to develop a personalized optical microscope for special biological research, will be the future direction of development. Here, we use the study of the nuclear pore complex as an example to show how to develop a personalized super-resolution microscopy technique to push the limits of spatiotemporal resolution to the requirements of biological research.

Short Bio:

Jiong Ma is currently Research Professor of Department of Optical Science and Engineering, School of Information Science and technology at Fudan University in Shanghai, China. He studied in the Physics Department of Fudan University in 1999-2008 and received the PhD degree in 2008. During his Ph.D. process, he visited as a research fellow at the Department of Chemistry at Rhodes University, South Africa at 2007 and the Department of Physiology at University of Oslo, Norway at 2007-2008. Then he worked as the post-doctor in the Department of Biology at Bowling Green State University, USA in 2008-2012, as the Research Assistant Professor in the Department of Biology at Temple University, USA in 2012-2015. Since 2015, he has been working in the Department of Optical Science and Engineering of Fudan University. His research direction is the application and development of optical technology in biology. The research of optical technology focuses on the development and application of new super-resolution microscopy, and the research of biology mainly focuses on the selection mechanism of nuclear pore complexes for gene-related substances transport. He was selected into the Youth Project of the "Thousand People Program" and the “Raising Star Program” in 2016.

Symposium 10

Label-free, single molecule detection using frequency-locked microtoroid optical resonators

University of Arizona, USA

Judith Su

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Label-free single molecule detection has been a long-standing goal of bioengineers and physicists. The main obstacle in the detection of single molecules, however, is to sufficiently decrease the noise level of the measurements such that a single molecule can be distinguished from background fluctuations. We have used laser frequency locking in combination with balanced detection and data processing techniques to improve the signal-to-noise ratio of microtoroid optical resonators and report the detection of a wide range of nanoscale objects including nanoparticles with radii from 100 to 2.5 nm, exosomes, ribosomes, and single protein molecules. We further extend the exosome results toward the creation of a minimally-invasive tumor biopsy assay. Our results agree with established model predictions for the frequency shift of the resonator upon particle binding across several orders of magnitude of particle radius (100 nm to 2 nm). A numerical simulation of our feedback control system was also carried out to elucidate our results. We are pursuing many applications, including more sensitive medical diagnostics and fundamental studies of single receptor-ligand and protein-protein interactions in real time.

Short Bio:

Judith Su is an Assistant Professor in Biomedical Engineering and an Assistant Professor of Optical Sciences at the University of Arizona. She is also a Visiting Associate at Caltech and on the Editorial Advisory Board of the journal, Translational Biophotonics (Wiley-VCH publishing). Judith received her B.S. and M.S. from MIT in Mechanical Engineering and her Ph.D. from Caltech in Biochemistry & Molecular Biophysics. Her background is in imaging, microfabrication, and optical instrument building for biological and medical applications. In general, her research interests are to develop new techniques to reveal basic biological functions at the molecular, cellular, and tissue levels. Recently her work has centered on label-free single molecule detection using microtoroid optical resonators with a focus on basic research, and translational medicine through the development of miniature field portable devices (https://wp.optics.arizona.edu/jsu /).

Symposium 10

Bioinspired graphene actuators prepared by unilateral UV irradiation

Jilin University, China

Dongdong Han

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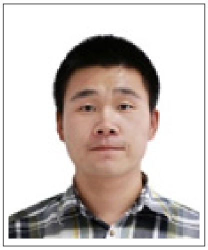
Inspired by natural autonomous systems that demonstrate controllable shape, appearance, and actuation under external stimuli, a facile preparation of moisturere sponsive graphene-based smart actuators by unilateral UV irradiation of graphene oxide (GO) papers is reported. UV irradiation of GO is found to be an effective protocol to trigger the reduction of GO; however, due to the limited light transmittance and thermal relaxation, thick GO paper cannot be fully reduced. Consequently, by tuning the photoreduction gradient, anisotropic GO/reduced GO (RGO) bilayer structure can be easily prepared toward actuation application. To get better control over the responsive properties, GO/RGO bilayer paper with a certain curvature and RGO patterns are successfully preparedfor actuator design. As representative examples, smart humidity-driven graphene actuators that mimic the cilia of respiratory tract and tendril climber plant are successfully developed for controllable objects transport.



Short Bio:

Dongdong Han received his B.S. degree (2013) and Ph.D degree (2018) from College of Electronic Science and Engineering, Jilin University, China. Currently his research interests mainly include light enabled manufacture of graphene-based robots.

Single cell precisely sorting based on laser induced forward transfer (LIFT)

CIOMP, CAS, China

Peng Liang

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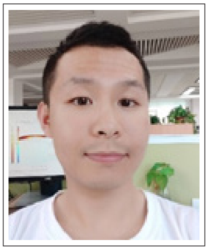
Laser-induced forward transfer (LIFT) has attracted considerable attention in recent years for the ability to precisely transfer many kinds of materials (metal, semiconductor, dielectric, polymer, biological tissue) in a wide dimension range (from several hundred nanometers to several hundred microns) with appropriately chosen parameters and film materials. This versatility, in turn, translates into a broad field of applications, from embedded electronic circuits to integrated optical devices, from the fabrication of chemicals sensors to tissue engineering. Recently, LIFT has been developed for biological materials, and has been successfully used to transfer stem cells in tissue engineering. Compared to other single cell sorting technologies such as fluorescence activated cell sorting (FACS), magnetic activated cell sorting (MACS), laser capture micro-dissection (LCM), LIFT shows its unique advantages. Here we will present some work about LIFT-based single cell sorting and its promising role in cell mapping, biomedical research, and 3D bioprinting.



Short Bio:

Peng Liang is currently a PhD student at Changchun Institute of Optics, Fine Mechanics, and Physics, University of Chinese Academy of Sciences (CIOMP, UCAS). He got his bachelor's degree in Mechanical Science and Engineering in 2017 at Jilin University (JLU) and took a successive postgraduate and doctoral program in CIOMP. Currently his research interests mainly include thermodynamic analysis of laser-induced forward transfer of metals.

Reduced non-radiative losses for efficient inverted planar heterojunction perovskite solar cells

Peking University, China

Deying Luo

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Metal halide perovskites have been the most active fields of photovoltaic research for the delivery of efficient and inexpensive solar energies. At present, perovskite solar cells (PSCs) can be classified as two types: regular (n-i-p) and inverted (p-i-n) structures. In contrast to regular structures, the inverted PSCs offer the promise of easy fabrication, versatility of energy-band engineering, and the possibility of fabricating multijunction cells. However, their device efficiencies are limited by lower open-circuit voltages (V_{oc}). The focus of current research is thus on finding solutions to further improve the device efficiencies through enhancing the V_{oc}. This talk will present reduced non-radiative losses for high-voltage high-performance inverted planar heterojunction PSCs, via controlling the semiconductor nature with the assistance of guanidinium bromide. Controlling the semiconductor nature enables us to attain an exceptionally high V_{oc} of 1.21 volts and a record power conversation efficiency of 21.51% for the inverted planar heterojunction PSCs.

Short Bio:

Deying Luo received his B.S. degree in Electronic Science and Technology, and M.S. degree in Condensed Matter Physics from Yunnan University in 2011 and 2014, respectively. Then, he joined the Laboratory of Organic Optoelectronic Materials and Devices at Kunming University as a research staff. From 2015 to 2016, he worked on perovskite solar cells in the Institute of Modern Optics at Peking University as a research assistant. Since 2016, he has been a Ph.D. student majoring in Atomic and Molecular Physics in the Department of Physics at Peking University. His researches focus on novel organic and/or organic-inorganic hybrid optoelectronic materials for applications in optoelectronic and photovoltaic devices, along with device physics of semiconductors. He has authored 26 peer-reviewed papers, including Science,Nat. Commun.,Adv. Mater., and he also contributed 4 oral talks in international and/or domestic conferences.

Ultrafast carrier transfer and interlayer coulomb coupling in 2D/3D perovskite heterostructures

National University of Defense Technology, China

Ke Wei

Email: weikeaep@163.com

Lead halide perovskites $MPbX_3$ (M = CH_3NH_3,Cs; X = Cl, Br, I) have emerged as one of the most promising next-generation photovoltaic materials due to their outstanding properties. However, the long-term stability to light, moisture, oxygen and heat remains unproven. In contrast to 3D perovskite materials, 2D Ruddlesden-Popper phase layered perovskites have shown superior moisture stability, but at a cost of the sharp drop of power conversion efficiency due to the inhibition of out-of-plane charge transport by the insulating spacercations. Combining the stability of the 2D perovskites and the excellent carrier transport properties of the 3D ones, that is, the 2D/3D hybrid perovsites, may be one of the most promising solutions to the stability limitation of the lead halide perovskites.

To date, 2D/3D hybrid perovskites have been successfully applied to different photoelectric fields, such as light-emitting diodes and solar cells, with both high efficiency and long-term stability. On the microcosmic level, fully efficient carrier transfer between different perovskite phases should play a key role in these high performance devices, which however, have not been well understood so far. In this talk, by utilizing comprehensive femtosecond optical measurements, we will present the ultrafast carrier behavior and the interlayer Coulomb coupling in the 2D/3D hybrid perovskites, which may be utilized to address high performance devices in both light-emitting and light-harvesting applications under specific device architectures.

Short Bio:

Ke Wei is currently a PhD student at the National University of Defense Technology (NUDT). He got his bachelor's degree in 2014 at Tsinghua University and the master's degree in 2017 at NUDT. Since 2014, He has been mainly engaged in the research of laser-matter interaction and ultrafast nanophotonics. Currently, he has published 4 papers as the first author in optical journals such as Laser & Photonics Reviews, Advanced Optical Materials and Optics Letters, with a total of 81 citations.

Light Conference 2019

Symposium 11

Airborne optical imaging and measurement (Internal Meeting)

Chairs:

Ping Jia

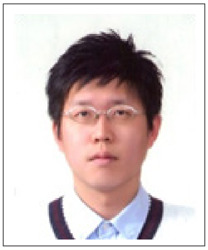
Chao He

University of Oxford, UK

Email: chao.he@eng.ox.ac.uk

Chao He is currently a DPhil student in Department of Engineering Science, University of Oxford, supervised by Prof. Martin Booth. He received his master degree in both Tsinghua University (Biomedical Engineering) and Imperial College London (Biomedical Research). He has obtained Clarendon Scholarship and Scholarship of Adaptive Optics in Microscope from University of Oxford; he hasalso obtained Excellent Graduate of Tsinghua University, Excellent Graduate of Beijing, National Scholarship for Graduate Students and Nomination for Special Scholarship ofTsinghua University. He has published more than ten peer-reviewed journal papers. His research interests include: Adaptive Optics, Microscopy/Micro-endoscopy, Vector Vortex Beam, Orbital Angular Momentum, and Biomedical Optics.

Title: Complex vectorial optics through gradient index lens cascades



Junsuk Rho

Pohang University of Science and Technology (POSTECH), Republic of Korea

Email: jsrho@postech.ac.kr

Junsuk Rho is currently an associate professor with a joint appointment in the Departments of Mechanical Engineering and Chemical Engineering at Pohang University of Science and Technology (POSTECH), Republic of Korea. Also, he is an adjunct professor in Yonsei University as part of POSTECH-Yonsei open campus program. Before joining POSTECH, He received a degree his B.S. (2007) and M.S. (2008) in Mechanical Engineering at Seoul National University, Korea and the University of Illinois, Urbana-Champaign, respectively. After getting Ph.D. (2013) in Mechanical Engineering and Nanoscale Science & Engineering from the University of California Berkeley, he had worked as a postdoctoral fellow in Materials Sciences Division at Lawrence Berkeley National Laboratory and UgoFano Fellow in Nanoscience and Technology Division at Argonne National Laboratory. His research is focused on developing novel nanophotonic materials and devices based on fundamental physics and experimental studies of deep sub-wavelength light-matter interaction. Dr. Rho has published approximately 40 high impact peer-reviewed journal papers including Nature, Science, Nature Materials, Nature Photonics and Nature Communications. He has received honorable awards including Samsung Scholarship (2008-2013), the Optical Society of America (OSA) Milton/Chang Award, the International Society for Optics and Photonics (SPIE) Scholarship (2011 & 2012), Materials Research Society (MRS) student award (2012), U.S. DOE Argonne Named Fellowship (2013-2016), Edmund Optics educational award (2015), the Optical Society of Korea young investigator award (2016), SPIE Rising Researcher Award (2017), Korean Government MSIP Minister’s Commendation (2017), Distinguished Teaching Award at POSTECH (2018) and Proud POSTECHIAN award (2018).

Title: Dielectric metasurfacesfor holography, color printing and crypto-display

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Title: Observation of excitonic gain in two-dimensional layered semiconductors well below the Mott transition

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Title: Towards optimal single-photon sources from polarized microcavities

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Purushothaman Varadhan received his PhD degree in Physics from Bharathidasan University, India. Currently he is a Postdoctoral Fellow of Prof. Jr-Hau He, Nanoenergy Laboraotry, King Abdullah University of Science and Technology (KAUST), Saudi Arabia.

Title: 15% solar-to-fuel conversion using solar-driven CO_2 reduction by employing triple junction III-V photoelectrode

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Fan Yang received his PhD degree in Electrical Engineering from The Hong Kong Polytechnic University. He is now a postdoctoral researcher in the Group for Fibre Optics (GFO) at École Poly Technique Fédérale de Lausanne (EPFL). His research to date has resulted in more than 20 peer-reviewed journal publications in the fields of Brillouin scattering, optical sensing, and laser spectroscopy.

Title: Large nonlinear optical amplification in gas: from sensing to lasing

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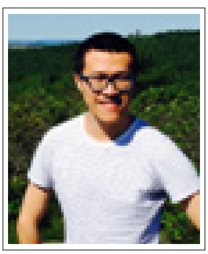

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Yi Yang received his B.S. and M. S. degrees in Peking University, China. He is a now a PhD candidate in Marin Soljacic group at MIT.

Title: A General Theoretical and Experimental Framework for Nanoscale Electromagnetism

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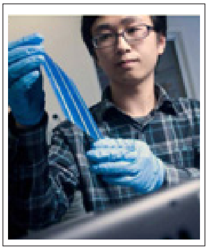
His current research interests include high-power ultrafast thin-disk lasers and their applications in driving mid-infrared generation.

Title: Mode-locking beyond the emission bandwidth limit



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Title: Coloring solar cells with simultaneously high efficiency by low-index dielectric nanoparticles

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Jie Zhao completed her PhD study in Quantum Optics from the Australian National University under the supervision of professor Ping Koy Lam. Her primary research interest is in the continuous variable quantum information. She is acurrently a postdoctoral fellow in the Australian National University.

Title: Demonstration of a high-fidelity heralded squeezing gate

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