United Nations
Educational, Scientific and
Cultural Organization
International
Day of Light
Lighting the Blue 2020
International Day of Light 2020
16 May
Photonic Materials Group
哈爾濱工程大學
光子材料课题组
Light | Science & Applications
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PROGRAM

Lightting the Blue Forum

Content

Greetings

Welcome to the Lighting the Blue (LtB) Forum 2020.

We, the chair and the members of the planning committee, are delighted to invite you to join this event, hosted jointly by Harbin Engineering University (HEU), Photonic Materials Group and Light: Science & Applications, on May 16, 2020 to present the latest progress in photonics, marine optics, and related disciplines, as well as to celebrate International Day of Light, proclaimed by United Nation Educational, Scientific and Cultural Organization (UNESCO).

The Blue as representative of the ocean, which is one of the most mysterious places in the world, constantly inspires and attracts people to explore the uncharted area, as well as demonstrates the nature of scientific research: truth-seeking curiosity. In the past decades, HEU has gained a worldwide reputation in the fields of ship industry, marine equipment and exploration. The systems (e.g., vessel engines, navigators and underwater communicators) designed and produced by HEU have been integrated into vessels, such as aircraft carrier (LIAONING), icebreaking research vessel (XUELONG), manned deep-diving submarine (JIAOLONG), etc., and provided critical support for the safety and success of related missions. However, our knowledge of the ocean is still rather limited. To advanced related research, it is necessary to promote interdisciplinary collaboration and integrate the most advanced technologies from diverse fields.

Light science and technologies have profoundly shaped human society and played vital role for mankind's sustainable development. Recently, the advanced nanofabrication techniques greatly promote applications of emerging nanodevices, such as nanoscale meta-lens, nanolaser, nanoenergy generator, etc., which offer tremendous advantages in size and energy consumption than the traditional devices. Without doubt, these emerging photonic technologies and devices definitely will provide new approaches to explore the ocean. Hence, we would like to foster a platform to encourage interdisciplinary research in light and marine science by inviting renowned scientists, engineers, and editors in wide range of photonics, nanofabricating, optical engineering, ship industry, and underwater acoustics engineering from various countries to give 40 plenary and invited talks. Participants will present their perspective around these topics, and exchange their exciting research progresses as well as innovations, which not only advance interdisciplinary collaboration, promote careers in related fields, but also help to achieve the goals of UNESCO - education, equality, and peace.

Even though the event in this year will be a virtual event due to COVID-19 pandemic, participants can still hear and engage with colleagues about innovative science and technologies through live meeting, recorded oral presentations, and/or audio/video Q&A.

Finally, we would also like to thank our funding agencies, without whom this event would not be possible. On behalf of the planning committee, we encourage you to attend this event, celebrate the 3rd International Day of Light, and share your work!

Prof. Dr. Wenxin Wang,
Chairman of LtB2020 & IDL2020

About LtB2020 & IDL2020

Lighting the Blue (LtB) Forum | International Day of Light (IDL) celebrating

May 16 – June 16, 2020 http://ltb.hrbeu.edu.cn

The 1st Lighting the Blue (LtB) forum will be jointly held on May 16, 2020 (International Day of Light 2020, IDL2020) by Photonic Materials Group (PMG) in College of physics and optoelectronic engineering at Harbin Engineering University (HEU), and Light: Science & Applications. Taking this opportunity of celebrating IDL2020 to organize an academic event virtually. IDL hold on May 16 every year, it is a global initiative that provides an annual focal point for the continued appreciation of light and the role it plays in science, culture and art, education, sustainable development, and in fields as diverse as medicine, communications and energy. IDL2020 will be celebrated online because of the recent outbreak of COVID-19, cities and countries worldwide are putting into place a number of containment measures that seriously impact the organization of conferences and public events. In these challenging times, "See The Light" is still a worldwide message encouraging all to join the conversation and celebrate the importance of the science of light and light-based technologies in our lives.

LtB2020 & IDL2020 are dedicated to discuss new concepts and techniques of photonic and plasmonic materials to solve fundamental cross-cutting problems for advanced applications of ocean optics, photonic and electronic devices, highlighting the important application of light in exploitation of marine resources for better sustainable development. This international forum will bring together the leading scientists, researchers, engineers, and technology developers to communicate and exchange their exciting research progresses and innovations.

The topics of the forum include, but are not restricted to:

- Photonic nanostructures, surface nanostructuring and patterning.
- Ocean optics, optical and electronic devices based on photonic nanostructures.
- Blue/ocean energy-related device applications of photonic nanostructures.

LtB2020 & IDL2020 is a full-day forum combining presentations and discussions in the form of live video streaming and recorded oral talks. The world-leading scientists will give 3 plenary and 8 keynote invited talks online, especially a few well-known scientists in the optical field. More than 40 talks will be uploaded in Scientists Section and Young Scientists Section on forum website (ltb.hrbeu.edu.cn), and it will last for a month from May 16 to June 16 June, 2020. The forum will be held in the Harbin Engineering University and supported by Natural Science Foundation of China (NSFC), Fundamental Research Funds for the Central Universities and Programme of Introducing Talents of Discipline to Universities. High-level international collaborations among worldwide research groups are highly expected based on the scientific discussions during the forum.

Organization

Forum Chair

Wenxin Wang

Forum Secretary

Yi Wang (Scientists Session)
Fanzhou Lv (Young Scientists Session)

Forum Committee

Zhihai Liu
Yi Wang
Yufeng Zhang
Wenxin Wang
Yudie Huang
Fanzhou Lv
Jiaxu Chen
Zhihang Wang
Dongda Wu

Program Organization

Yi Wang
Yufeng Zhang
Wenxin Wang

Organizer

Photonic Materials Group
Light: Science & Applications (LSA)
Harbin Engineering University

- College of physics and optoelectronic engineering
- Key Laboratory of In-Fiber Integrated Optics, Ministry of Education
- Innovation and Development Base (Qingdao)

Heilongjiang Overseas Returned Scholars Association

Financial Support

Natural Science Foundation of China (NSFC)
Fundamental Research Funds for the Central Universities
Programme of Introducing Talents of Discipline to Universities
College of physics and optoelectronic engineering
International Office of Harbin Engineering University
College of Science and Technology
The Optical Society of America (OSA)
Society of Photo-Optical Instrumentation Engineers (SPIE)

Synopsis of the Daily Program

Saturday, 16 May, 2020

Live-broadcasting Platform: Tencent Meeting ID: 447 795 924, Links: https://meeting.tencent.com/l/5hvtUw676ba7 Bilibili UID：LtB2020_IDL2020, Links: https://live.bilibili.com/22229566 Tik Tok: LtB2020_IDL2020		Page
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9:15-9:20	**Greeting Speech from LSA** *Prof. Yuhong Bai, General Chief Editor of Light: Science & Applications, China*	/
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Introduction of the Forum Chair

Prof. Dr. Wenxin Wang earned his academic degree of *Dr. rer. nat.* (cum laude) at the Technische Universität Ilmenau (Germany) in 2018 and became the group leader of Photonic Materials Group (PMG) in the College of Physics and Optoelectronic Engineering as well as the Innovation and Development Base (Qingdao) at the Harbin Engineering University (HEU) in the same year. His main research interests include fabrication of planar and microtubular photonic crystals using artificial alumina membranes, developing plasmonic lattice resonances, and studying band structure of photonic crystals as well as structural color modulated by nanoscale lattice arrangement. So far, he has authored for more than 30 papers, many of which are published in high-impact scientific journals, and received some research prizes and prestigious fundings (5.21 million RMB in total), such as the third prize of the "Rising Stars of Light" in the Light conference of LSA in 2018, HEU group-starting grant in 2018, NSFC grant in 2019, Fundamental Research Funds for the Central Universities in 2019 and 2020. Meanwhile, he has given quite a few invited talks, such as Postdeadline talk at DPG conference, and organized scientific conference (e.g., the CPFN in 2014) as well as several social events in Germany. Furthermore, he has been invited by the Chinese Embassy in Germany as a scholar representative to welcome President Xi and Premier Li in their visit to Germany in 2014. Currently, he serves as the deputy president of Heilongjiang Western Returned Scholars Association (Oversea-educated Scholars Association of Heilongjiang), the mentor of HEU "CHEN GENG" Talent Class, and the advisor of OSA-HEU student chapter as well as SPIE-HEU student chapter.

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Introduction of Greeting Speakers

Prof. Dr. Yu Yao
President
Harbin Engineering University, China

Prof. Dr. Yu Yao is the president of Harbin Engineering University. He is a distinguished professor of Yangtze River Scholars of the Ministry of Education, and an expert of the National Defense 863 Expert Group, the General Armament Department, and Manned Aerospace Expert Group. Moreover, he is a standing director of the Chinese System Simulation Society, and a deputy director of the Teaching Steering Committee for Automation of the Ministry of Education. He has been engaged in research of advanced guidance and nonlinear control theory for a long time, especially in novel missile guidance and control methods as well as their technical verifications. He was PI of many important projects, such as National 863, National Defense 973, Key Project of National Defense Pre-Research Program, National Natural Science Foundation General Projects and Key Projects.

Prof. Yu Yao received 1 Special Prize and 2 Second Prize of National Science and Technology Progress Awards, and multiple provincial and ministerial awards. He has published 1 monograph, more than 100 peer-reviewed articles and more than 10 patents. He was awarded the title of the inaugural class national candidate of the New Century Talents Project, the Excellent Young Teachers Program of MOE， the Science & Technology Award for Chinese Youth, and received special government allowance from the State Council.

http://www.hrbeu.edu.cn/

Prof. Dr. Yuhong Bai
General Chief Editor
Light: Science & Applications, China

Prof. Dr. Yuhong Bai is the general chief editor of the journal Light: Science & Applications (LSA), a world-renowned high-profile optics journal. Now she is also the vice director of Guo China-US Photonics Lab, PI of US-China joint project with Bill & Melinda Gates Foundation, and the chief editor of journal Optics and Precision Engineering. After obtaining her PhD from Dalian University of Technology, Yuhong Bai joined Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences and founded LSA in 2012. Within a short time, she led LSA to a highly visible resource in the optics community and has served as the steering committee member of International Day of Light of UNESCO since 2015. Yuhong Bai is the winner of - China's Government Prize in Publishing and China's Leading Talent in News & Publishing- China's most prominent awards in publishing. Since 2016, she is an editorial board member of Chinese Journal of Scientific and Technical. Yuhong Bai is an author of a book and 50 peer review journal papers, she also gave keynote/invited talks at more than 200 international conferences.

https://www.nature.com/lsa/

Introduction of Plenary and Keynote Speakers

Plenary Speakers

Prof. Dr. Dayong Jin, a Distinguished Professor at the University of Technology Sydney since 2017 and a Chair Professor at Southern University of Science and Technology since 2019. Professor Jin is the recipient of Australian Museum Eureka Prize 2015, 2017 Australian Academy of Science engineering science medal, and Australian Prime Minister Prize for Science–Physical Scientist of the Year 2017. His research has been in the physical, engineering and interdisciplinary sciences. He is a technology developer with expertise covering optics, luminescent materials, sensing, automation devices, microscopy imaging, and analytical chemistry to enable rapid detection of cells and molecules and engineering of sensors and photonics devices.

Prof. Dr. Xuan Zeng (M'97) received the B.S. and Ph.D. degrees in electrical engineering from Fudan University, Shanghai, China, in 1991 and 1997, respectively. She is currently a Full Professor with the Department of Microelectronics, Fudan University. She was a Visiting Professor at the Department of Electrical Engineering, Texas A&M University, College Station, TX, USA, and the Department of Microelectronics, Technische Universiteit Delft, Delft, The Netherlands, in 2002 and 2003, respectively. She was the Changjiang Distinguished Professor at the Ministry of Education Department of China, Beijing, China, in 2014. She was the recipient of the Chinese National Science Funds for Distinguished Young Scientists in 2011. She was the Director of the State Key Laboratory of ASIC & System from 2008 to 2012. Her current research interests include analog circuit modeling and synthesis, design for manufacturability, high-speed interconnect analysis and optimization, circuit simulation, and ASIC design. She has published more than 200 refereed journal/conference papers and 14 filed Chinese patents. She was a recipient of best paper award of Integration, the VLSI Journal 2018 and the Best Paper Award from the 8th IEEE Annual Ubiquitous Computing, Electronics and Mobile Communication Conference (UEMCON) 2017, the First Class of Natural Science Prize of Shanghai in 2012, the 10th For Women in Science Award in China in 2013, the Shanghai Municipal Natural Science Peony Award in 2014, and Best Paper Nominations from DAC 2014, DAC2017, ICCAD 2013, ASP-DAC 2017, and DATE 2017. She is an Associate Editor of the IEEE Transactions on Circuits and Systems: PART II, the IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems, and the ACM Transactions on Design Automation on Electronics and Systems. Dr. Zeng served on the Technical Program Committee for Design Automation Conference (DAC), ICCAD, ASP-DAC, and VLSI-DAT, and the TPC Sub-Committee Chair for the IEEE/ACM ASPDAC, in 2005, 2015, 2017, and 2018. She is a IEEE Senior member.

Prof. Dr. Lingdong Sun, State Key Laboratory of Rare Earth Materials Chemistry and Applications, Peking University. Her research interests includ (1) Solution route towards rare earth and noble metal nanocrystals, and 2D or 3D self-assemble architectures; (2) Luminescent rare earth nanocrystals, upconversion and downshifting for multiplex/multifunction detection and imaging; (3) External field effect on the excited states and radiation transition probability of luminescent semiconductor and rare earth nanocrystals. Prof. Sun received the honors of "The National Award of Science and Technology Progress, the 2nd Grade (1999)", "Youth Chemistry Prize" by China Chemical Society (2005), "Research Prize for Youth Scientists" awarded by the Hok Ying Dong Education Foundation (2006), and "Youth Science Award" by China Association for Science and Technology (2007), The National Award of Natural Science, the 2nd Grade (2011), Distinguished Young Researcher (2014). She has published more than 170 papers in such as Science, J. Am. Chem. Soc., Nano Lett., Angew. Chem. Int. Ed., Adv. Mater. Dr. Sun's publications have been cited for over 8000 times.

Keynote Speakers

Prof. Dr. Tao Li is a doctoral supervisor at the College of Engineering and Applied Sciences, Nanjing University. He received his Ph.D. degree at NJU in 2005, joined College of Engineering and Applied Sciences in 2008, and was promoted to full professor in 2013. He worked as a visiting scholar in Nanyang Technology University, Singapore, in 2012, and Hong Kong Baptist University under the support of "K.C. Wong Education Foundation" scholarship in 2013. He won "Dengfeng Talent Program B" from NJU (2012), "National Funds for Outstanding Young Scientists" (2013), and "Young and middle-aged leading scientists" from MOST (2018). His research includes plasmonics, metamaterials nanophotonics. Till now, he has published >90 SCI papers (including Nature Subs., PRL, LSA, Nano Lett., etc.) with a recent H index of 32, presented >50 invited talks in international conferences and seminars. He is currently working as the Topical Editor of Chinese Optical Letters, Executive Board Member of Science Bulletin, and Editorial Committee of Frontier of Optoelectronics.

Prof. Dr. Huigao Duan was working as a researcher in Institute of Electrical Engineering, Chinese Academy of Sciences from 2006 to 2008. He was a visiting Researcher in Prof. Karl K. Berggren's group at Massachusetts Institute of Technology (MIT) from 2008 to 2010, focusing on the resolution limits of electron-beam lithography. He was working in IMRE, A*STAR, Singapore as a Research Scientist from 2010 to 2012, focusing on nanoplasmonics and its applications in solid state devices. He was supported by Baden-Württemberg Stipend as a visiting scientist in Prof. Harald Giessen's group at University of Stuttgart, Germany for 3 months. He joint Hunan University, China as a full professor in 2012 and is now a principle investigator in College of Mechanical and Vehicle Engineering. He has authored or co-authored 140 peer-reviewed journal papers with citations more than 4600 times and an H-index of 40. His research interests include sub-10-nm patterning, nanophotonics, smart micro/nanosystems and their relevant applications. He has served as editors or associate editors for several distinguished journals such as Research (a SCIENCE partner journal), IEEE Transactions on Nanotechnology, Microelectronic Engineering and Journal of Microelectronic Manufacturing. He is the founder of Micro/Nanomanufacturing and Microsystems Technology Research Center at Hunan University, co-founder of Advanced Manufacturing Laboratory for Micro/Nano-Optical Devices (Shenzhen Institute of Hunan University).

Prof. Dr. Xiangping Li completed his Ph.D. at Swinburne University of Technology in 2009. His research interests cover from metasurface, plasmonics and optical data storage. Dr. Li is a recipient of a number of prestigious awards including the Australian Postdoctoral Fellow funded by Australian Research Council in 2011, Swinburne's Vice Chancellor Award for early career researcher in 2012, Victoria Fellowship in 2013, Discovery Early Career Researcher Award by Australian Research Council in 2014, and Distinguished Young Scholars from National Natural Science Foundation of China in 2015. He joined the Institute of Photonics Technology in Jinan University as a full professor and principle investigator in nanophotonic devices group in 2015.

Prof. Dr. Jin Liu is a doctoral supervisor of physics in Sun Yat-Sen University. He obtained his Ph.D. degree in 2012 from Technical University of Denmark under the supervision of Prof. Peter Lodahl. Before moving back to China, he worked with Dr. Kartik Srinivasan at National Institute of Standards and Technology (NIST) to develop integrated quantum photonic circuits. His current research activities cover integrated quantum photonics and nanophotonics by utilizing molecular beam epitaxy, semiconductor nanofabrication and cryogenic optical characterizations.

Prof. Dr. Lei Shi, Department of Physics, Fudan University. He graduated from Nanjing University in 2005, and completed his Ph.D. at. Fudan University in 2010. He studied as a short-term visiting scholar at the Department of Physics, National University of Singapore in 2010. Whereafter, he worked as a postdoctoral fellow at the Madrid Institute of Materials Science, Valencia University of Technology, and Aalto University in Finland from 2011 to 2013. He joint Fudan University as a Associate Professor in 2013 and is now a Professor in Department of Physics. His academic interests include Photonic crystals, Artificial Bandgap materials, Nano- and Micro- photonics structures, Advanced optical characterization technics, Optical methodology for nanostructures. Prof. Shi has published more than 36 papers and cited more than 330 times in the past 5 years.

Prof. Dr. Fei Ding is a tenured full professor in Leibniz University Hannover (a member of TU-9), Germany. He is a W3 chair in Nanophysics, with the research direction in semiconductor materials and quantum optical devices. He obtained the bachelor degree in 2003 from Hefei University of Technology, and the PhD degree in 2009 from the joint program between Chinese Academy of Sciences and Max Planck Society Germany. He joined IBM Zurich Laboratory in 2010 and worked in the exploratory photonics group. Since 2012, he worked in Leibniz Institute for Solid and Materials Research Dresden as a group leader, and then became the deputy head of institute. In 2016, Dr. Ding obtained the full professorship from Leibniz University Hannover. He served as a referee for European Research Council, Chinese Academy of Sciences (Strategic Priority Program), Federal Ministry of Education and Science Germany, Alexander von Humboldt foundation, etc. He received a number of awards so far, which include Marie Curie fellowship, IBM patent achievement award, IFW excellence award, and the prestigious ERC grant. Several of his group members have received professorships (including the 1000 young talent program). Currently he is also the Chairman for Gesellschaft Chinesischer Physiker in Deutschland.

Prof. Dr. Peng Gao studied since 2006 as Ph.D. at the Max-Planck Institute for Polymer Research (Mainz, Germany) in the group of Prof. Klaus Müllen. His Ph.D. thesis is about organic field-effect transistors. Since 2010, he joined the lab of Prof. Grätzel at EPFL (Lausanne, Switzerland) as a postdoctoral researcher and studied dye-sensitized solar cells and perovskite solar cells. From 2015 he worked with Prof. Nazeeruddin at the EPFL Sion Energy Polis ((Sion, Switzerland)) as a group leader on perovskite solar cell related semi-conductive materials. He started the Laboratory for Advanced Functional Materials in 2017 at Fujian Institute of Research on the Structure of Matter (FJIRSM), the Chinese Academy of Sciences, and focus on the application of rare-earth elements in organic optoelectronics and energy conversion materials.

Prof. Dr. Jun Wang, Shanghai Institute of Optics and Fine Mechanics (SIOM), Chinese Academy of Sciences (CAS). He obtained the PhD degree from the Chinese University of Hong Kong in 2006. Then he was granted an IRCSET postdoctoral fellowship and worked at Trinity College Dublin, Ireland. In 2011, he relocated his research activities to SIOM under the financial support from the 100-Talent Program of CAS. In 2019 and 2015, he was awarded by the National 10000-Talent Program and National Natural Science Foundation-Outstanding Youth Foundation, respectively. His research interests are focused on nonlinear optics in low-dimensional materials. So far, he has published more than 160 peer-reviewed SCI journal papers in Nature Nanotech., Prog. Mater. Sci., Adv. Mater., Nature Commun., ACS Nano, Laser Photon. Rev., etc., including 10 ESI papers and having over 5500 citations.

Introduction of HEU Special Speakers

College of Shipbuilding Engineering

The Science and Technology on Underwater Vehicle Laboratory has always been exploring the new theories and methods in underwater vehicles technology, based on the major demand of the construction of Chinese navy, and the development of Chinese ocean strategy. The major research areas of the Laboratory include: architecture and intelligent control, underwater environment perception and target detection based on acoustic and non-acoustic devices, marine environmental adaptation technology. The principal task of this lab is to undertake fundamental and application research, as well as tackle the critical problems and technical bottlenecks around these areas. Efforts will be concentrated on swarm intelligence and sustainable utilization of unmanned underwater systems including autonomous underwater vehicles etc. The Laboratory has become an advanced education center, and a research platform of Chinese underwater vehicle technologies.

Prof. Dr. Hongde Qin received the Ph.D. degree from Harbin Engineering University, Harbin, China in 2003. He is a Professor and Director of Science and Technology on Underwater Vehicle Laboratory at the Harbin Engineering University. His current research interests include unmanned underwater vehicle, hydrodynamic analysis of offshore structures, single beacon underwater navigation. Professor Hongde Qin is an IEEE senior member and currently the Associate Editor of SIVP, Science Progress.

College of Underwater Acoustic Engineering

The main research interests of the Polar Acoustics and Sonar Simulation Team (PASST) include underwater acoustic communication and detection, sonar simulation, multi-static sonar and formation combat, and physical characteristics of under-ice acoustic. Relying on the existing technologies in underwater acoustic physics, underwater acoustic communication, sonar simulation and signal processing, the PASST steadily advance research in the traditional underwater acoustic field and also the acoustic characteristic, signal processing and equipment development in special polar ocean environment. The PASST combines basic underwater acoustic physics with engineering applications and also combines virtual reality simulation with equipment development to achieve mutual promotion and parallel development of traditional underwater acoustic and emerging polar acoustic technologies. In recent years, the PASST has undertaken more than thirty projects including the National Key R&D Program of China, the National Natural Science Foundation of China, the Innovation Special Zone of National Defense Science and Technology, the Fok Ying-Tong Education Foundation, Basic Research of National Defense Technology, Pre-Research of the Navy and the Marine Nonprofit Industry Research Subject. The PASST has won 5 provincial and ministerial science and technology awards, hold more than 40 invention patents, and published more than 200 papers and 3 books.

Prof. Dr. Jingwei Yin is the leader of the Polar Acoustics and Sonar Simulation Team. He received his B.S, M.S, and Ph.D. degrees in underwater acoustic engineering from Harbin Engineering University, China in 1999, 2006, and 2007, respectively. He is a visiting professor at the Russian Far Eastern Federal University (FEFU) and currently a professor and director of the Science and

Technology Research Institute in Harbin Engineering University. He has published over 120 scientific articles and two books, one of which is awarded as the Excellent Publication of Shipbuilding Engineering Society of China. He holds 18 authorized invention patents, one of which has been transformed. As the projects leader, he won the First prize of Science and Technology Progress of Heilongjiang Province, the Second prize of Science and Technology Progress of Marine Engineering, the Second prize of Natural Science of Heilongjiang Province, and the Nomination prize of National Excellent Doctoral Dissertation. As a scholar, he is awarded Distinguished Young Scholar of Chang Jiang Scholars Program by the Ministry of Education and Outstanding Youth of Heilongjiang Province. He is a winner of the Fok Ying Tung Education Foundation. Prof. Yin also serves as the leader of the National Defense Science and technology innovation team, an expert of the Innovation Special Innovative Zone of National Defense Science and Technology, and the deputy director of the underwater acoustic branch of the Acoustical Society of China. He is also the director of the Key Laboratory of Marine Information Acquisition and Security (Harbin Engineering University), Ministry of Industry and Information Technology.

Assistant Professor, Dr. Xiao Han received the B.S., M.S., and Ph.D. degrees in underwater acoustic engineering from Harbin Engineering University, Harbin, China, in 2011, 2014, and 2016, respectively, where he is currently an Assistant Professor with the College of Underwater Acoustic Engineering. He has been a visiting scholar with Acoustic Research Laboratory, National University of Singapore since April, 2019. He is a member of the youth working committee of the Chinese Society of Naval Architects and Marine Engineers, also a member of Acoustical Society of China. He has published more than 30 research articles in related journals and international conference proceedings. He is the holder of 13 patents. He is the principle investigator of more than ten research projects, including National Key R&D Program of China, National Natural Science Foundation of China, Innovation Special Zone of National Defense Science and Technology, and Postdoctoral Science Foundation of China, etc. His research interests include underwater acoustic communication, underwater acoustic communication reconnaissance and confrontation, and underwater array signal processing.

College of Nuclear Science and Technology

Prof. Dr. Sichao Tan received his Ph.D. in Nuclear Science and Technology from the Harbin Engineering University (HEU), China, in 2006. He continued his research as an Assistant Professor after graduation at HEU, where he established the Laser Diagnose Laboratory. In 2009, he became Full Professor of the College of Nuclear Science and Technology (CNST) of HEU. In 2018, he was elected as the Young Distinguished Professor of Longjiang Scholar.Prof. Tan's research interest includes fundamental studies on the Nuclear Reactors Thermal Hydraulics for both Land-based and Ship Nuclear Reactor, the performance and characteristics of the Ship Nuclear Reactor, the Small Nuclear Reactor, and the Advanced Laser Diagnostic Technology. He is the PI of several research projects of the National Key R&D Program of China and received approximately $3 million research funding. He has published more than 120 journal papers, held 10 patents, and written an academic monograph entitled "Characteristics of Nuclear Reactor Thermal Hydraulics under Ocean Conditions". The Laser Diagnose Laboratory at HEU is founded by Prof. Sichao Tan in 2009. The lab focuses on detailed optical non-intrusive measurements, including velocity, temperature, concentration, phase fraction in both steady-state and transient conditions. Focuses are also addressed on measurement in complex geometries, such as conventional rod bundle, annular fuel, plate type fuel, reactor core downcomer, pump, and others. A few example figures are listed in the following.

Assistant Professor, Dr. Shouxu Qiao earned his Ph.D. degree in Nuclear Engineering at the Pennsylvania State University in 2017. He then joined the College of Nuclear Science and Technology at Harbin Engineering University as an assistant professor in 2018. His research interests include thermal-hydraulics and reactor safety, advanced single-phase and two-phase flow measurement, two-phase flow experiments and modeling, interfacial area transport modeling, and two-phase flow instrumentation development. Dr Qiao has published about 20 journal articles in IJMF, IJHMT, NED, ANE and others in nuclear area. He currently holds several projects supported by the National Natural Science Foundation, the National and Provincial Postdoctoral Science Foundation and the nuclear industry.

College of Physics and Optoelectronic Engineering

Prof. Dr. Weimin Sun is the Dean of the College of Physics and Optoelectric Engineering, Harbin Engineering University, P. R. China. He is the Vice Chairman of Physical Society and the Vice Chairman of Optical Society of Heilongjiang Province, P. R. China. Professor SUN works on astrophotonics and fiber X-ray sensors. He published hundreds of articles and dozens of patents.

Prof. Dr. Weimin Sun is the head of the AstroPhotonics Group (APG) in Harbin Engineering University. As its name indicated, APG focuses on the research and development of optics and photonics techniques, which aims at the observation for astronomy. APG has a long history of the in-deep cooperation with the top-level experts in the field of astronomy. Through the years-long development, APG is now an influential team in the international playground of astrophotonics. The research areas of APG include: 1) integral field unit (IFU) based 3-D spectrum technique, 2) fibers in astronomy, 3) fiber sensing technique, and 4) photonics integration technique. April 2019, the 242 units IFU, which was designed and engineered by APG, has grabbed its first light with excellent accuracy in the FASOT-1B system at Yunnan Observatory. The 8,064 units IFU for FASOT-2 is in its final phase of assemble. APG also has a great deal of systematic study on the focal ratio degradation (FRD) of the fibers in astronomy. Fiber cables with dynamic FRD monitoring are developed, which aims to be applied in LAMOST (Large Sky Area Multi-Object Fiber Spectroscopic Telescope). The fiber sensing technique involves specialty fibers, which can improve the accuracy of astronomical observation and promote the study on the cosmology and exoplanet. The photonics integration in APG is motived by the demand in the miniaturization of telescope equipment. A miniaturized spectrograph has been designed for high-density spectral sky survey and the space-based sky survey in the near future.

Prof. Dr. Zhihai Liu's research group has long been devoted to the basic and applied basic research of fiber optical tweezers, optical fiber devices, optical fiber sensors and other cross fields. The research group belongs to Key Lab of In-fiber Integrated Optics, Ministry Education of China, Harbin Engineering University. The main research directions include: (1) Optical trap: The current research mainly focuses on the theory, method and technology of optical fiber tweezers, including laser-induced photophoresis to realize the trap, movement, vibration and other operations and control of absorbent particles in the liquid environment; all-optical single fiber optical tweezers; new multiplexing method and control mechanism of single core optical fiber tweezers; new concepts such as wavelength division multiplexing optical tweezers and polarization multiplexing optical tweezers; practical optical fiber sensors based on optical fiber tweezers, such as micro force sensor, acceleration sensor and temperature sensor based on optical tweezers. (2) Fiber sensor and device: The current research mainly focuses on the integrated optical fiber devices, including a variety of new optical fiber sensing principles, micro devices and sensing systems; a new method of single fiber integration of interferometer; the key technologies such as the construction of optical fiber internal path and the insertion of single fiber of interferometer; a series of integrated interferometer optical fiber devices with Michelson and Mach-Zehnder. (3) The ultimate goal of our research is to develop lead optical trapping and sensing devices for practical applied in multiple researching fields.

Prof. Dr. Yu Zhang, belongs to Key Lab of In-fiber Integrated Optics, Ministry Education of China, Harbin Engineering University. For more than ten years, she has focused on the research of the mechanism and key technologies of optical fiber tweezers: 1. She proposes the research idea of using laser-induced photophoresis to adjust the heat exchange coefficient of the medium and perform the trap of absorbing particles in liquid. She takes the lead in realizing the capture, movement and vibration of the absorbent particles in the liquid environment, breaking through the technical barrier that optical means cannot operate the optical absorbent particles, and solving the problem of energy absorption. 2. Based on the development and fabrication of microstructured multicore optical fiber, she performs the optical micro hand for the first time, which solves the limitation of multi-functional optical field integrated in a single fiber, and expands many optical micro operations such as capture, position adjusting, deflection, rotation and screening. 3. Based on the principle of mode multiplexing, she proposes a general-purpose single fiber optical tweezers to realize the controllable optical operation for all types of particles, including transparent particles represented by biological cells, low refractive index particles represented by ultrasound microbubbles and completely light absorbing particles represented by black microspheres. She has obtained research support from 10 projects such as NSFC, published 83 SCI papers, cited 501 times in SCI, and H factor 13. She has applied for 50 invention patents and 33 patents have been authorized.

Abstracts

Abstracts of Plenary Talks

New Modalities in Upconversion Super-resolution Microscopy

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ABSTRACT

Since our earlier report on using the highly doped upconversion nanoparticles for low-power high-contrast STED nanoscopy [1], our group has further developed several new modalities of super-resolution microscopy imaging and single molecule tracking techniques. In my talk, I will present the recent new modalities: Direct microscopic inspection and tracking of single upconversion nanoparticles in living cells [2, 3], Multi-photon near-infrared emission saturation nanoscopy using single beam scanning [4], Bessel beam scanning to map single nanoparticles inside tumor spheroids [5], Upconversion nonlinear structured illumination microscopy [6], Fourier domain heterochromatic fusion for single beam scanning super-resolution microscopy (new results not yet published), and Axial localization and tracking of self-interference nanoparticles by lateral point spread functions (new results not yet published).

KEYWORDS

Upconversion nanoparticles, Super resolution, Microscopy, Imaging, Single molecule

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Analog Integrated Circuit Modeling and Synthesis Based on Machine Learning

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ABSTRACT

As integrated circuit process technology continues to shrink down to the nanometer scale, analog integrated circuit design becomes a bottleneck of System-on-Chip design due to its relative high cost and low efficiency. In this talk, the novel algorithms based on Gaussian Process modeling and Bayesian optimization is proposed to solve the analog circuit optimization problem with very low computational cost. The Bayesian optimization approach for yield optimization of analog and SRAM circuits is also proposed. Gaussian process regression is employed to predict the yield over the design space with uncertainty information. By ensuring high estimation accuracies for promising designs while tolerating higher variabilities for low-yield ones, the proposed method can significantly cut down the average computational cost of yield estimations without surrendering the accuracy of the final result. The proposed Bayesian optimization approaches have demonstrated a promising direction for analog circuit optimization.

KEYWORDS

Integrated Circuits, Analog Integrated Circuit Optimization, Machine Learning

Efficient Photon Conversion: A Wonderland of Lanthanide Nanocrystals

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ABSTRACT

Luminescence from lanthanide nanocrystals, ranged from ultraviolet to visible and even the near infrared, are attractive for a broad field of photon conversion applications. Efficient tailoring of the lanthanide luminescence, *i.e.* intensity, *f-f* intra-configurational transition selectivity and lifetime, is of great importance for extended applications. We presented facile and effective strategies to tailor the upconversion emission by engineering the local structure, core/shell structure with precisely tuning the composition of the core and shell of the nanocrystals. To be noticed, the lattice parameter, as well as the coordination number and local symmetry of the lanthanide nanocrystals changed with the composition. And the luminescence selectivity, which is tuned from multiple possibilities to single transition, is also local structure dependent. Combined with core/shell structure, energy transfer localized in nanodomain benefits to multiphoton upconverting process, and orthogonal excitation and emission integration is achieved on single particle. These lanthanide nanocrystals show great promise for displays, multiplex labels and in vivo bioimaging applications.

KEYWORDS

Lanthanide nanocrystals, Luminescence, Photon conversion

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Abstracts of Keynote Talks

Compact Microscopy with Depth and Wide-field Metalens Imaging

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ABSTRACT

Metasurface is a kind of metamaterial with only one layer or very few layers of subwavelength structures, which has strong capability in manipulate the light within an ultrathin flat device and possibly promises tremendous applications in state-of-art optical instruments and technology. One popular application is metalens imaging, which promises extremely wide uses in optical systems. Although the imaging performances of metalenses (e.g., efficiency, working bandwidth, field of view) have been improved by various methods, they are usually constrained by each other. As a result, the comprehensive performance of today's metalenses is still inferior to the traditional refraction lenses and compound lenses. Compared with conventional imaging systems, an outstanding advantage of metalens is the miniaturization and compact integration. Therefore, microscopic imaging should be a very suitable application scenario. In this talk, I would like to show a newly developed metalens-based spectral imaging system with an aplanatic GaN metalens (NA=0.78), in which large chromatic dispersion is used to access spectral focus tuning and optical zooming in the visible spectrum. This aplanatic metalens is utilized to image microscopic frog egg cells and shows excellent tomographic images with distinct depth features of cell membranes nucleus[1]. In a further step, we developed an on-chip integrated compact imaging system by directly mounting the metalenses to CMOS senor. Here, silicon metalens were fabricated with its diameter focal length in hundreds micros scale. The imaging performances were investigated in detail, which reveals the capability of depth-of-field resolved imaging. Moreover, a parallel arranged metalens array is designed for a wide-field microscopic imaging by polarization multiplexing and image stitching. Our device show very compact architecture (working distance in hundreds micros) and achieved wide-field (mm scale) microscopic image with high resolution (about 1mm)[2], which is even expandable to centimeter scale without decreasing resolution. Due to the extremely compact architecture, our device shows uniqueness of meta-design for compact integration and cast light for new generation optical devices.

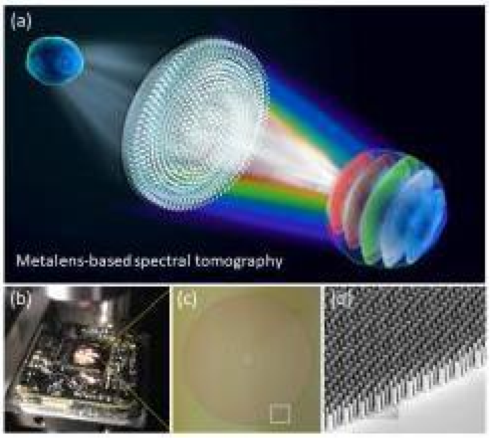

Figure 1. (a) Schematics of metalens-based spectral tomography. (b) Integrated metalens microscope system. (c) and (d) Zoom-in images of the metalens.

KEYWORDS

Metalens, Microscopy, Compact, Wide-field imaging

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Extreme Micro/Nanomanufacturing and Its Optical Applications

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ABSTRACT

Micro/Nanomanufacturing has been playing a key role on integrated-circuits industry and developing nanodevices and microsystems. Pushing the micro/nanomanufacturing towards ultrasmall dimension and ultrahigh precision is of great interest and importance for various applications. In this presentation, I will share our efforts on developing new processes to fabricate functional micro/nanostructures with citical dimension down to 10 nm. Novel applications on holography and color printing will be demonstrated.

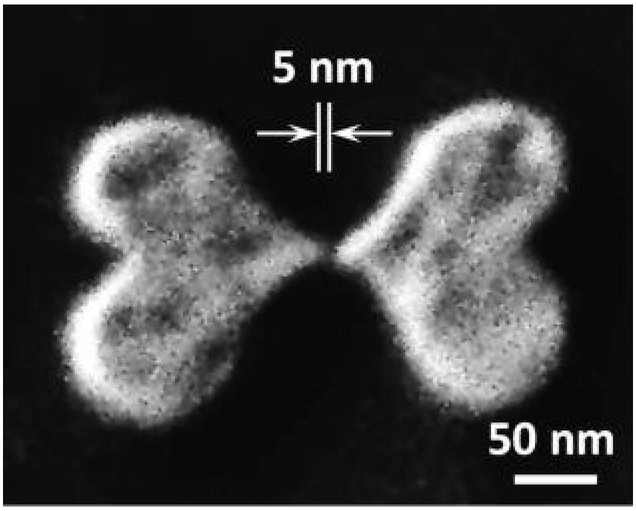

Figure 1. A heart-shaped plasmonic dimer with 5-nm gap for extreme nanofocusing.

Dimerized Metasurface for Multi-functional Flat Optics

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ABSTRACT

Metasurface based flat optics[1], an ultrathin layer of structured nano-antennas imparting local and space-variant abrupt phase changes, promises great potentials in shaping light's wavefronts in desirable manners. However, most of the reported metasurfaces are restrained by their design strategies and can only allow one or two physical parameters such as phase, polarization or amplitude to be controlled at the same time. Geometric metasurface provides dispersionless phases depending on the in-plane orientation angles of the meta-atoms. However, the polarization state of the incident light is restricted to circular polarization only. The combination of geometric phase with propagation phase was proposed to relieve the constraint and realize full control of the phase and polarization. However, this is achieved at the cost of increased thickness of the antennas to wavelength scale and concomitant massive computations for complicated meta-atom designs with intricate geometries at variant locations, meanwhile, the propagation phase is intrinsically dispersive, which restricts its ability to working at a specific wavelength. Here, we demonstrate a new dimerized metasurface design that can allow simultaneous control of the four basic parameters in one go[2,3] as well as underpin variety of multi-functional optical elements. The proposed dimerized metasurface is consisting of two identical meta-atoms with exquisitely controlled in-cell displacements and orientations. Consequently, multi-functional holography that the amplitude, phase, polarization and color components of the diffracted beam can be completely controlled has been demonstrated (Fig. 1). The proposed diatomic metasurfaces may extensively promote applications based on flat optics.

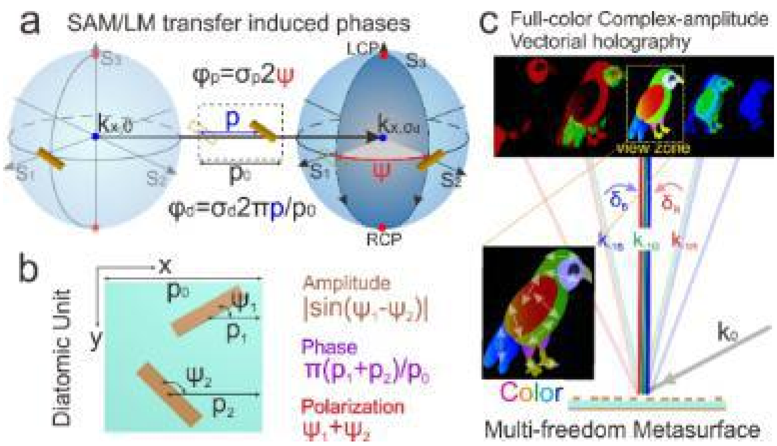

Figure 1. Design principle of the diatomic metasurfaces. (a) Physical principle by integrating linear and spin angular momentum transfer. (b) schematic illustration of diatomic meta-atoms. (c) Multifunctional holography based on four parameters controlled diffracted beams.

KEYWORDS

Metasurface, Metahologram, Diatomic

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High-Q Bound States in the Continuum Based on All Dielectric Metasurfaces

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ABSTRACT

High-Q resonance are universal resources across different branches of physics, e.g., in acoustics, electronics, and electromagnetics, etc. In the past decades, high-Q resonant modes of micro-resonators are one of the important research fields in nanophotonics, such as whispering gallery mode and Fabry-Pérot resonant mode, and defect mode of photon crystals, etc [1]. Recently, bound states in the continuum (BICs) has become an enabling platform for realizing high-Q resonance. BICs possess infinite lifetime (an infinite quality factor) in the ideal case, even though they are in the continuum spectrum of radiating modes that can couple to free space [2]. Therefore, it is highly attractive to employ the BICs for exploring the nonlinear optical processes in nanoscale with light coupling from space.

In this talk, I will present the realizations of high-Q quasi-BIC modes in all-dielectric metasurfaces by introducing asymmetry in the unit cells [3]. We've achieved quasi-BIC modes in telecom band with a record-Q factor close to 20,000 under the normal excitation condition. By tuning pico-second pulsed into the BIC resonance, highly efficient third harmonic generation and even pronounced second harmonic generation which is usually in absence in silicon are simultaneously achieved. Our devices may immediately boost the performances of BICs in a plethora of fundamental research and device applications, e.g., cavity QED, biosensing, nanolasing, and quantum light generations.

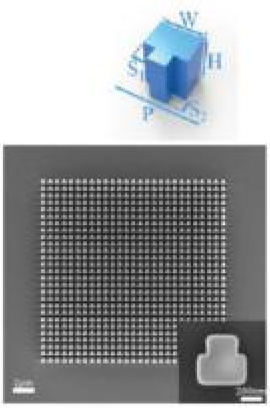

TABLE I. Comparison of Q factors measured under normal excitation conditions for all-dielectric metasurfaces.

Year	References	Wavelength/nm	Q factor
2014	[37]	1376	483
2016	[38]	1000	350
2017	[39]	1500	300
2017	[29]	1300	1011
2018	[40]	1490	1946
2018	[32]	825	2750
2018	[33]	2320	150
2018	[26]	5700	200
2019	[27]	855	144
2019	This work	1588	18 511

Figure 1. igh-Q bound States in the continuum based on all dielectric metasurfaces.

KEYWORDS

Bound states in the continuum, Metasurfaces, Third harmonic generations

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Circularly Polarized States Spawning from Bound States in the Continuum

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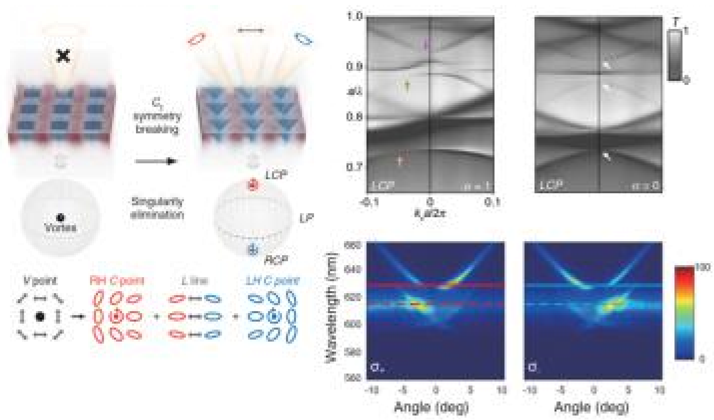
ABSTRACT

Bound states in the continuum (BICs) in periodic photonic systems like photonic crystal slabs are proved to be accompanied by vortex polarization singularities on the photonic bands in the momentum space [1]. The winding structures of polarization states not only widen the field of topological physics but also show great potential that such systems could be applied in polarization manipulating. In this talk, I report the phenomenon that by in-plane inversion (C2) symmetry breaking, pairs of circularly polarized states could spawn from the eliminated BICs. Along with the appearance of the circularly polarized states as the two poles of the Poincare sphere together with linearly polarized states covering the equator, full coverage on the Poincare sphere is realized [2].

As an application, ellipticity modulation of linear polarization is demonstrated in the visible frequency range. This phenomenon provides a new degree of freedom in modulating polarization. Moreover, coupling with circularly polarized states spawning from BICs, valley photons emitted by a two-dimensional monolayer materials are routed directionally and efficiently separated in far field with spatial coherence property. Further studying and manipulating the reported polarization singularities may lead to novel phenomena and physics in radiation modulating and topological photonics.



KEYWORDS

Photonic Crystals, Polarization states manipulations, Momentum space, Bound states in the continuum, Valley emission

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Highly Efficient Entangled Photon Sources Based on Semiconductor Quantum Dots

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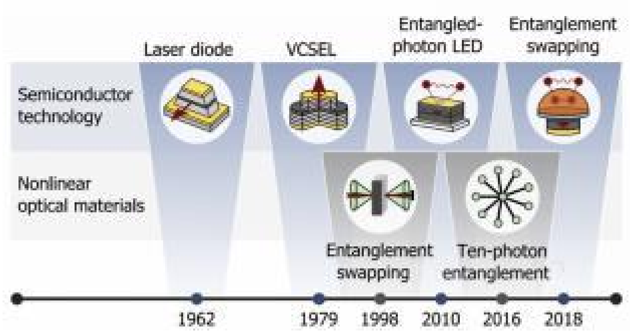
ABSTRACT

Entangled photon sources are important in quantum information sciences. Nowadays, they are mainly based on the probabilistic SPDC processes in non-linear materials. Self-assembled semiconductor quantum dots (QDs) are a promising candidate for the deterministic generation of entangled photons, due to a number of important advantages.

Unfortunately, more than 20 years have passed since the first report on QDs and we do not see yet any realistic applications of QD based quantum light sources. This is due to the fact that the QD sources are far from being ideal and several critical challenges need to be solved. In this talk, I will introduce our recent efforts in developing a QD-based entangled photon source with high performances (*see References*). The high yield, high fidelity, wavelength tunability, together with the demonstrations of electrical injection and on-chip integration, make these sources an ideal workhorse for the quantum photonic applications. As an example, the first experiment on QD-based entanglement swapping will be shown.



KEYWORDS

Semiconductor quantum dots, Entangled photons, Entanglement swapping, Single photons

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Passivation and Interface Engineering of Lead Halide Perovskite for High Performance Solar Cells

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ABSTRACT

To meet rising energy demand, traditional greenhouse gas-based power production must be offset with renewables, such as solar energy. With rapid power conversion efficiency (PCE) improvements from 3.83% to 25.2% in less than a decade, perovskite solar cells (PSCs) have great potential to serve as a low-cost, renewable electricity source to meet increasing energy demands. To realize its commercialization, performance and stability of the PSC devices must be addressed simultaneously. ‘Interface is the device’. The quality of the interface determines all the figure-of-merits of the device. This presentation focuses on the influence of different passivation techniques on the device’s performance and stability. (Fig. 1) Through the methods like lewis base induced remnant PbI_2 [1], anti-solvent screening[2] , amphiphilic additive[3] , sequential deposition of small cation[4][5], in situ growth of passivating phase inside 3D perovskite phase[6], we achieved deep understanding of the perovskite active layer crystallization and established several general methods in making high performance perovskite devices. In the end, through the passivation of the interface and grain boundaries, we realized perovskite solar cell devices with PCE above 21% and improved stability up to 1000 hours.

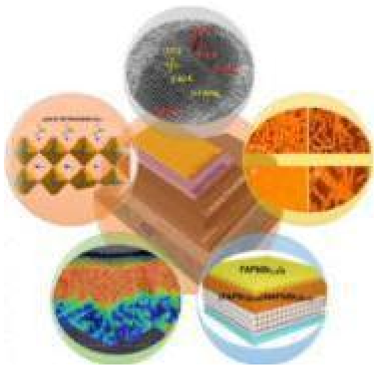

Figure 1. Passivation strategy of perovskite PV devices.

KEYWORDS

2-(4-fluorophenyl)ethylamine, Passivation, Perovskite solar cells, Stability, Dimensionality engineering

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Bacterially Synthesized Tellurium Nanostructures for Broadband Ultrafast Nonlinear Optical Applications

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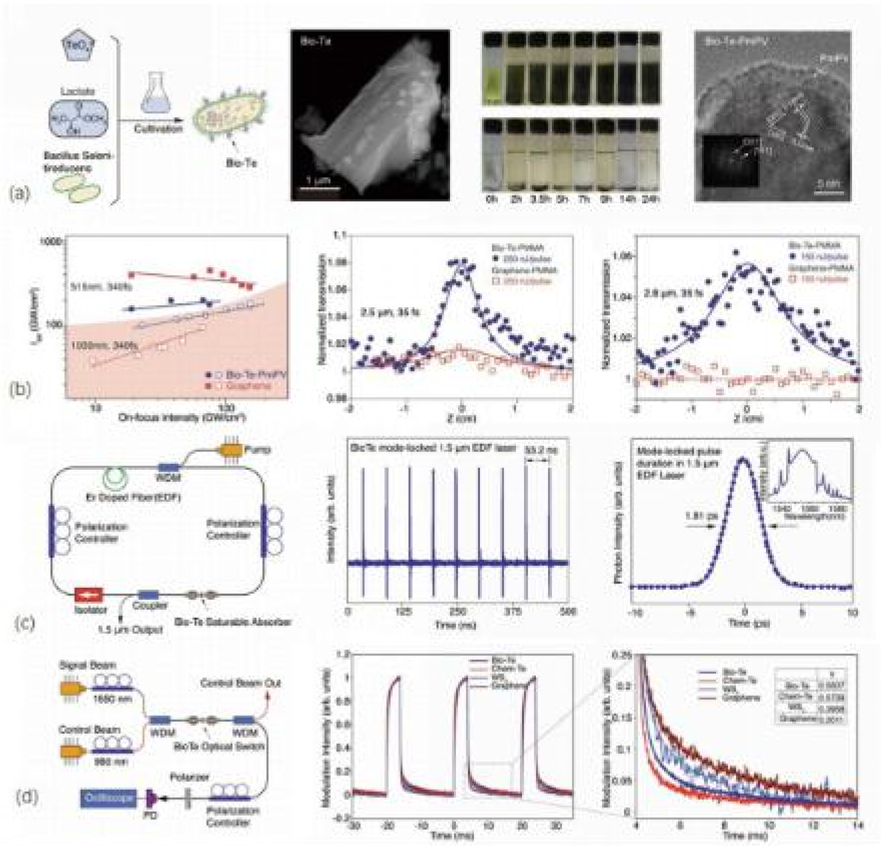
ABSTRACT

Elementary tellurium is currently of great interest as an element with potential promise in nano-technology applications because of the recent discovery regarding its three twodimensional phases and the existence of Weyl nodes around its Femi level. Here, we report on the unique nano-photonic properties of elemental tellurium particles [Te(0)], as harvest from a culture of a tellurium-oxyanion respiring bacteria. The bacterially-formed nano-crystals prove effective in the photonic applications tested compared to the chemically-formed nano-materials, suggesting a unique and environmentally friendly route of synthesis. Nonlinear optical measurements of this material reveal the strong saturable absorption and nonlinear optical extinctions induced by Mie scattering over broad temporal and wavelength ranges. In both cases, Te-nanoparticles exhibit superior optical nonlinearity compared to graphene. We demonstrate that biological tellurium can be used for a variety of photonic applications which include their proof-of-concept for employment as ultrafast mode-lockers and all-optical switches.



KEYWORDS

Tellurium, Nonlinear optics, Optical switching, Optical limiting, Ultrashort fiber laser.

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Abstracts of HEU Special Talks

Underwater Optical Images Stitching Based on CNN for Water Conveyance Tunnel Survey

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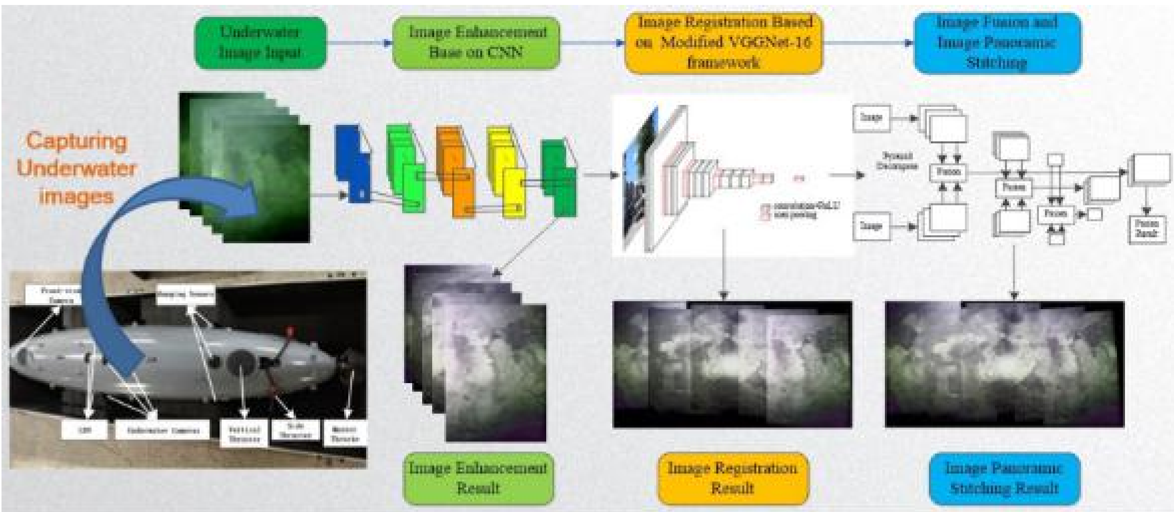
ABSTRACT

Regular underwater optical inspection is of great significance to the safety maintenance of water conveyance tunnel. However, the limited field of view of single underwater image makes it difficult to obtain sufficient underwater information, which also greatly limits the visible range and resolution ratio of the underwater optical vision image captured by AUV in the water conveyance tunnel. Panoramic stitching technology provides an effective solution for expanding visual detection range of the camera. However, absorption and scattering of light in the water seriously deteriorate the underwater imaging in terms of distance and quality. This reduces the number of matching feature points between the underwater images to be stitched, while fewer matched points generated make image registration and stitching failed. To address above issues, a joint framework is proposed, which firstly involves a CNN-like algorithm composed of a symmetric convolution and deconvolution framework for underwater image enhancement. Then, we presents an improved CNN-RANSAC method based on VGGNet-16 framework to generate more correct matching feature points for image registration. The fusion method based on Laplacian pyramid is implemented to eliminate artificial stitching traces and correct the position of stitching seam. Experimental results indicates that the proposed framework can restore the color and detail information of underwater images and generate more effective and sufficient matching feature points for water conveyance tunnel images stitching.



KEYWORDS

Optical image stitching, AUV, Underwater image, Convolutional neural network

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Spectral Image for Astronomical Applications Based on Fiber Components

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ABSTRACT

Fiber was introduced to astronomical observation since 1970s[1]. Recently, fibers are mainly used to transfer light from the telescope to spectrometers to get the spectral signal of the stars. In addition, fibers could be used to monitor the situation of telescopes as sensors, or to connect some telescopes to form a telescope array, or to generate optical comb signal and so on. Fiber based integrated field units (IFUs) were built in our lab for solar telescopes to collect the polarization information of the Sun. Fibers form a pair of 2D arrays to get two orthogonal polarized images of the Sun after an electro-optic modulator. Every fiber array is covered by a microlens array to guarantee 100% light collection. All fibers are bunched into some fiber cables. On the other ends of the fiber cables, all fibers are rearranged in rows to match the input slits of one or some spectrometers. After getting these spectra, we can restructure a series of images of the Sun at different wavelengths. After collecting these polarized images, we can calculate the magnetic field on the surface of the Sun based on Zeeman effect.

Many techniques were developed to build the IFUs. A kind of quartz plates with microholes are designed and manufactured to hold the fibers to match the microlens arrays. All components are made by quartz to reduce the influence of the varying temperature. The fibers in the fiber cables are divided to many tiny bundles to reduce the focal ratio degradation. Some singlemode fibers are embedded inside the fiber cables to monitor the bending or twisting situation of cables. Quartz V-grooves are used to fix the ends of the fibers, and the glue among the gaps is a slow drying adhesive to avoid stress concentration. Some translation stages are used to realize the alignment of the microlens arrays and the fiber ends. In addition, a rapid measurement system of focal ratio and transmission efficiency of fibers is developed to fit the requirement to measuring thousands of fibers.

A 242-fiber IFU was built by us for Yunnan Observatory and got first light in April, 2019. We observed the total solar eclipse in Chile in July, 2019 using this IFU. An updated version of IFU of 8064 fibers are being built in our lab to get high spacial, temporal and spectral resolution in solar observation. This spectral imaging system could be used in ocean protection, pollution monitoring and other area.

The telescope with IFU in Chile for total solar eclipse observation.

KEYWORDS

Fiber components; Astrophotonics; Spectral image; Integrated field units

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A Barrier to Robust Information Transmission Under the Arctic Ice: Impulsive Ambient Noise

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ABSTRACT

With the rapid development of various applications in the Arctic in recent years, more and more ocean observation equipment such as underwater unmanned vehicle (UUV) is being used in the Arctic to gain insight into the temporal and spatial processes below the ice surface. Since most of the Arctic and its adjacent waters are covered by ice all year round, underwater acoustic (UWA) communication is the most effective means of information exchange under the Arctic ice. Different from open-water environment, the sea ice can introduce some new barriers to robust information transmission under the Arctic ice, one of which is the impulsive ambient noise. In addition to the hydrodynamic noise (such as waves, tides, ocean currents, etc.), marine noise (such as dolphins, whales, etc.), man-made noise (such as ships, exploration, etc.), the ambient noise in the Arctic can also be produced by the combination of thermal, wind, and current stresses on the ice canopy such as ice cracking, ice breaking, ice collision, ice melting, and ice drifting. Generally, it is supposed that the ambient noise follows the Gaussian distribution. However, experimental data of the ambient noise under the Arctic ice show obvious impulsive features and no longer follows Gaussian distribution. This presentation will show some research results of the impulsive ambient noise in the Arctic based on the data recorded by autonomous hydrophones at the long-term ice station during the 9th Chinese National Arctic Research Expedition, including time-frequency analysis, power spectral density variations, its relationship with meteorological variables.

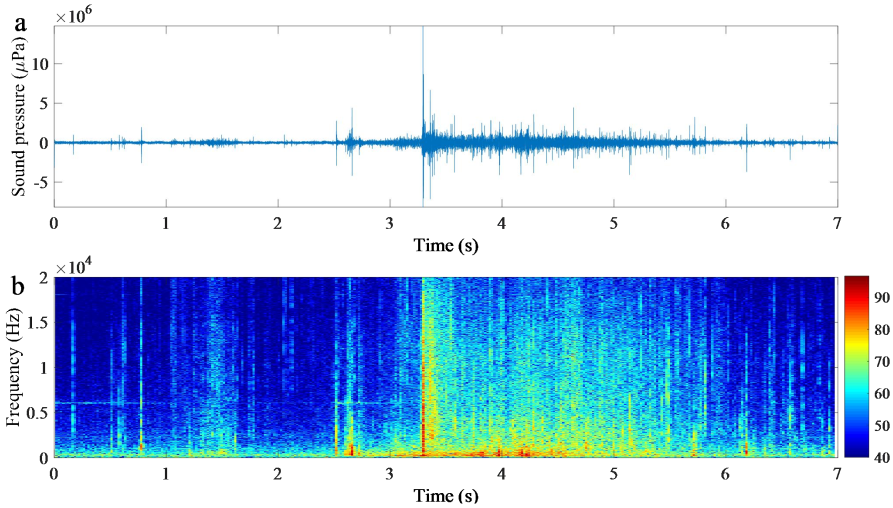

Figure 1. (a) The time domain waveform of the Arctic ice collision noise recorded by autonomous hydrophone at the long-term ice station during the 9th Chinese National Arctic Research Expedition; (b) the corresponding spectrogram of the Arctic ice collision noise shown in (a).

KEYWORDS

Arctic, Impulsive ambient noise, Time-frequency analysis, Power spectral density variations, Meteorological variables

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Application of Laser Diagnostic Techniques in Nuclear Engineering

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ABSTRACT

Laser diagnostics technique (LDT) is a fast-developing advanced measurement technique. It typical includes Laser diagnosis techniques include the Particle Image Velocimetry (PIV), Planar Laser-Induced Fluorescence (PLIF), Pressure-Sensitive-Paint Technique and others, which can be used to measure the velocity, temperature, concentration, pressure fields and other parameter measurement. Compared to the conventional measurement methods, LDA measurements are characterized of non-intrusive, full-field, transient measurement with high measurement accuracy and free from temperature or density effects, such that it be used to achieve high spatiotemporal resolution and high-fidelity measured data. In Nuclear Engineering research, there exist numerous demands for thermal hydraulic parameter measurements in complex geometries, which is difficult to achieve with the conventional measurement techniques.

This presentation introduces the measurement principles, characteristics, and typical applications of laser diagnosis technique in the Nuclear Engineering area, including the flow and temperature fields measurements in fuel bundle, the flow and thermal boundary layers near the rod surface, the boron concentration evaluation in downcomer, the flow induced vibration and others. The results demonstrate the capabilities of the Laser diagnosis technique and its contributions in promoting the safety and economics of the advance nuclear equipment, and the development of the nuclear power.

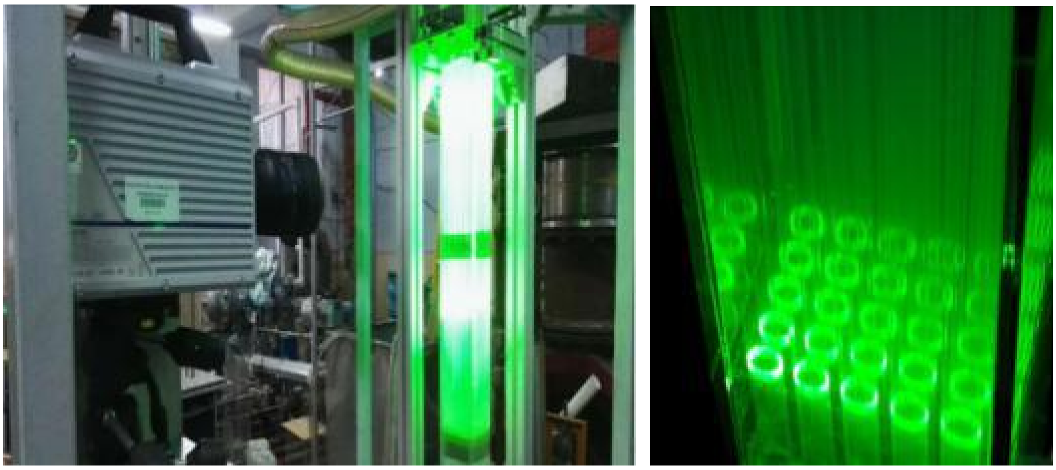

Figure 1. Flow field measurement in nuclear rod bundle channel.

KEYWORDS

Laser diagnosis technology, Nuclear engineering, Complex geometry, Non-intrusive measurement

Optical Attraction and Manipulation of Strongly Absorbing Particles in Liquids

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ABSTRACT

Although optical tweezers function well for majority of the transparent particles, the absorbing particles experience a considerably high absorption force that can destroy the stable optical traps. Photophoretic force is an alternative mechanism that can be used to trap the absorbing particles. The major difficulty that is associated with the utilization of photophoretic forces for trapping strongly absorbing particles in liquids is the presence of considerable absorption on the illuminated side; a positive photophoretic force is usually induced, thereby pushing away the absorbing particles from the high-intensity region of the laser source. Here, we demonstrate a novel principle for the optical trapping and manipulation of strongly absorbing particles by harnessing strong Δα-type photophoretic forces while suppressing their stochastic nature in pure liquid glycerol using a normal divergent Gaussian beam and a Bessel-like beam. Further, our approach expands the optical manipulation of strong absorbing particles to liquid media and provides position control over the trapped particles, including the optical transportation and pinpoint positioning of the 3-μm objects over a distance of a millimeter.

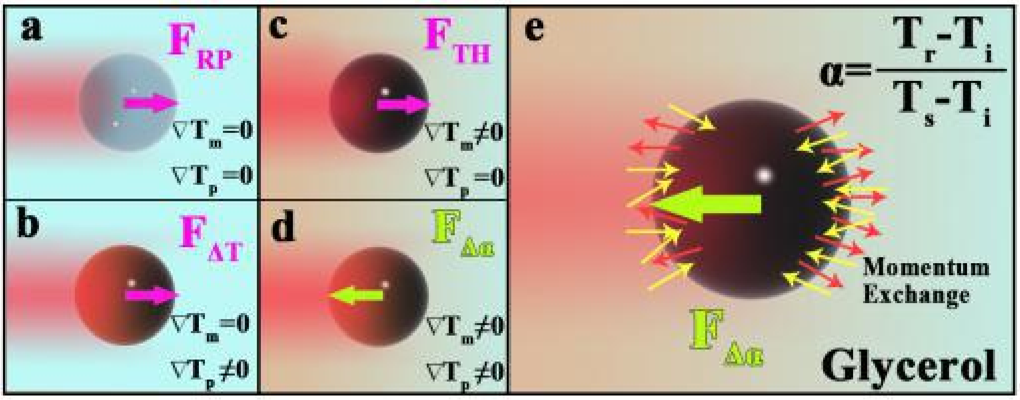

Figure 1. Principle of Δα photophoretic force. (a) Schematic of an optical radiation pressure force that is exerted on a transparent particle; (b) schematic of a ΔT-type photophoretic force that is exerted on an absorbing particle; (c) schematic of a thermophoretic force that is exerted on an absorbing particle; (d) schematic of a Δα-type photophoretic force that is exerted on an absorbing particle; (e) schematic of the momentum exchange between the microparticle surface and glycerol molecules, where T_i denotes the temperature of the liquid molecules that are incident on the particle surface (before momentum exchange), T_s denotes the temperature of the particle surface, and T_r denotes the temperature emitted by the particle after the momentum exchange is completed.

KEYWORDS

Optical tweezers or optical manipulation; Photothermal effects; Thermal effects; Laser trapping; Fiber optics components

Abstracts of Invited Talks

World Class Information Accelerating World Class Research

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ABSTRACT

The objective of this presentation is to demonstrate how citation index can help researchers to quickly find high quality and related information, to identify hot or emerging research topics, and to accelerate the research process.

By indexing the cited references of publications, the citation index automatically formed a network of publications and the network in fact relies on the informed judgement of researchers themselves. The connections represented by citations are not confined to one field and a citation index is inherently cross-disciplinary and breaks through limitations imposed by source coverage. A search can proceed from a known work of interest to more recently published items that cited that work. By looking into the citing papers, we can find if the idea or method in the source paper has been further developed or applied in another field.

Moreover, the citation index also allows researchers to conduct many types of citation analysis. For example, based on highly cited papers that are influential and are likely representative of key concepts in specific specialties, co-citation analysis can generate clusters of the similar themes, which are named as Research Fronts. Co-citation analysis brings publications together by what cites them. When new citing papers published, the similarity between documents determined by co-citation change. Therefore, the most current Research Fronts can reflect the scientists' active and changing perceptions, which can be used for monitoring the development of scientific fields. Research Fronts are also inherently cross-disciplinary, which is a strength since interdisciplinary territory is well recognized as fertile ground for discovery.

Furthermore, citations can reflect the academic impact of a research. Thus, analysis based on citation index can demonstrate the scholarly impact of universities, research institutes, and countries in different disciplines. Integrated with peer assessment, citation analysis provides a complementary view in the research evaluation practice.

A sensible use of citation index tracks ideas across disciplines and helps the researcher to identify knowledge gap. Effective and responsible citation analysis can quickly identify the research trends and the top institutions in a field.

KEYWORDS

Citation index, Information retrieval, Citation analysis, Research Front, Co-citation, Academic impact

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Publish in High-profile Journals: Light: Science & Applications, eLight and LAM

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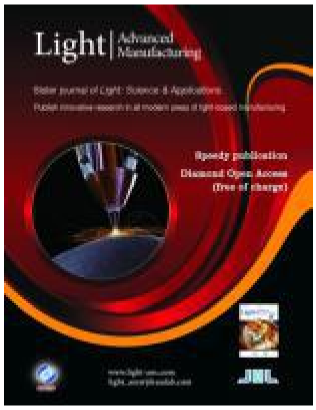
ABSTRACT

After its launch, Light: Science & Applications (hereinafter referred to as LSA) established itself as a leading resource of the optics community within less than 3 years. [2] According to the Journal Citation Report 2019, the latest impact factor of LSA is 14, ranking No.2 among all optics journals in the world. Despite its continuing growth in volume, LSA has already been the Top 3 optics journals for five consecutive years. LSA was well acknowledged by the authority, e.g., Japan's national TV Channel - NHK - reported LSA as the world's leading optics journal and can be competitive for Nobel-Prize-Level works. Based on LSA, we've been devoted to providing the global scientists with support, resources and ultimately, a multifunctional platform. In this talk, we'll first briefly introduce what we have done to steer Light: Science & Applications towards the World's leading optics journal, what kind of papers does LSA want? How to get published in LSA? And why shall you choose to publish in LSA?

Since 2019, the managing team of LSA has been preparing two new initiatives——journal eLight targeting at the finest works in emerging topics with rapid peer review and an option to transparent review; Journal Light: Advanced Manufacturing (LAM) which focuses at optics engineering with diamond open access. In this talk, we'll elaborate on how eLight functions, how it differs from LSA and the confirmed papers from leading groups. Then LAM with its unique platform and diamond open access move will be introduced.

Finally, I'll talk about some science writing skills which I summarized from being the editor of LSA and eLight, which hopefully can help early-career researchers pave the way towards publishing their works.



KEYWORDS

Science writing

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Isomerization on Small Molecule Nonfullerene Acceptors Towards High Efficiency Organic Solar Cells

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ABSTRACT

Due to the unique advantages such as low processing cost, flexibility, and light weight, organic solar cells (OSCs) have attracted extensive attention.[1-2] Generally speaking, bulk heterojunction (BHJ) OSCs employ conjugated small molecules or polymers as electron donors, and take fullerenes derivatives, conjugated small molecules, or polymers as electron acceptors. Comprehensive design idea at a molecular level on the polycyclic aromaticity of a donor-core in state-of-the-art acceptor-donor-acceptor (A-D-A) type nonfullerene acceptor (NFA) materials is still of great importance for regulating the electron push-pull effects for the sake of optimal light-harvesting, frontier molecular orbital levels, and finally their photovoltaic properties, especially based on the three-dimensional stereo-chemical structure of such NFAs, which is essential for exploring structure-photovoltaic properties from the view points of molecular design. Here in, series of constitutional isomers of fused multicyclic nonfullerene acceptors (NFAs) based on a naphthalene core with or without fluorination at the ending groups have been developed. For details as presented in Figure 1, N66-IC, N66-2FIC , N65-IC, N65-2FIC , PTT-IC and PTT-2FIC, with six-member-ring bridge and/or one five-member-ring bridge for the former four, and whereas thieno[3,2-*b*]thiophene was adopted for fusing into naphthalene at 4-,8-positions in bay-area via six-member ring linkage for the latter two were respectively designed and synthesized. Organic solar cells using PBDB-T:PTT-IC or PBDB-T:PTT-2FIC as active layers have achieved decent PCEs up to 6.96% or 10.36%, respectively, While for solar cells based on PBDB-T-2F:N65-2FIC achieved a promising power conversion efficiency of 10.19%, which is three times higher than that of its counterpart PBDB-T-2F:N66-2FIC cell (3.46%). While being blended with PBDB-T as the donor material, the asymmetric acceptor analogue N65-IC based solar cell pronounces a PCE of 9.03%, being significantly improved from that of 5.45% for the PBDB-T:N66-IC based cell, which is in consistency with the results from those cells from their both fluorinated donor and acceptor counterparts. Design rules on either both fluorinated, both non-fluorinated, or cross-combined donor/acceptors for device fabrication has been explored. In addition, PBDB-T-2F:N65-2FIC possesses very promising device stability with 85% of its initial PCE after an exposure time of 1500 h under one sun illumination, which is meaningful for their future commercial devices. Such investigation on isomerization effects explore design strategy for developing novel high efficiency OSCs.

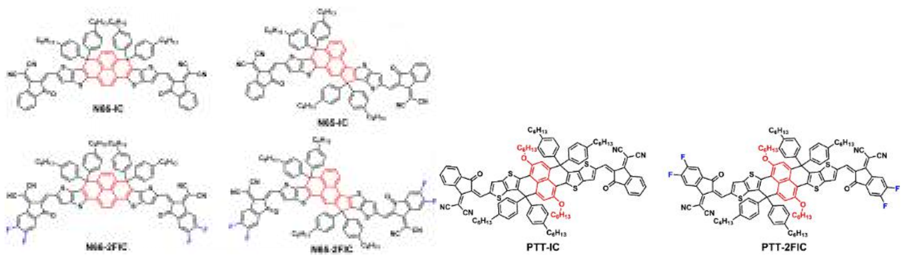

Figure 1. tereoisomers of perylene and naphthalene based organic small molecular acceptors.

KEYWORDS

Isomerization, Naphthalene, Nonfullerene acceptors, Organic solar cells, Efficiency

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Generating Entangled Photons on Monolithic Chips

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ABSTRACT

Generating entangled photons on monolithic chips is a significant progress towards real-life applications of optical quantum information processing such as quantum key distribution and quantum computing. Here we present our recent achievements in generating polarization entangled photons on monolithic III-V semiconductor chips without any on-chip component. We demonstrate the direct generation of broadband polarization entangled photons from a semiconductor chip for the first time with a record degree of entanglement. We also show an alternative approach for polarization entangled photon generation on the same epitaxial structure, which enabled a single chip generating both co-polarized and cross-polarized entangled photons. With recent progress on pump laser integration, our results pave the way for fully integrated entangled photon sources in the foreseeable future.

Active Broadband Manipulation of Terahertz Beam Steering Based on Gyrotropic Pancharatnam-Berry Metasurface

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ABSTRACT

Controlling terahertz (THz) waves, especially the polarization state and deflection angle, is important in THz application systems. But most of conventional THz metasurfaces have limitations in efficiency and working bandwidth. Although Pancharatnam-Berry (P-B) metasurfaces shows excellent manipulation for the circular polarized (CP) waves (or called photonic spin states) without phase dispersion, there is still challenge in active controlling. In my speech, I will introduce our recent work about a magnetically tunable gyrotropic P-B metasurface by combining the gyroelectric semiconductor InSb and the P-B elements, which obtain two important effects: One is the active photonic spin Hall effect, which controls the conversion between two CP states and the deflection in space. A broadband working frequency of 1.02~1.7 THz is obtained with the sweeping deflection angle from 36.6° to 83.5° and the highest efficiency of over 70%. The other is photonic spin filter effect, which reflects one CP state but absorb the other orthogonal CP state, realizing nonreciprocal absorption with the isolation of 24 dB. This active, high efficiency and broadband P-B metasurface opens a new way in manipulation of the THz wave propagation and polarization states in both space and frequency domains.

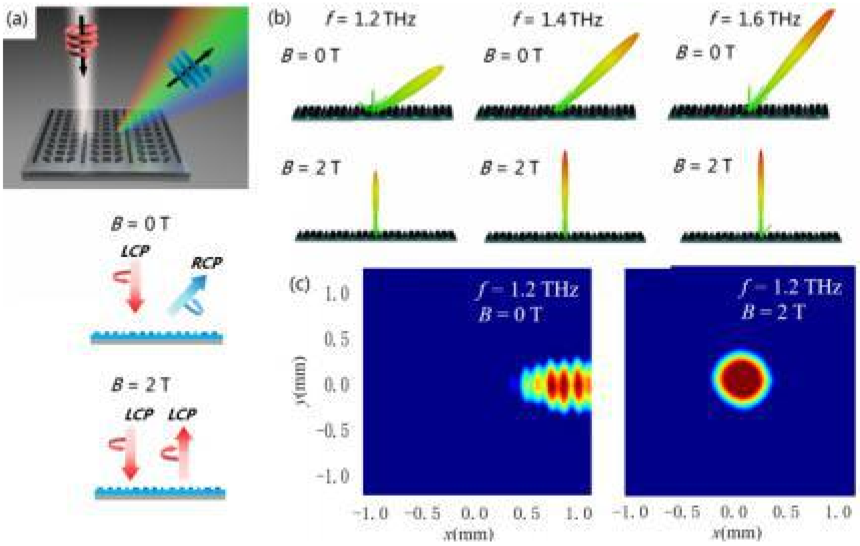

Figure 1. (a) Schematic diagram of structure and working principle of the gyrotropic Pancharatnam-Berry metasurface; (b) Far field distribution of devices at different frequencies with or without external magnetic field; (c) The near field distribution for active photonic spin Hall effect of device.

KEYWORDS

Magneto-optical device, Metasurface, Terahertz wave, Nonreciprocal transmission

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Broadband Achromatic Sub-diffraction Focusing Metalens

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ABSTRACT

Recently, there are growing interests in developing super-resolution meta-lenses for applications of focusing and imaging [1,2]. Although various sub-diffraction metalenses have been demonstrated [3-7] at single wavelength or multiple discrete wavelengths [8,9], very few work has been done in sub-diffraction metalenses with continuous broadband achromatic performance. The previously reported broadband achromatic metalens are diffraction-limited [10-13], and therefore their focal spots are larger than Abbe diffraction limit, 0.5λ/NA, where λ and NA are the lens working wavelength and numerical aperture. In this work, an approach of realizing sub-diffraction focusing with broad achromatic bandwidth has been proposed utilizing both dispersion engineering and wave front manipulating. To verify this concept, a broadband achromatic sub-diffraction focusing metalens was designed with a radius of 5.11 mm, a focal length of 40.39 mm in the terahertz frequency range of 2.4-2.6 THz by simultaneously controlling the distributions group of the delay, frequency-dependent phase and amplitude transmittance. Theoretical and experimental studies have been conducted to investigate its focusing performance, which show an achromatic sub-diffraction focusing within a broad bandwidth of 2.4-2.6 THz. Our method shows a promising way of realizing broadband achromatic super-resolution metalenses, which might have potential applications in super-resolution focusing and super-resolution imaging.

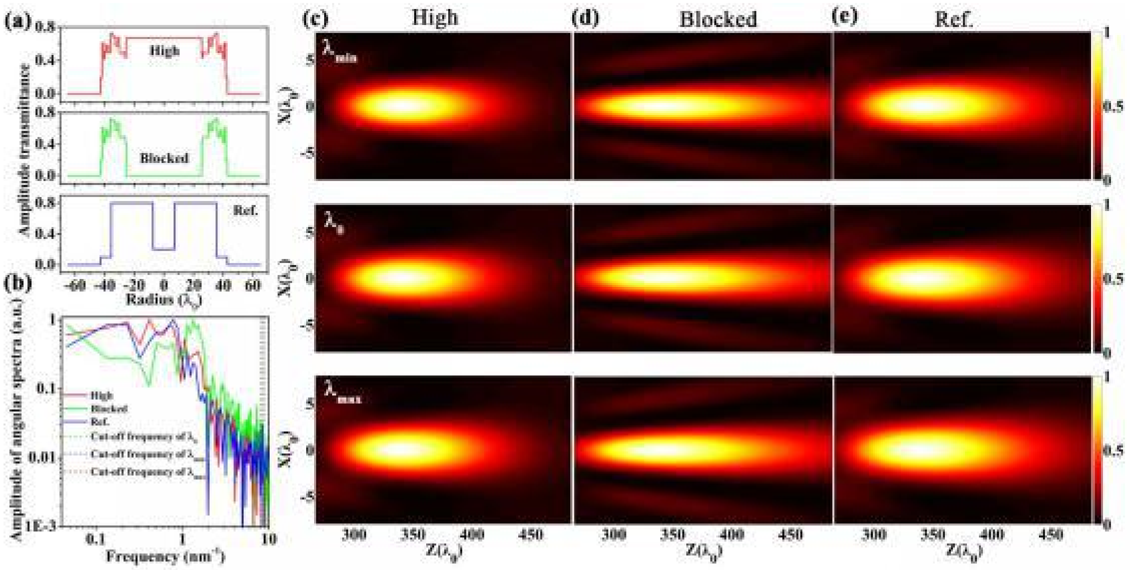

Figure 1. (a) Amplitude transmittance distributions of the broadband achromatic metalens with different amplitude-modulated configurations along the radial direction at the wavelength λ_0 = 118.8 μm. (b) Amplitude of angular spectra for the different amplitude-modulated configurations. The dashed lines denote cut-off frequency of λ_0, λ_{min} and λ_{max}, respectively. (c-e) Two-dimension intensity profiles along the propagation direction at wavelength of λ_{min}, λ_0 and λ_{max} corresponding to amplitude transmittance distribution as marked with high, blocked and Ref.

KEYWORDS

Sub-diffraction; Super-resolution; Achromatic Metalens

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Highly Efficient and Thermally Stable Phosphors Based on Local Lattice Optimization and Defect Control

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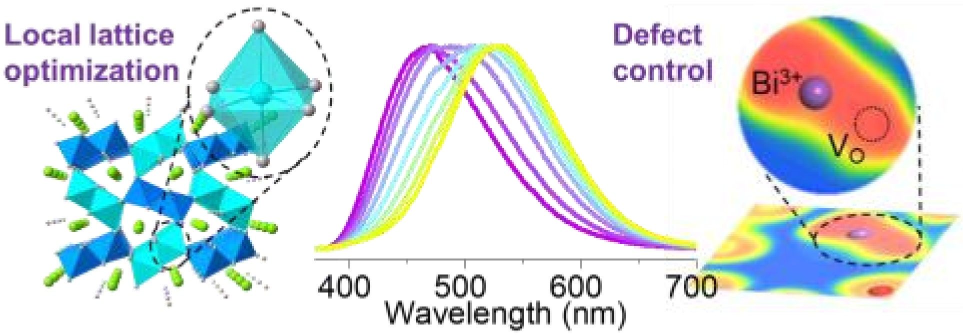
ABSTRACT

With the rapid development of white light emitting-diodes (*w*-LEDs), the high luminous efficiency and superior thermal stability are the key challenges for the development of phosphors[1]. Many strategies have been reported to improve the luminescence performances, among them, local lattice optimization and defect control are the most efficient methods. Herein, two strategies are proposed to improve the luminous efficiency and thermal stability. The first strategy is the local lattice optimization induced lattice symmetry and local lattice rigidity optimization. High efficiency (90%) and superior thermal stability (92%@498 K) are successfully achieved when designing rare-earth ions Eu^{2+} in highly symmetric $BaAl_{12}O_{19}$ lattice sites[2]. Meanwhile, narrow-band (fwhm < 25 nm) blue emission are obtained[3], which enable the as-prepared phosphors are the potential candidates in *w*-LEDs as well as backlit display area. Based on the local lattice modification, the selective narrow-band blue/green emission is successfully achieved in Eu^{2+}-activated UCr_4C_4 structure. Secondly, a novel orangish-red La_4GeO_8:Bi^{3+} phosphors are successfully prepared based on the local defect generation[3], whose emission wavelength locates at 600 nm. The internal quantum efficiency (IQE) exceeds 88%. According to Rietveld refinement analysis and density functional theory (DFT) calculations, the oxygen-vacancy-induced electronic localization around the Bi^{3+} ions is the main reason for the highly efficient orangish-red luminescence. These results provide a new perspective and insight from the local lattice optimization and electron structure for designing rare earth ions and Bi^{3+} activated phosphor materials that realize high luminous efficiency and superior thermal stability.



KEYWORDS

Local lattice optimization, Defect control, Luminescence improvement, Phosphor, *w*-LEDs

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Structural Perturbations for Nano-steganography

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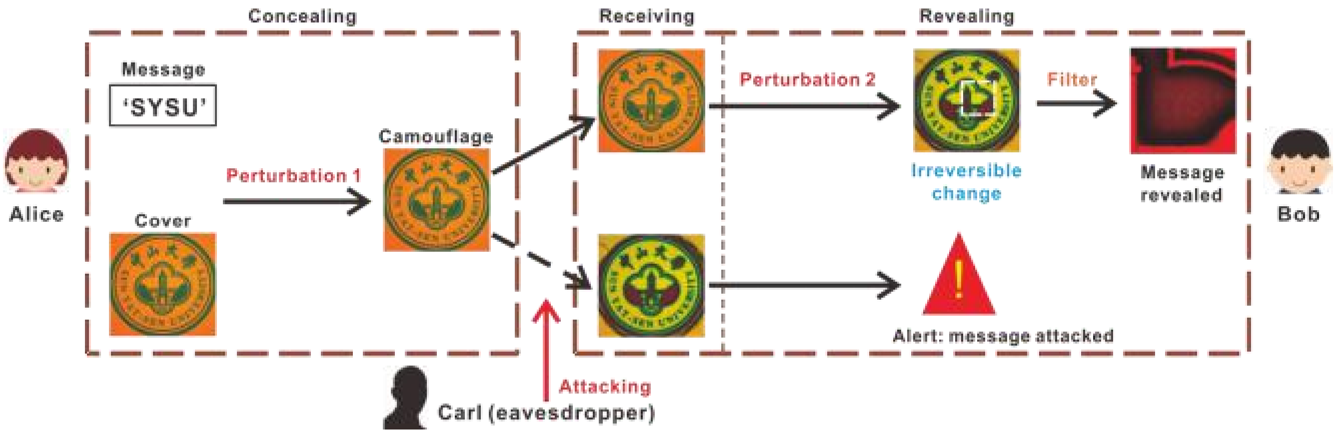
ABSTRACT

A well-recognized practice in the field of nanophotonics is achieving progress by designing new functional geometries or synthesizing new material components[1,2]. In the applications of nanophotonics, precise control of shapes and sizes of the photonic nanostructures is always a normal requirement to obtain stable performance with desired functionalities. As a consequence, perturbations are normally perceived not as contributory factors but as disturbances that need to be suppressed. However, this perception hinders the utility of perturbations as powerful tools in the design of metaoptics[3]. Here, we show that with appropriate design, perturbation can work as an additional dimension in metaoptics to realize new functionalities while maintaining the original performance of the designed nanostructures[4]. As an example, we use perturbations to implement steganography in plasmonic color nanostructures[5], hiding secret information under the cover camouflage of color prints. Furthermore, by taking advantage of the properties of the material components, we develop a nano-steganography strategy with the functions of near-perfect information hiding and perturbation-induced countersurveillance, where the product can self-indicate whether the hidden information has been attacked during delivery. Our results not only demonstrate perturbation as an applicable design dimension in the construction of metaoptical systems, but also establish a perturbative strategy of nano-steganography for securing a safer world of information.



KEYWORDS

Perturbation, Nano-steganography, Structural color, Information hiding, Spectral offset

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Latest Advances in Self-assembled Nanomembrane-based Optical Microcavities

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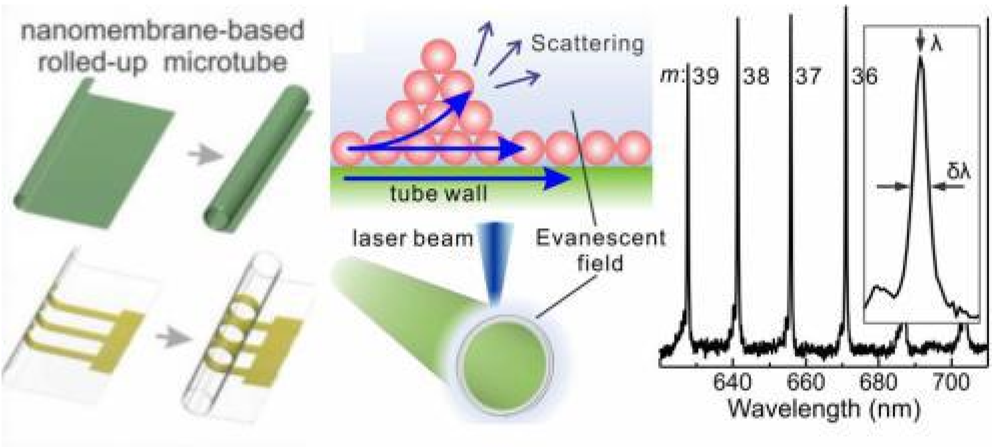
ABSTRACT

Whispering-gallery-mode (WGM) optical microcavities have been continuously attracting research attention due to their key merits of long photon lifetime and small mode volume over the past two decades. For conventional on-chip integrated WGM microcavities, the light field is strongly confined in a 2D plane due to the inherent limitation of top-down fabrication methods. Microtubular microcavities made by patterning and self-assembling pre-strained nanomembranes naturally support 3D WGM resonances [1]. In this talk, I will present the latest progress on both fundamental investigations and practical applications of nanomembrane-based microtubular cavities. The tailored 3D cavity shape and spiral rolling shape with a broken rotational symmetry leads to the free modification of multiple split eigenstates in a 3D space and the deterministic resonant light emission directionalities [2]. In addition, the sub-wavelength-thick cavity wall facilitates constructing novel "photonic molecule" systems with controllable inter-cavity coupling strength and coupling regimes [3]. At last, I will introduce the latest sensing application based on nanomembrane-based optical microcavities. By virtue of the strong evanescent field, the tubular microcavities have been proved as ultra-sensitive detectors for in-situ monitoring the dynamics of molecular adsorption/desorption at the tube surface [4].



KEYWORDS

Nanomembrane, Whispering-gallery mode, Optical resonances, Optical sensing, Coupling

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Polarized light meets metamaterial: coherent control and asymmetric transmission

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ABSTRACT

Over the past decades, many attempts have been devoted to manipulating polarization, phase, amplitude and propagation direction of electromagnetic wave using metamaterials. We present that in slabs of linear material of sub-wavelength thickness optical manifestations of birefringence, optical activity, anomalous refraction and polarization-dependent absorption can be controlled in the coherent technique [1-3]. Such control can be exerted at arbitrarily low intensities, thus arguably allowing for fast handling of electromagnetic signals without facing thermal management and energy challenges. Next, we discuss asymmetric transmission of linearly polarized metamaterials [4-6]. We numerically, theoretically and experimentally study high-performance dichroic asymmetric transmission of linearly polarized waves in terahertz chiral metamaterial. The proposed chiral metamaterial consists of twisted S-shaped patterns with symmetry broken along light propagation direction in Fig. 1. It is worth mentioning that the so-called dichroic AT effects are robust within a wide angle of incidence up to 60° and suitable for manipulating different linearly polarized waves. In comparison with previously reported metamaterials, S-shaped chiral metamaterial offers an opportunity to realize high-efficiency dichroic nanophotonic devices with a wide range of potential applications in optical polarization manipulation, chiral biosensing and polarization information processing.

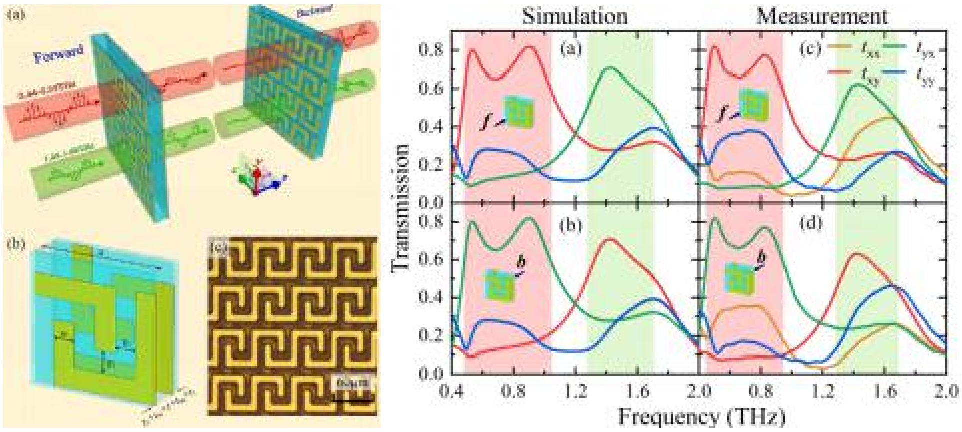

Figure 1. Dual-band dichroic asymmetric transmission in terahertz metamaterial

KEYWORDS

Metamaterials, Coherent perfect absorption, Asymmetric transmission

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Nonlinear Plasmon-exciton Coupling Enhances Sum-frequency Generation from a Hybrid Metal/semiconductor Nanostructure

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ABSTRACT

Nonlinear plasmonics holds great promise to create subwavelength coherent light and electron sources. The integration of metallic plasmonic nanoantennas with quantum emitters can dramatically enhance coherent harmonic generation, often resulting from the coupling of fundamental plasmonic fields to higher-energy, electronic or excitonic transitions of quantum emitters. The ultrafast optical dynamics of such hybrid plasmon–emitter systems have rarely been explored.

Here, we study those dynamics by interferometrically probing nonlinear optical emission from individual porous gold nanosponges infiltrated with zinc oxide (ZnO) emitters (Fig. 1a-b). Local scattering spectra recorded by scanning near-field optical microscopy reveal high-quality (Q>40) hot spot modes localized on a 10-nm scale [1]. Interferometric frequency-resolved autocorrelation measurements of Au/ZnO hybrid nanosponges show that, the locally enhanced plasmonic near-field couples to the ZnO excitons, enhancing sum-frequency generation from individual hot spots and boosting resonant excitonic emission (Fig. 1b). More importantly, the quantum pathways of the coupling are uncovered from a two-dimensional spectrum correlating fundamental plasmonic excitations to nonlinearly driven excitonic emissions (Fig. 1c). The sum-frequency quantum pathway also explains the quantum beats observed in the time dynamics of the excitonic emission peak (Fig. 1d). To conclude, the revealed coherence dynamics and quantum pathways of the nonlinearly coupled plasmon-exciton system improve our understanding of the mechanism of enhanced coherent nonlinear emission from the hybrid nanostructure.

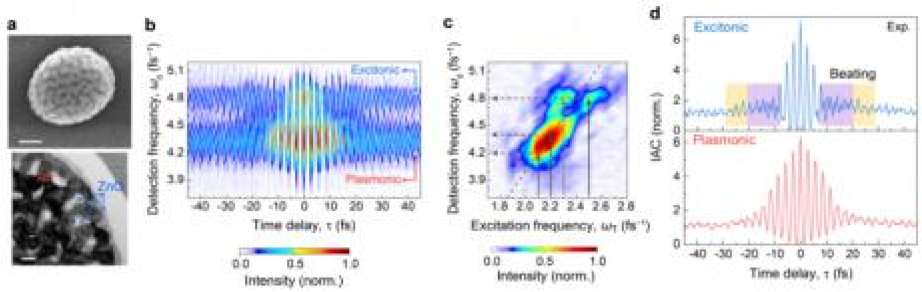

Figure 1. (a) SEM and TEM images of a Au/ZnO hybrid nanosponge (scale bar 100 nm and 20 nm, respectively). (b) Interferometric frequency-resolved autocorrelation (IFRAC) trace of a single hybrid Au/ZnO nanosponge. Distinct Au plasmonic and ZnO excitonic emissions are observed. (c) Fourier transformed spectrum of the IFRAC trace in b, correlating fundamental excitation (vertical arrows) to nonlinear emission signals (horizontal arrows). (d) Interferometric autocorrelation (IAC) traces integrated over the range of the plasmonic (bottom) and excitonic (top) emission frequency range from the IFRAC trace in b. The beating pattern results from the coherent superposition of the two fields at ω_1 and ω_2 for sum-frequency generation.

KEYWORDS

Plasmonics, Nonlinear optics, Ultrafast coherent dynamics

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Passive Dynamic Optical Modulators: Material Exploration & Applications

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ABSTRACT

Optical modulators refer to the devices that can modulate the properties of the light beam flexibly. Different from the static optical modulators, dynamic optical modulators can dynamically change the output according to meet different requirements. Devices based on the dynamic optical modulators are fundamental for most optical applications. Conventional types of dynamic optical modulators are mostly based on active control mechanisms. As a consequence, to process a large amount of data consumes much energy. Passive dynamic optical modulators offer solutions for this problem. They are self-adaptive, energy saving, and fast responsive. In this talk, two categories of passive dynamic optical modulators are studied. The first category is based on the amplitude control of light. The second category is based on the phase control of light. Based on these passive modulation mechanisms, three devices are also fabricated. These examples demonstrate that passive dynamic optical modulators are promising for energy-saving, fast responsive and high-performance optical devices.

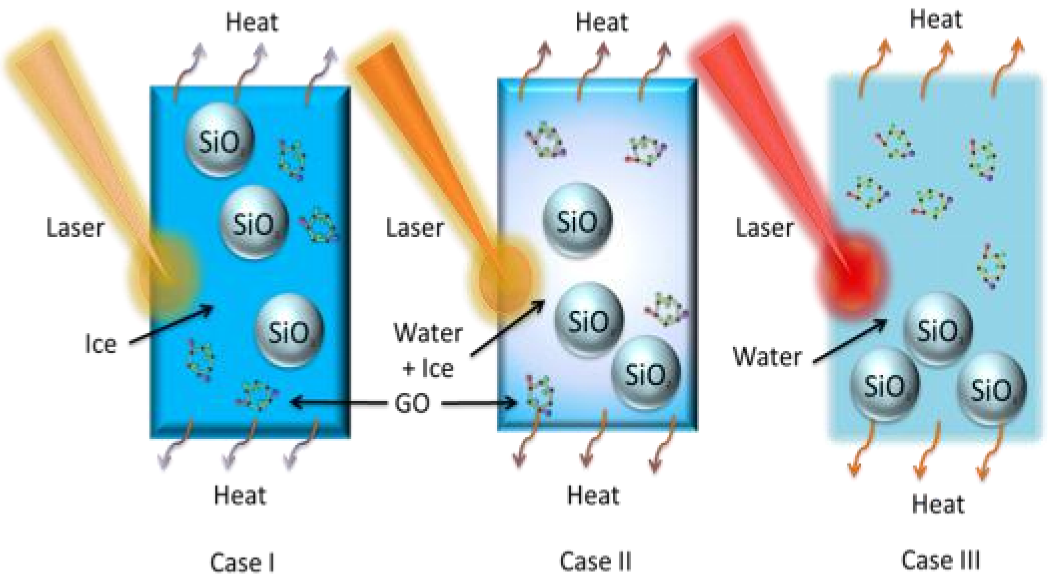

Figure 1. Schematic diagram of the phase change materials as a passive dynamic optical modulator.

KEYWORDS

Phase change materials, Passive modulation, Optical materials

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An Electrically Modulated Single-Color/Dual-Color Imaging Photodetector

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ABSTRACT

In this work, an electrically modulated single-/dual-color imaging photodetector with fast response speed is developed based on a small molecule (CO*i*8DFIC)/perovskite ($CH_3NH_3PbBr_3$) hybrid film in consideration of its high charge mobility, suitable energy level matching between them with a small valence offset, and nonoverlapping absorption[1,2]. Owing to the type-I heterojunction, the device can facilely transform dual-color images to single-color images by applying a small bias voltage. The photodetector exhibits two distinct cut-off wavelengths at ≈544 nm (visible region) and≈920 nm (near-infrared region), respectively, without any power supply. Its two peak responsivities are 0.16 A/W at ≈525 nm and 0.041 A/W at ≈860 nm with a fast response speed (≈10^2 ns). Under 0.6 V bias, the photodetector can operate in a single-color mode with a peak responsivity of 0.09 A/W at ≈475 nm, showing a fast response speed (≈10^2 ns). A physical model based on band energy theory is developed to illustrate the origin of the tunable single-/dual-color photodetection. This work will stimulate new approaches for developing solution processed multifunctional photodetectors for imaging photodetection in a complex circumstance.

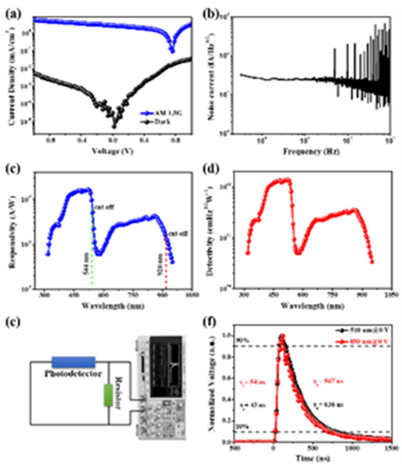

Figure 1. (a) *J-V* curves for the photodetector in dark and under a solar simulator (AM 1.5G, 100 mW cm^{-2}). (b) The frequency dependence of the noise current for the photodetector. (c) The responsivity spectrum for the photodetector at 0 V. (d) The specific detectivity (D^*) spectrum for the photodetector. (e) Schematic illustration for the home-made transient photoresponse measurement system. (f) The transient photoresponse for the photodetector at 0 V under the excitation of 510 nm and 850 nm pulsed laser.

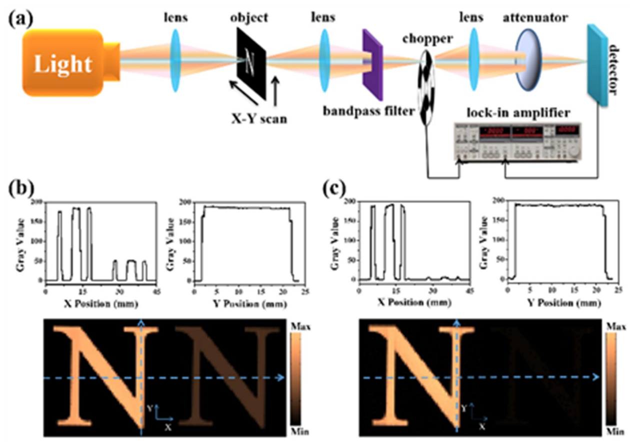

Figure 2. (a) Schematic diagram for the imaging system employing the photodetector as imaging pixel. (b) Dual-color (visible: left; NIR: right) imaging result obtained from the imaging system at 0 V. (c) The imaging result obtained from the imaging system at 0.6 V.

KEYWORDS

Dual-color imaging, Organic/perovskite Photodetector, Response speed

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Integrated Acousto-optics on Thin-film Lithium Niobate

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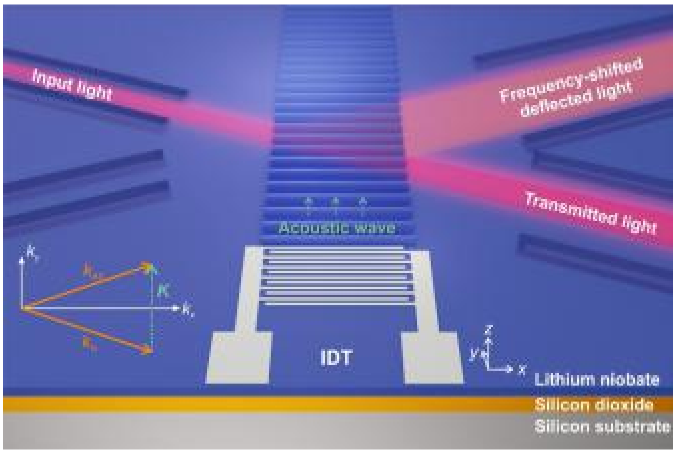
ABSTRACT

Scattering optical light by acoustic waves, or namely Brillouin scattering, has enabled various optical devices from modulators, frequency shifters, frequency comb generators, ultra-narrow-linewidth lasers, and nonreciprocal isolators. The strong piezoelectricity and photoelasticity of thin-film lithium niobate with its low propagation loss for optical light and acoustic waves provide a promising platform for integrated acousto-optics. In this talk, we explore acousto-optic devices that we recently developed on thin-film lithium niobate. First example is an integrated microwave-to-optical converter, where the high-quality-factor acoustic resonator efficiently mediates the conversion between the microwave signals and the optical modes. The second device is an integrated acousto-optic frequency shifter. The traveling acoustic wave on lithium niobate thin film shifts the optical frequency by a few gigahertz, which is much higher than the current acousto-optic frequency shifter based on bulk materials.



KEYWORDS

Lithium Niobate, Acousto-optics, Piezo-electricity, Microwave-to-optical conversion, Optical frequency shifter.

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Carrier-modulated strategies towards g-C_3N_4 for photocatalytic HER and CO_2RR

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ABSTRACT

Graphic carbon nitride (g-C_3N_4) is visible-light responsive organic semiconductor, which possesses favorable mechanic properties and stability, hence well studied as the photocatalyst materials. Its high conduction band (CB) determines sufficient reduction ability of photoelectrons capable of inducing the hydrogen evolution (HER) and CO_2 reduction reactions (CO_2RR). However, the photoactivity of g-C_3N_4 is still significantly limited by the poor charge separation and fast photocarrier recombination. Accordingly, feasible strategies of modulating carrier from the view of thermodynamics have been proposed to prolong the lifetime of the high-energy-level photoelectrons (HELEs). In specific, two types of designing schemes have been developed as shown in the Figure. Firstly, traditional wide bandgap semiconductors like TiO_2, SnO_2 and ZnO, ect or organic ones like phthalocyanines would be introduced to couple with g-C_3N_4. As mode I, photoelectrons could transfer from the CB of CN to those of coupled semiconductors to prolong the lifetime with the thermodynamic energy maintained. The second scheme is to couple with the narrow-band with suitable band structure to construct the Z-scheme photocatalysts. As mode II, both the narrow bandgap semiconductor and g-C_3N_4 are excited, then the photoelectrons would recombine the holes of g-C_3N_4 to indirectly prolong the lifetime of the HELEs of g-C_3N_4. More importantly, single-atom sites would be designed and engineered to capture the photoelectrons meanwhile to facilitate targeting catalytic processes.

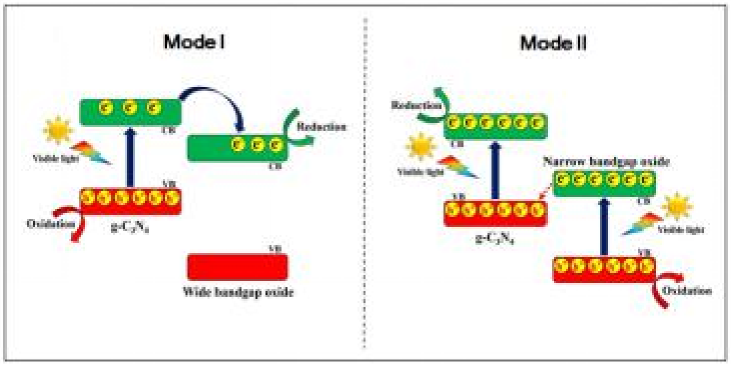

Figure 1. Two modes of carrier-modulated strategies towards g-C_3N_4.

KEYWORDS

g-C_3N_4, Carrier-modulation, HELEs, Charge separation, Single-atom

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Enzyme-Triggered Defined Protein Nanoarrays: Efficient Light-Harvesting Systems to Mimic Chloroplasts

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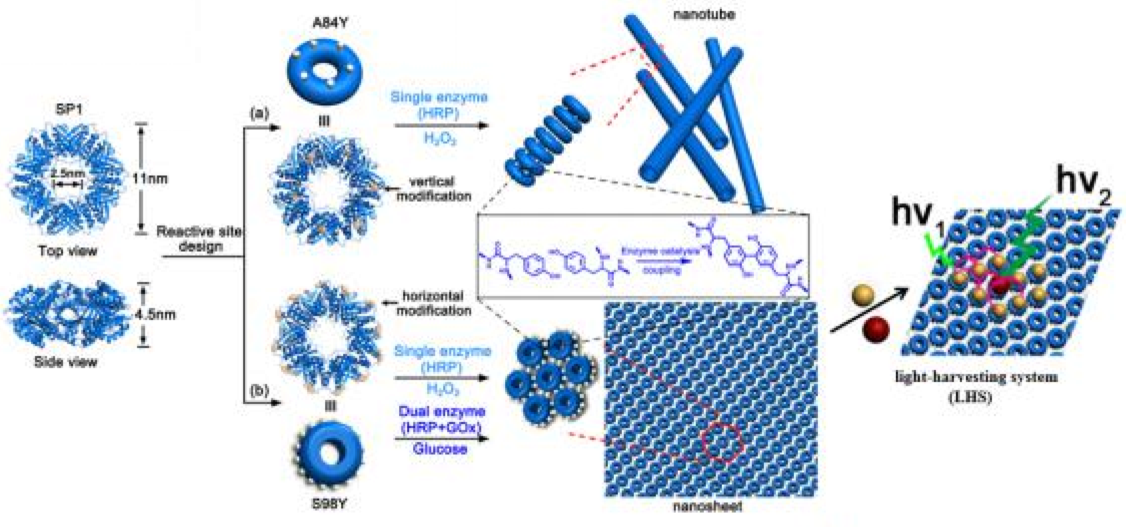
ABSTRACT

The elegance and efficiency by which chloroplasts harvest solar energy and conduct energy transfer have been a source of inspiration for chemists to mimic such process. However, precise manipulation to obtain orderly arranged antenna chromophores in constructing artificial chloroplast mimics was a great challenge, especially from the structural similarity and bioaffinity standpoints. Here we reported a design strategy that combined covalent and noncovalent interactions to prepare a protein-based light-harvesting system to mimic chloroplasts. Cricoid stable protein one (SP1) was utilized as a building block model. Under enzyme-triggered covalent protein assembly, mutant SP1 with tyrosine (Tyr) residues at the designated sites can couple together to form nanostructures. Through controlling the Tyr sites on the protein surface, we can manipulate the assembly orientation to respectively generate 1D nanotubes and 2D nanosheets. The excellent stability endowed the self-assembled protein architectures with promising applications. We further integrated quantum dots (QDs) possessing optical and electronic properties with the 2D nanosheets to fabricate chloroplast mimics. By attaching different sized QDs as donor and acceptor chromophores to the negatively charged surface of SP1-based protein nanosheets *via* electrostatic interactions, we successfully developed an artificial light-harvesting system. The assembled protein nanosheets structurally resembled the natural thylakoids, and the QDs can achieve pronounced FRET phenomenon just like the chlorophylls. Therefore, the coassembled system was meaningful to explore the photosynthetic process *in vitro*, as it was designed to mimic the natural chloroplast.



KEYWORDS

Protein nanostructures, Protein assembly, Light-harvesting,Quantum dot, Chloroplast mimic

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Electrode Material Design for Na/K-ion Battery: Order vs. Disorder

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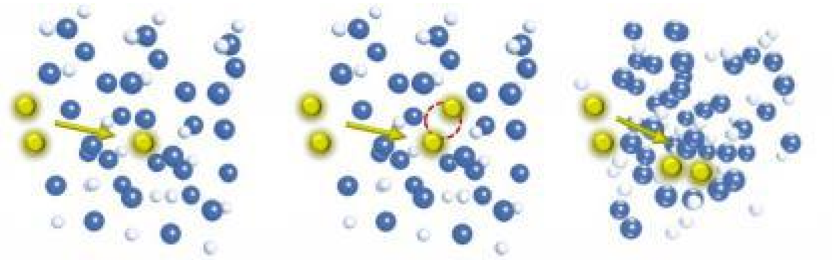
ABSTRACT

To face the growing energy and environment, rechargeable ion batteries stand out as a highly promising way. Lithium-ion batteries (LIBs) have been commercialized, but suffered from limited distribution of global lithium resources. There exists an immediate need for rechargeable ion batteries that are beyond Li. Recent research shows several alternatives including Na/K-ion batteries. The large sizes of Na/K-ion cause a low ionic diffusivity. It is necessary to look for more active electrodes and improve their electrochemical performance. We aim at tackle the challenges of the accommodation and diffusivity of large-size Na/K-ion by disorder engineering of electrode materials. We introduce synergistic adjustment of local short-range disorderliness and long-range disorderliness as a powerful and universal strategy. The accomplishment shall lead to significant progress in fundamental research and device applications of Na/K-ion battery and further large-scale energy storage.



KEYWORDS

Rechargeable ion batteries; Electrode; Disorderliness; Ionic diffusion

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Luminescence Modulation of Rare Earth Phosphors for Theranostics

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ABSTRACT

We focus on the bioimaging and early-diagnosis applications of luminescent materials, especially I have done lots of efforts on the rare earth luminescence probes. In order to "improve the sensitivity and accuracy of molecular imaging probes for detecting microscopic tumors", the following four aspects are carried out: (1) Heuristic algorithms are used to guide the optimization and synthesis of luminescent materials with higher intensity. Rare earth luminescent probes can respond to near-infrared excitation light by doping with different elements, ensuring the near infrared excitation has the largest penetration depth and negligible self-interference of the light source. (2) The luminescence properties of rare earth probes were adjusted by the introduction of gold nanocrystals. The lanthanide-gold composite probes with different shapes and sizes were simulated by discrete dipole approximation method, and verified by actual test results. The feedback from such an algorithm can guide the fabrication of the optimal composite nanocrystal structure required. (3) The multi-functional probes with photoactive synergistic anti-cancer therapy composites were designed with multi-modal imaging methods (photoacoustic, upconversion luminescence, down-conversion NIR II imaging, etc.). (4) The multi-modal molecular imaging platform was used for in vivo real-time luminescence-guided surgery navigation with high precision and sensitivity.

KEYWORDS

Luminescence modulation; Heuristic algorithm; Upconversion luminescence; NIR II luminescence

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Separation of SERS Excitation/Emission Processes by Angle-Dependent Spectroscopy

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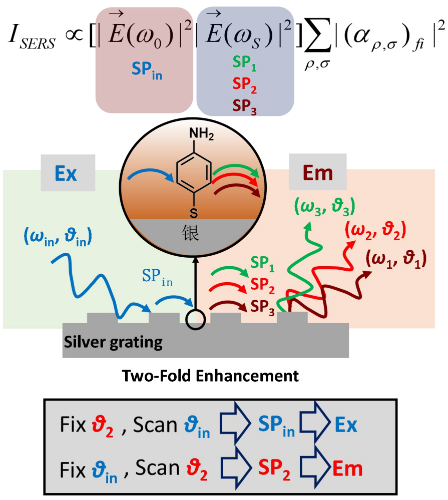
ABSTRACT

In the surface-enhanced Raman scattering (SERS) mechanism and SERS substrate designs, the excitation and emission coupling processes are two main aspects for optimizing the physical enhancement process to obtain the stronger SERS signals, which was also named as "two-fold enhancement" model.[1] In most SERS measurements, these two processes are mixed together and can't be considered individually. To distinguish them, we proposed the angle-scanned Raman spectroscopic setup, which works for separating these two coupling processes.[2] By integrating many optical elements and devices, e.g. long-range surface-plasmon resonance configuration,[3] optical waveguide,[4, 5] and plasmonic nanoantenna,[6] etc, we achieved the optimization of excitation/emission processes. As a result, the SERS signal can be significantly improved, which is of significance for the SERS mechanism and SERS substrate designs.

This work is supported by the National Natural Science Foundation of China (NSFC No. 21873039, 21573092, 21573087, 21373096, 91027010, 21073073, 20973075, 20773045, and 20627002) and National Instrumentation Program (NIP) of the Ministry of Science and Technology of China No. 2011YQ03012408.



KEYWORDS

Surface plasmon, Surface-enhanced Raman scattering

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Study of Strong Light-matter Coupling Dynamics in Plasmonic Systems: a Full Quantum Approach

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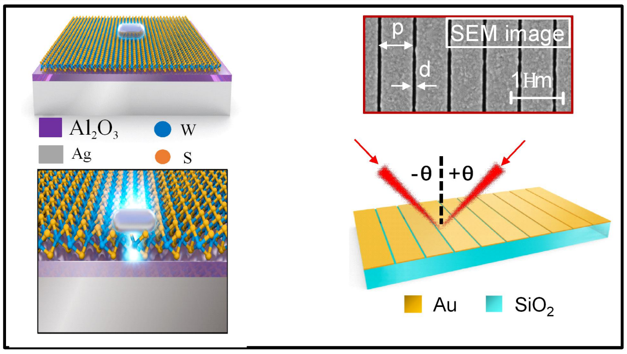
ABSTRACT

Strong light-matter interaction in plasmonic systems has attracted much interest due to its great importance in both fundamental quantum science research and potential applications in quantum information devices. Based on Heisenberg-Langevin formalism, a full quantum approach is developed to describe the strong interactions between different optical excitations in plasmonic systems. Here we demonstrate its applications in two strongly coupled systems: (i) We investigate the strong coupling between a plasmon-induced magnetic resonance supported by a single nanorod and excitons in a two-dimensional atomic crystal. We demonstrate a record of Rabi splitting over 220 meV at ambient condition with the involvement of only a few excitons. The coherent and incoherent coupling dynamics of the hybrid modes is quantitatively analyzed, and (ii) we also give a microscopic insight into both optical properties and coupling dynamics for plasmon-plasmon interaction in a 1D plasmonic crystal. We analytically derived the generalized Rabi frequency between two coupled plasmonic modes and revealed the quantum origin of the Rabi phase. We further demonstrated that the interplay between Rabi phase and coupling-induced incoherent damping process modulates the ultrafast dynamics of the polariton modes, leading to distinctly different spectral responses.



KEYWORDS

Light-matter interaction; Strong coupling; 2D materials; Quantum plasmonics

Material Independent Multi-Physical Transparent Device Based on The Theory of Composites

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ABSTRACT

One side, electromagnetic transparent devices have been studied extensively. On the other hand, thermal-electric transparent devices have been explored by multifarious theoretical methods, and the effective functions, which can make an object transparent both in thermal and DC current fields, have been demonstrated by the methods of simulation and experiment. But the conventional transparent devices only valid for one or two physical fields, and with the restrictions of circumscribed materials and complex methods. In this letter, a new type of effective medium method based on the theory of composite [1] will be exhibited and demonstrated, and a kind of multi-physical fields transparent device based on neutral inclusion theory will be constructed and verified through simulation and experiment, which could render an object in steady state or quasi-static state physical fields of thermal field, electric field, electromagnetic field, acoustic field [2,3] and elastic waves [4] simultaneously. The device has three features: it could work for five physical fields simultaneously; the effective functions of the device independent on materials which could employ most materials in nature; the method is exceedingly simple which only refer to the volume fraction of different phase materials.

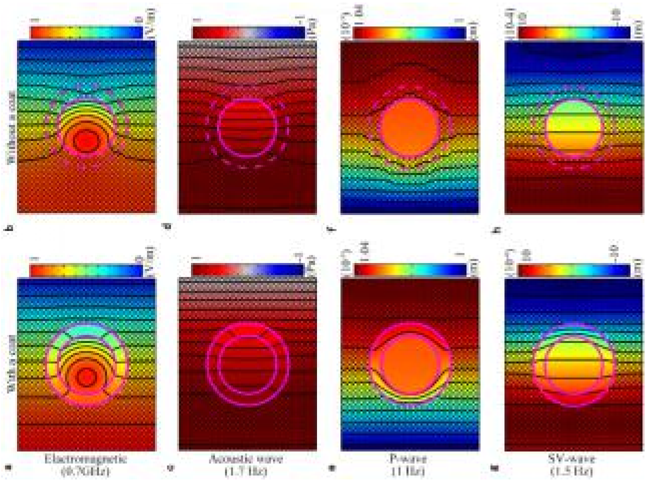

Figure 1. The multi-physical transparent device works in quasi-static state physical fields. The first and the second columns are the results of the object covered with a transparent coat and without a coat respectively. **a** and **b** are the distributions of the electric intensities(E) of electromagnetic field under 0.7 GHz. **c** and **d** are the distributions of the acoustic pressure (P).

KEYWORDS

Multi-physical fields; Transparent device; Neutral inclusion; Effective medium method

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Integrated Microwave Photonics for Measurements and Communications

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ABSTRACT

By using integrated microwave photonics, approaches and systems for diverse microwave measurements and broadband wireless communications are implemented, including microwave frequency measurement, and electromagnetic interference detection along high-speed railways, and radio-over-fiber system for high-mobility scenarios.

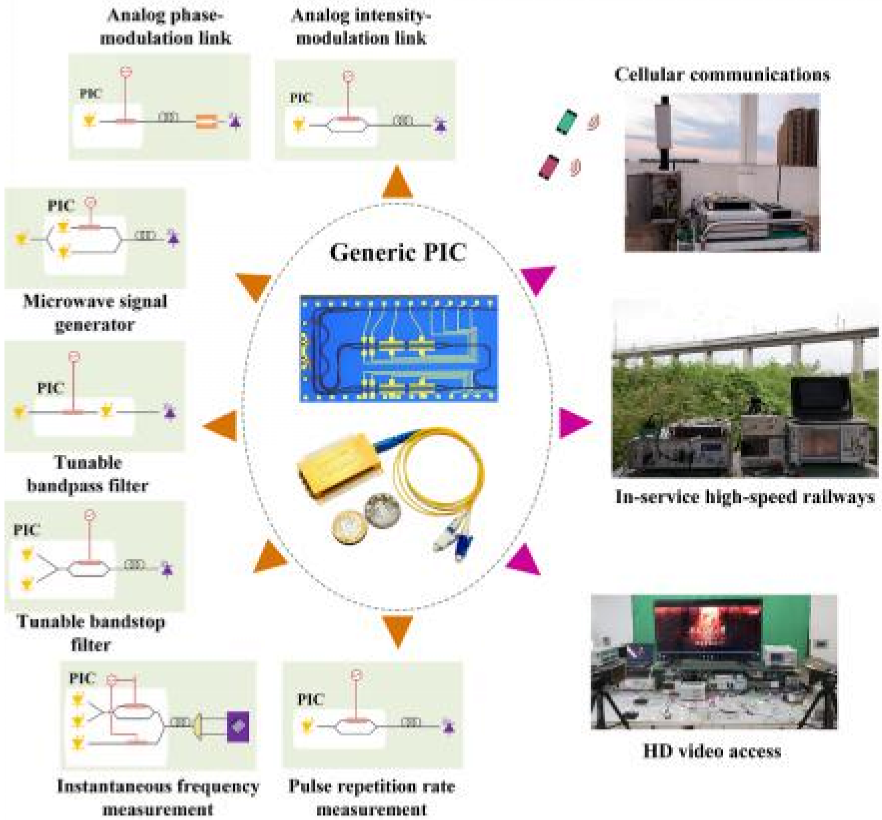

Figure 1. Integrated circuit (PIC) of microwave photonics and applications.

KEYWORDS

Integrated microwave photonics; Microwave measurements; Radio-over-fiber communications.

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Sodium Guide Star Laser Generated in Diamond Crystal

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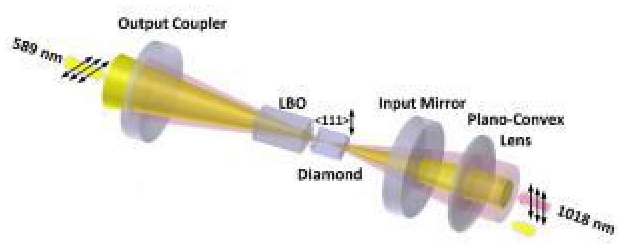
ABSTRACT

Artificial sodium guide star generated in mesosphere by 589 nm laser is considered a critical component for adaptive optical systems to enable the full-resolution imaging of large ground-based optical telescopes [1]. Such systems are also of intense interest for applications in optical free-space communications, space debris tracking, sodium layer lidar and mesospheric magnetometry[2-5]. A 589 nm output with high power and narrow linewidth is a key factor in determining the brightness of sodium beacon and thus the quality of image correction.

Diamond Raman lasers afford a highly efficient scheme for achieving 589 nm output based on the state of art Yb-doped silica fiber lasers and frequency doubling technology. Output power scaling and single frequency operation are favored due to its capability for rapid thermal handing and the benefit of the spatial hole burning-free gain nature. We, for the first time, proposed and experimentally demonstrated a continuous-wave Na D2-resonance 589 nm output in a diamond Raman resonator with intra-cavity second harmonic generation.

The experimental configuration is shown in Fig. 1. The pump was a diode-pumped 1018 nm Yb-doped fiber laser. Cavity mirror coatings and intracavity elements were selected to minimize losses at the pump and Stokes wavelengths. The pump was focussed into the diamond crystal using a plano-convex lens. The direction of pump polarization, diamond <111> axis and LBO slow axis were aligned parallel to each other, providing the highest Raman gain and SHG angle match. The coatings of the input mirror and output coupler were partially transmissive at 589 nm, resulting in double-ended output beams. This diamond sodium laser delivers more than 20 W output power with an overall conversion efficiency of 18.6% from the diode pump power at 976 nm to 589 nm, which is a record for any diode-pumped LGS system.



KEYWORDS

Sodium guide star laser, Diamond Raman laser, Stimulated Raman scattering, Second harmonic generation

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Investigating Surface Plasmons and Photonic Bandgap of Ordered Nanoarray Constructed by Hierarchical Alumina Membranes

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ABSTRACT

The purpose to manipulate photonics and the trend of device miniaturization prompt people to design sophisticated ordered nanostructures with well practicability over large scale. Attributing to the inherent structure feature of ordered pore array, alumina membranes (AMs) are widely used in preparation of ordered nanoarrays for various device applications. For the reason that, artificial modulated AMs can offer porous membranes with uniform geometric parameters, in order to achieve controllable distribution of nanomaterials. Here, we demonstrate the idea to fabricate hierarchical alumina membrances (HAMs) with controllable subwavelength patterns as promising platform to construct plasmonic structures. By precisely controlling the anodization potential, sophisticated structures of AMs are regulated into distinctive patterns (Fig. 1). After replicating HAMs with functional polymer and noble metal, hierarchical nanostructures (HNs) with unique surface plasmon resonance (SPR) properties are obtained, which is developed as dynamic plasmonic sensing device[1]. In addition, the photonic bandgap brought by HNs are investigated in detail. This approach for elaborate HNs fabrication broadens the scope for the design and application of functional nanostructures in the field of nanophotonic devices.

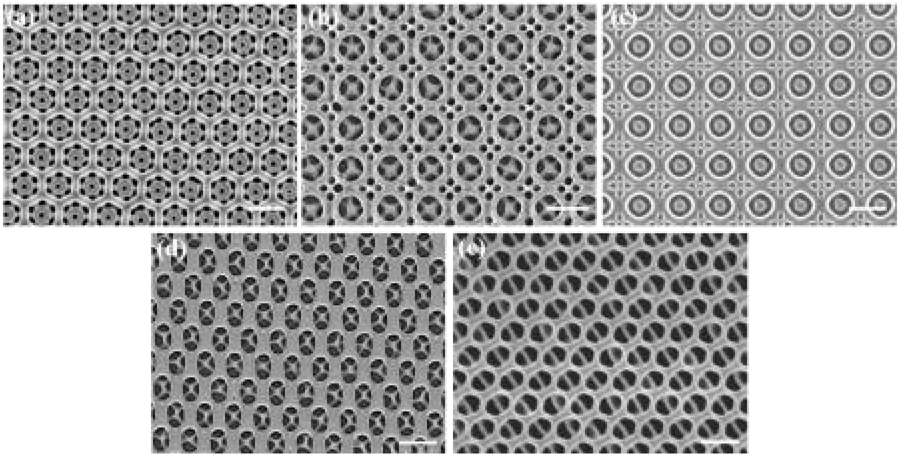

Figure 1. SEM images of hierarchical AAO template in (a) hexagonal close-packed, (b, c) tetragonal and (d, e) hexagonal arrangement.

KEYWORDS

Surface Plasmons, Dynamic modulation, Periodic nanoarray, Photonic bandgap

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The Chemical and Electronic Structure of Ge-substituted Kesterite Thin-film Solar Cell Absorbers Studied by Hard X-ray Photoemission

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ABSTRACT

By completely substituting Sn with Ge and adjusting the [S]/([S]+[Se]) ratio in $Cu_2ZnSn(S,Se)_4$ kesterites, it is possible to increase the optical band gap (E_g) of the material to value > 1.5 eV and tune the positions of the energy levels. The first makes this material a promising candidate as top cell absorber for high efficiency and low cost tandem solar cell configurations with c-Si as the bottom cell, while the latter opens the route for a deliberate optimization of the electronic structure. To understand the correlation between the chemical and (opto)electronic properties, a set of Ge-kesterite samples with S contents that range from nominally 0 to 100% (i.e., from S-free $Cu_2ZnGeSe_4$ to Se-free Cu_2ZnGeS_4) was fabricated by two different deposition routes ({a} via a wet-chemical solution process according to [1] and {b} via a vacuum deposition based process according to [2]) and characterized using hard x-ray photoelectron spectroscopy (HAXPES) performed at the HIKE endstation of the KMC-1 beamline located at BESSY II. Due to the expected formation of secondary phases (as, e.g. ZnSe) the samples have been characterized before and after an HCl etch step (that is supposed to remove secondary phases at the surface) as well as after a subsequent $(NH_4)_2S$ "passivation" step (that is suggested to increase the quality of the etched sample surface).

It is found that, unlike the bulk properties, the surface properties are strongly influenced by both the deposition parameters and the deposition routes. For example, the surface [S]/([S]+[Se]) ratio and the position of the valence band maximum (VBM) of the samples prepared following route {b} is much larger and further away from the Fermin level (E_F), respectively, compared to the properties of the samples prepared according to route {a}. In general, we also find that a higher [S]/([S]+[Se]) ratio results in an increased E_g (as expected), but also (counterintuitively) in a shift of the VBM closer to E_F. Secondary phases, such as ZnSe, which are generally believed to limit device performance, are removed by HCl etching. However, the etching procedures results in the formation of additional foreign species (e.g., germanium selenide, selenium oxides), causing a deterioration of device performance. It is found that the "passivation" step, decreases the number of foreign species mediating this problem, and resulting in enhanced device performance.

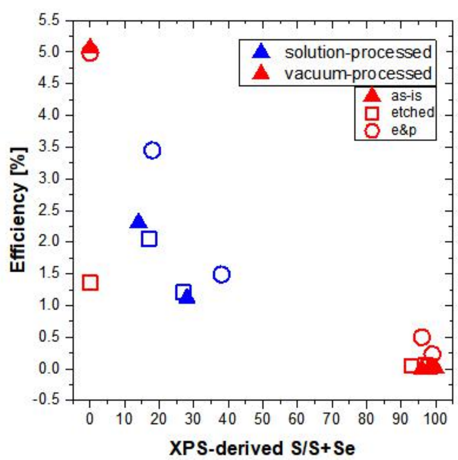

Figure 1. the efficiencies of kesterite solar cells change with the S/(S+Se) ratio in $Cu_2ZnSn(S,Se)_4$ absorbers.

KEYWORDS

Ge-kesterite, HAXPES, [S]/([S]+[Se]) ratio, Electronic structure, Chemical structure

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Slef-assembly of Non-spherical Nanoparticles into Functional Supercrystals

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ABSTRACT

Nanoparticles are fascinating in many ways Self-assembly of various building blocks into macroscopic structures with desired features and functions, that is, ‘’bottom-up’’ assembly, is an interesting theme that runs through chemistry, biology and material science. First, I will show our recent progress in the self-assembly of non-spherical nanoparticles including nanocubes, nanorods, and nanodumbells. The roles of non-spherical nanoparticle shape during this self-assembly behavior are of great interest, and different solvents have been demonstrated to modulate the individual particle interactions to control the final nanoparticle assembly pattern. Additionally, the stability of different nanoparticle superlattice polymorphs has also been provided by delicate solution calorimetric measurements. Last, I will talk about how to use self-assembly technique to prepare ordered Au mesoporous nanosheets with plasmonic hotspots.

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An Atomic-level View of Picosecond Infrared Laser-driven Molecular Plumes with Femtosecond Electrons

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ABSTRACT

Imaging reaction dynamics of molecules in isolated gas systems and solvated systems would reveal the mechanism of how solvent affect and control chemistry. Here we developed a picosecond infrared laser (PIRL) driven molecular beam based on the principle of desorption by impulsive vibrational excitation (DIVE)[1-2] to prepare biomolecule plumes ranging from gas clouds, thin-liquid films to fluid jets by varying PIRL fluencies.

We coupled this PIRL-DIVE plume with a femtosecond electron gun, which was driven by a third harmonic of the Ti:Sapphire femtosecond laser. We demonstrated that we could image both gas-phase and liquid-phase samples in real space and reciprocal space with femtosecond electron pulses by tuning the magnetic lens current [3]. This will allow us simultaneously study reaction dynamics in isolated gas phase systems and directly observe the same reaction dynamics in liquids with atomic spatial resolution and femtosecond temporal resolution.

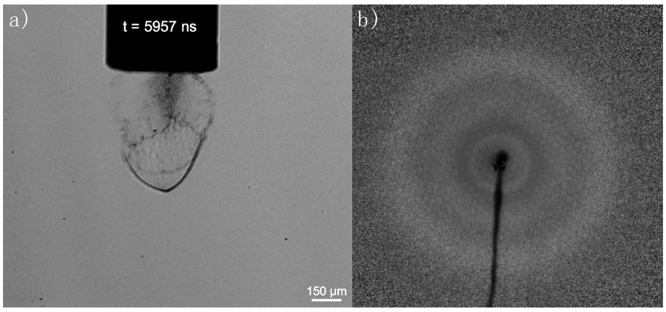

Figure 1. Optical bright-field imaging a) and Electron diffraction imaging b) of a PIRL-DIVE plume.

KEYWORDS

Picosecond Infrared Laser, Desorption by Impulsive Vibrational Excitation, Femtosecond Electron Diffraction

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Shack-Hartmann Wavefront Sensor Based Phase Microscopy

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ABSTRACT

The phase or optical path difference (OPD) of the microscopic sample provides plentiful information about the sample, such as creating good image contrast in the transparent and translucent cases and characterizing the profile of the surface in reflective cases. The quantitative phase can be measured by a Shack-Hartmann wavefront sensor when the spatial coherence condition is satisfied that the numerical aperture of the illumination should be smaller than the numerical aperture of the imaging lens. Comparing with the holographic or interferometric methods, the SH technique needs no delicate reference beam in the setup, which simplifies the system.

A transmissive microscope was transformed into an optical path difference microscope by placing a Shack-Hartmann wavefront sensor in the imaging plane. The scheme of the setup and the reconstruction process are shown in the figure. A collimated LED was used as the light source in the experiments. The gradients of optical path difference are fast retrieved from the Shack-Hartmann sensor image by a Fourier demodulation method. A reference is registered in advance without any sample for sensor calibration. Then the OPD is reconstructed from unwrapped gradients by using two-dimensional integration techniques. In the experiment, a micro-lens array is characterized. The measured results shown a good agreement with the manufacturer's data which verified the feasibility of this method.

We have shown an instrumental application of an SH sensor to measure the phase of sample in an imaging microscope. It is a non-interferometric method which is easy to deploy and has a rather relaxed requirement on the illumination coherence. The preliminary results show that the method could represent an efficient and inexpensive alternative to interferometric and holographic methods.

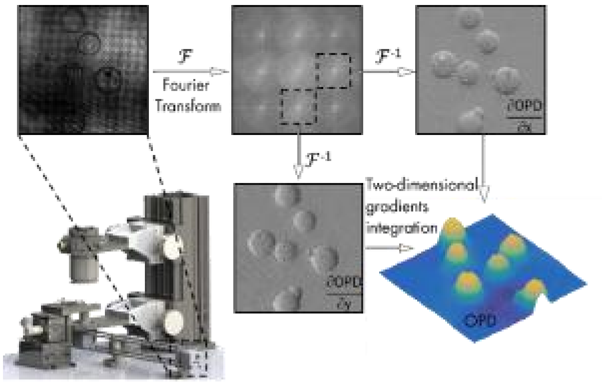

Figure 1. The scheme and the process of SH optical path difference reconstruction.

KEYWORDS

Optical instrument, Wavefront, Microscopy

REFERENCES

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Introduction of Organizer

Introduction of Harbin Engineering University

Harbin Engineering University (HEU), founded in 1953, is located in Harbin, near beautiful Songhua River. It is a national key university of glorious history and fine traditions. It is also an important base for talent cultivation and scientific research in the fields of ship industry, ocean exploration and nuclear application.

1. Historical Reform

1953：PLA Military Institute of Engineering
1994：Renamed as Harbin Engineering University
1996：The first batch of ‘211 Project’ key construction universities of China
2011：One of the universities of ‘985 Advantage Subject Innovation Platform Project’
2017：One of the national ‘Double-top’ universities
2019： Co-constructed by the Ministry of Industry and Information Technology, Ministry of Education, Heilongjiang Province, Harbin City.

2. Features

In the past 67 years, the school has adhered to the national strategy, national defense needs and local economic development needs, formed a distinct "Three Oceans and One Nuclear" school characteristics, and has now developed into the largest high-level talent training base and one of the most important high-level scientific research bases in one of the most important high-level scientific research base.

3. **Talent development**

More than 120,000 senior professionals were trained, including more than 200 generals, ministers, governors and academicians of the People's Republic of China. More than 50,000 graduates will be sent directly to the national defense science, technology and industry system. The university is hailed as "a naval academy

without military uniform".

4. **Research platform**

The university has more than 20 national-level scientific research platforms including national key laboratories, with ample scientific research funding, annual research funding per capita exceeding one million, and personalized scientific research equipment support.

Introduction of Photonic Materials Group

Even though photonic devices and technologies have profound influence on human's society, its capabilities have not been fully exploited. In the broadest sense, nano-scale patterning are the critical promoters that will allow mankind to take full advantage of photonic systems. In order to further utilize the nanopatterns, we must gain better understanding of the light-matter interactions that occur in nano-scale, and develop advanced techniques to construct artifical nanoarrays in large scale for practical applications. The Photonic Materials Group (PMG) takes responsible to efficiently construct complex nanopatterns beyond centimeter scale. The ultra-fast laser source, angle-resolved spectrometry, and numerical simulation are deployed to shed light on their physical properties. The specific researchs in PMG include:

1. Novel photonic properties based on plasmonic lattice resonance over centimeter-scale sample

The presence of standing wave in photonic lattice arrays is due to the constructive interference of coherent photons in nanopattern arrays (a), which delocalize the surface plasmons, suppress the radiative loss/damping, form strong coupling that enhances the near-field optics. Ultrasharp lattice resonance modes can be observed in the index-matching environments (b). These linear behaviors, sometimes followed by strong coupling (c), affact their 2nd order nonlinear optical performances upon irradiation of polarized light (d). In addition, they are good candidates for producing structral color (e).

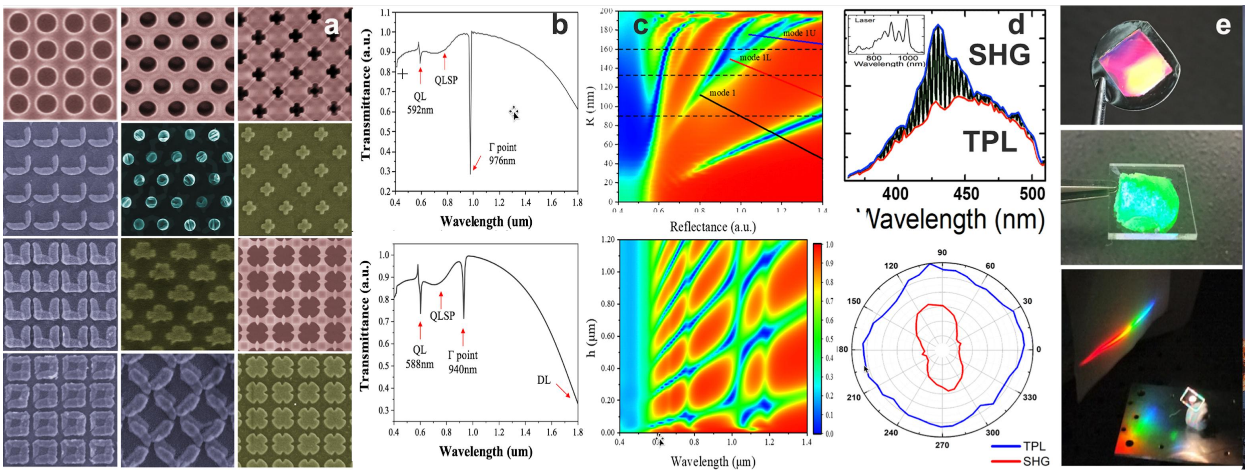


Figure 1 (a) Photonic crystals; (b) Lattice resonance modes; (c) Strong coupling; (d) The 2nd order optical nonlinearities; (e) Structural color.

2. Band structure modulation based on complex lattice

Because of the periodicity and symmetry of the lattice, the macroscopic optical properties of photonic crystals can be modulated by lattice arrangement, which correlate with their charactertistics in the reciprocal space. For instance, embed photonic atoms at high symmetry points (a) can modify the first Brillion zone by lifting or supressing the Dirac point (or Dirac-like point) in hexagonal/honeycomb lattice (or square lattice), or generating flat band structure (b). The morden diffraction theory (c) and group theory are useful tools to investigate the evolution of degenerate states and their symmetrical propertics.

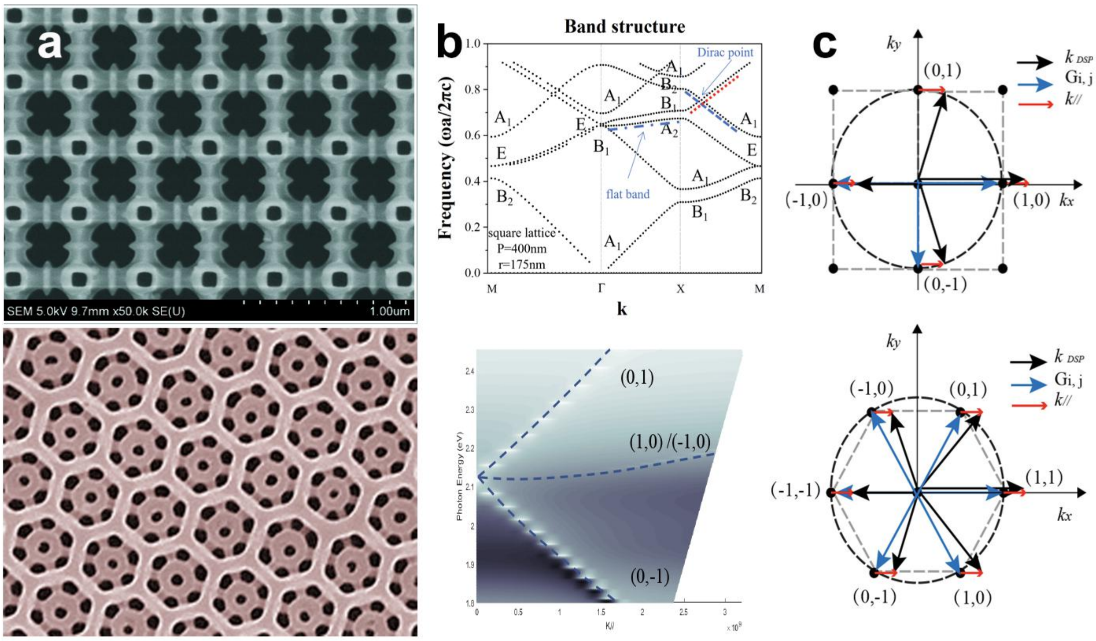


Figure 2 (a) Superlattice with different embedded structures at high symmetry points; (b) Experimental and theoretical dispersions and band structures; (c) Energy-momentum diagram of the diffracted photons.

3. Reversible / gradual deformation 2D hierarchical superlattices and their optical properties

The flexible modulation of Surface Plasmons (SPs) on micro-/nanostructures is an interdisciplinary frontier of materials science and nanophotonics. With the assistance of hierarchically structural alumina membrane (a), it is possible to actively tune SPs based on reversible/ gradual micro-deformation of 2D superlattices using external (optical, electric, thermal) fields (b), which is of great importance for promoting the applications of active response optical devices (c).

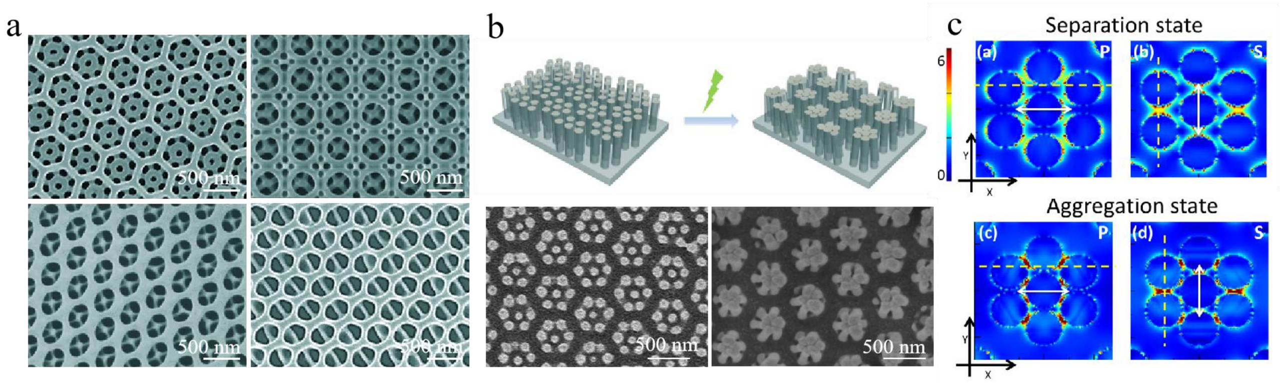


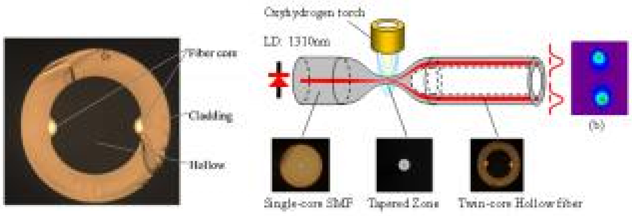
Figure 3 (a) Hierarchical alumina membranes; (b) Actively reversible hierarchical photonic crystals; (c) Simulated E-field distributions before and after external stimulation.

Introduction of Light: Science & Applications (LSA)

Introduction of College of Physics and Optoelectronic Engineering

1. In-fiber Integrated Optic Devices

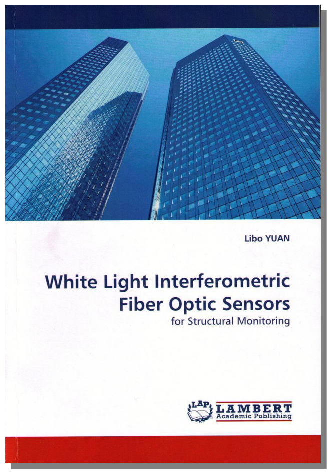
One of our research directions is index-guided microstructured fibers. The fabrication technology similar to the conventional silica based optical fibers, but multi cores are rearranged and embedded in one cladding. Based on this kind microstructured fiber, the in-fiber integrated optic devices and functional fiber optic sensors could be designed and developed. The objective of in-fiber integrated optic devices is to develop fiber based integrated micro-scale optic devices. The fundamental issues are how to integrate several basic optical components inside in one fiber? How to implement the link between microstructured fibers based optical components and standard single mode fiber? How to control the light flow of each channel inside in one fiber cladding? And How to develop the functions and applications of in-fiber integrated interferometers?



The advantages of in-fiber integrated optics devices, similar to the integrated optics, are their compactness and stability, easy linkage with standards single mode fibers, and packaging compatibility with the current fiber optic components.

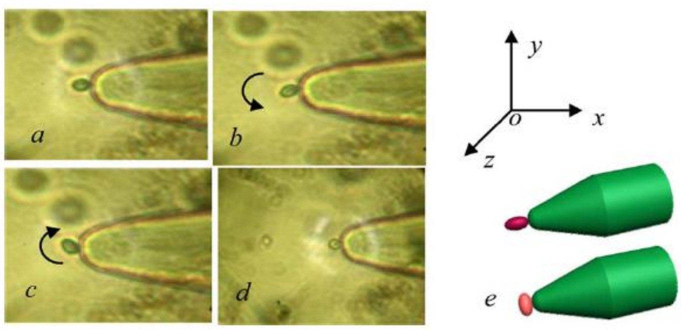
2. Fiber Optic Sensors & its Application

Fiber optic white light interferometric sensor is one of the most exciting technologies in the field of optical fiber sensors and appears to be ideally suited for structural health monitoring of composite materials and civil engineering applications. In this research direction, we are devoted fiber optic sensors design multiplexing and loop topology based network techniques by utilizing advanced white light interferometric knowledge to meet the requirement of large-scale structural monitoring. What we focus on are：(1) How to create an interferometer system for white light interferometric fiber optic sensors interrogating? (2) How to calibrate and predict the embedded fiber optic sensors performance? (3) How to build a fiber optic sensors array on a single fiber by low coherence multiplexing techniques? (4) How to configure a loop topology based fiber optic sensors local network by white light interferometer for large-scale smart materials and structures health monitoring?



3. Fiber Optic Tweezers and Micro Optical Hand Technology

The aim of the current study in this research direction is to investigate and develop a practical and easy operated fiber optic tweezers for simplify manipulation of small particle, for the assembly of microstructures and for conducting advanced research on cells, viruses, bacterias and DNA molecules. (**OE**, 2006, **14**(25), 12510-12516; 2008, **16**(7), 4551-4558).



Recently, we have developed multi-core fiber and annular-core fiber based “micro optical hand”, not only trapped the small particle, but also could change the orientation and coordinating state of the trapped particle. Its manipulation functionality has been greatly expended and towards the human’s hand. (China Patent, No. 201010197496.8; **JLT**, 2012, 30: 1487-1491).

4. Ultra-high Precision Optic Measurement Instrumentation

This research direction are focus on the detection signals processing of fiber optic related sensing or measuring and integration of software and hardware such as electronics circuits unit, mechanical moving unit as well as system control and display unit. It is include (1) embedded single chip micro controller system; (2) DSP and FPGA technology applications and (3) LabVIEW software based system control, data acquisition, data processing and display program. For example, an OCDP based fiber optic Gyroscope testing and diagnostics system has been developed for Integrated Waveguides Modulator/Demodulator (Y type waveguide) testing and fiber coil evaluation. The specifications are as follows:

Polarization Crosstalk	Sensitivity	-95dB
	Dynamic range	0 ~ 95dB
PER measurement range		0 ~ 85dB
Spatial resolution		±5cm, birefringence $\Delta n=5\times10^{-4}$
Sensing range of PM fiber		3.0km （maxim 5km）
Measuring device types		White-Light Source, Y Waveguide, Optical fiber Coil, PM coupler

5. Microstructured Optical Fiber Fabrication System

The way of manufacturing the index-guided microstructured optical fibers involves three main steps: (1) optical fiber perform preparing by MCVD; (2) reform the optical fiber performs and reconstruction of the microstructured optical fiber perform according to the specific design; and (3) draw optical fiber at the drawing tower. The main facilities include: (1) MCVD fiber perform manufacturing equipment; (2) optical fiber drawing tower.

Special designed F-MCVD facility

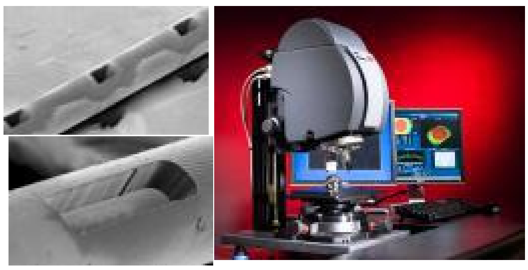
Fiber drawing tower

6. Laser Machining System

The main facilities in this research direction include (1) Laser machining system working at 157nm for silica and glass micro scale machining; (2) FK eximer laser based fiber Bragg grating manufacturing system; (3) CO2 laser based long period grating fabrication system; and (4) Fiber Bragg grating sensors demodulation system.

157nm Laser machining system

Fiber micro manufacturing evaluation

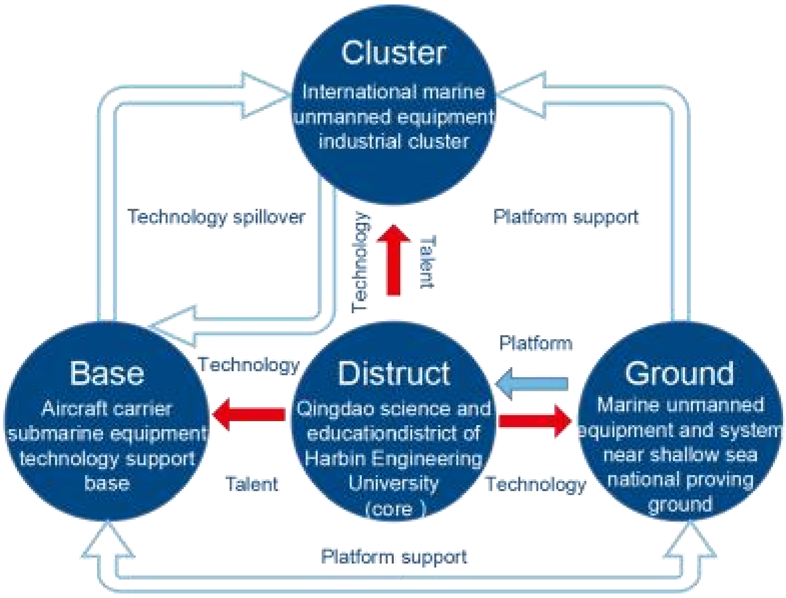


Introduction of Innovation and Development Base (Qingdao)

1. Development Orientation

Qingdao innovation and development base takes the construction of campus as the standard, as the port of characteristic education, the extensional campus and experimental field of cross-disciplinary, which is closely connected with the positioning of "four functions" and seeks development in deeply connecting with the ocean strategy of our country and Shandong Province.

- Positioning 1: Serving the needs of several disciplines for long-term ocean observation and the construction of permanent scientific research facilities, becoming an important base for offshore experiments.
- Positioning 2: Taking the economic environment and geographical advantages to become an important base for attracting high-level innovative talents at home and abroad.
- Positioning 3: Meeting the needs of international cooperation in schools, becoming an important base for HEU cooperatively-run school with world-class universities.
- Positioning 4: Deeply integrate with sea-related organizations, and becoming an important base of HEU for the transformation and industrialization of ship-sea and related fields.



2. General plan

The Qingdao campus of Harbin Engineering University covers an area of 2,000 mu, with a total construction area of about 1.4 million square meters. Among them, the first phase covers an area of 352,078 square meters, including No. 11 comprehensive building, No. 41, No. 51 experimental building, student dormitory, teacher

turnover apartment, canteen, international exchange center and No. 53 emerging basic interdisciplinary research building. Up to now, the first phase of the project will be completed and put into operation in December 2021.

3. General framework

Around the development goal of Qingdao base, strengthen the positioning of "Four Functions". Supporting the realization of the development goal and function positioning of Qingdao base by promoting the construction of "Four Major Projects (1 + 3)".

a. Science and education zone (Qingdao) of Harbin Engineering University.

It mainly carries out high-level personnel training, innovative scientific and technological research, international joint school running and school enterprise joint school running in the marine field, and arranges the specialties of ships and oceans, marine information, ship power, advanced nuclear energy and nuclear safety, marine new materials, marine science and cultural management.

b. Unmanned equipment and system near shallow sea national test site.

In the Qingdao sea area, with the characteristics of the unmanned system at sea, the comprehensive test capability of the unmanned system near the shallow sea is constructed to serve the full cycle of "technical research-equipment development-formation capability" of the unmanned system at sea, which is incorporated into the capability system of the National Offshore test field, so as to provide the guarantee conditions for basic and applied basic research for the Qingdao science and education zone.

c. International Marine unmanned equipment industry cluster.

Through the gathering of high-level talents, training of marine talents, marine technology and equipment technology innovation, achievement transformation and industrialization and other innovative elements in the whole field, we will create an international marine unmanned equipment industry cluster, drive the surrounding supporting industrial areas, realize the integration of industry and city, gather the first-line demonstration enterprises in the field of marine unmanned equipment, and build Qingdao International Marine unmanned equipment industry cluster with global competitiveness.

d. Carrier submarine equipment technical support base.

On the basis of the existing technical support center for ship equipment, relying on the talents and technical advantages in the field of marine technology and equipment in Qingdao science and education zone, the front support base for aircraft carrier, the submarine and other ship equipment technology will be established.

Partners

Academic Partners

Weiping YUE, Ph.D.
Chief Scientist
Clarivate, Greater China

As the Chief Scientist of Clarivate of Greater China, Dr. Yue works with government organizations, universities, and publishers in Greater China to provide them with customized solutions and projects on research discovery, research management and assessment. Since joining Clarivate in September 2005, she has been very active in the China and Asia Pacific scientific community, engaging with researchers, research administrators, and funding agencies on research evaluation and assessment, and dialogues on best practices in driving research excellence.

Dr. Yue holds a Ph.D. in Information Management from the University of New South Wales, Australia. Her doctoral work was awarded the 2005 American Society for Information Science and Technology (ASIS&T) Doctoral Dissertation Award. Her research area focuses on bibliometrics and scientometrics.

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Chenzi GUO
Managing Editor
Light: Science & Applications, China

Editor Chenzi Guo is a managing editor of journal *Light: Science & Applications*, a worldwide leading comprehensive optics journal, she is also the director of a new journal *eLight* published with Springer Nature, which targets at the finest works in emerging optics. She chairs the Excellent Move of China STM Journals Project–high-profile new journal eLight, and two other state/provincial projects. She co-authored a translation book of "Optics and Photonics: Essential Technologies for Our Nation" (Science Press), and authored/co-authored papers in *Nano Today*, *Nanomaterials*, *Science China Materials*, *Applied Optics*, *Applied Sciences*, *Nanotechnology*, *Japan Science and Technology Agency*. She is the winner of National Campaign for Young Science Journal Editors, 2019 CIOMP Advanced Individual, 2020 Chinese Academy of Sciences Changchun Branch Young Pioneer.

About: Light: Science & Applications

Light: Science & Applications (hereinafter referred to as LSA) is a leading optics journal, co-published by Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences and Nature Publishing Group (now known as Springer Nature).

LSA seeks to promote research from all aspects of optics and photonics, including basic, applied and engineering research and applications. This open access journal primarily publishes new research results in cutting-edge and emerging topics in optics and photonics, as well as covering traditional topics in optical engineering. The article types broadly range from Original articles, Letters, Reviews, Perspectives and Historical Overviews to News & Views that are of high quality, high interest and far-reaching consequence.

According to Journal Citation Reports, the latest impact factor of LSA is 14, ranking No.2 among all optics journals in the world.

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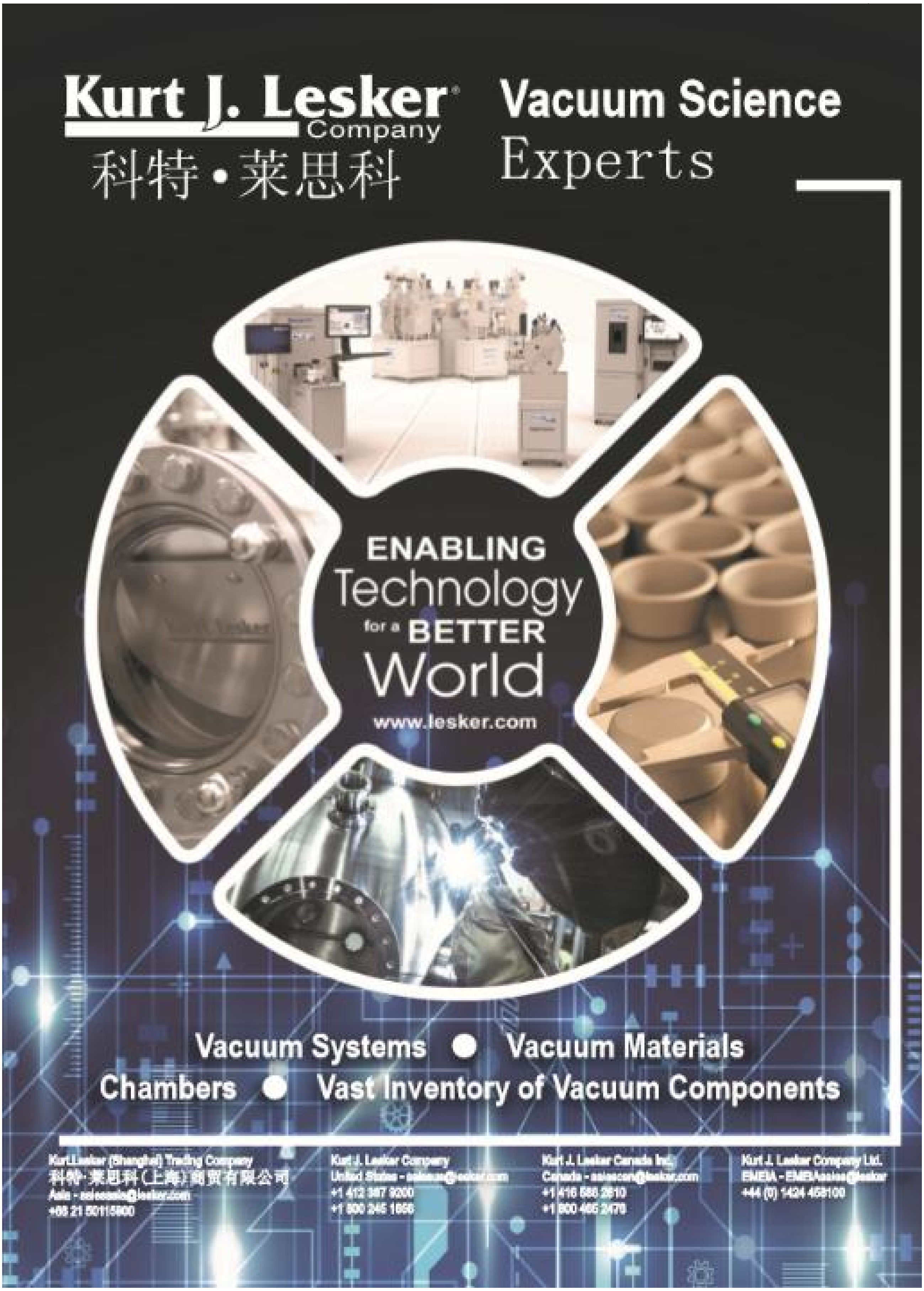
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LtB2021 & IDL2021

See You Next Year!

The forum program is written by Yi Wang, Yufeng Zhang and Wenxin Wang

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