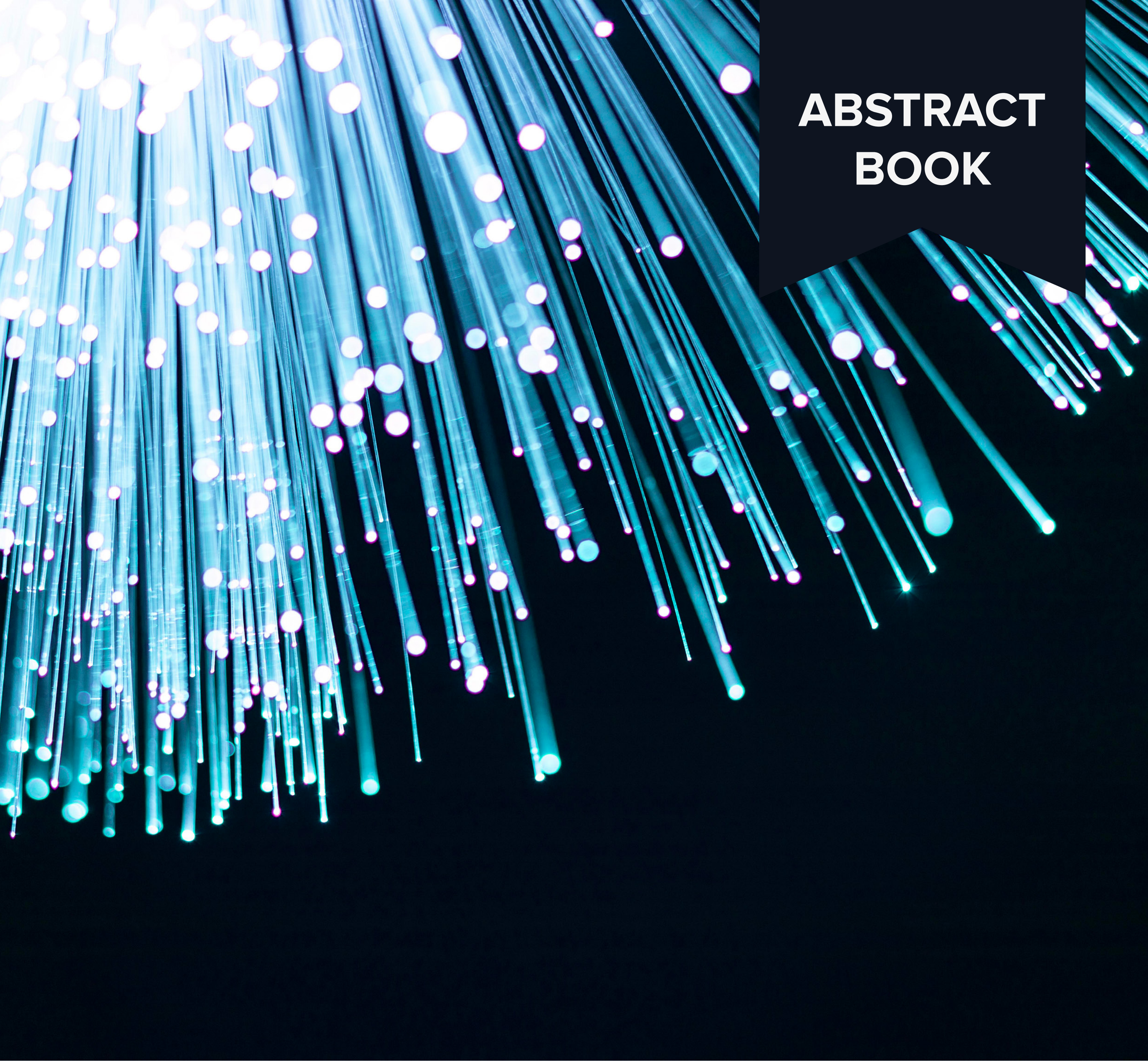

ABSTRACT BOOK

SCIENTIFIC SUMMITS

WSELOP-2024

October 17-18, 2024 | Bern, Switzerland

WORLD SUMMIT AND EXPO ON

LASERS, OPTICS AND PHOTONICS

FOREWORD

Conference Chair Welcome Message

On behalf of the Organizing Committee, I warmly welcome you to the World Summit and Expo on Lasers, Optics & Photonics (WSELOP-2024) October 17-19, 2024 Bern, Switzerland. Bern, the capital of Switzerland, is one of the most attractive and historically important places in Europe. The Suisse efficient railroad and highway system gives you the opportunity to explore both the wonderful nearby lakes as well as the highest alpine mountains of Europe.

WSELOP-2024 will be a 3 days event bringing together renowned researchers, scientists and scholars with Ph.D. candidates and post-docs from various communities including industry all over the world to exchange ideas, present latest research and discuss hot topics in these fields, sharing their experiences, connecting all aspects of modern Lasers Optics & Photonics up to novel applications in devices based there upon.

We are looking forward to an excellent meeting with scientists from many different countries around the world, sharing their new and exciting results Hope you will share your results and ideas there

Conference Chair
Prof. Dr. Dr. h. c. mult. Dieter Bimberg
Executive Director "Bimberg Chinese-German Center for Green Photonics" at CLOMP, CAS, China
Founding Director of Center of Nano Photonics", TU Berlin, Germany

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PLENARY ABSTRACTS

PURSUING SUPER-RESOLUTION IN FS LASER 3D MANUFACTURING

Website: http://faculty.dpi.tsinghua.edu.cn/hbsun.html

Hong-BoSun

State Key Laboratory of Precision Measurement Technology and Instruments, Department of Precision Instrument, Tsinghua University, Beijing 100084, China

ABSTRACT

Femtosecond laser manufacturing is unique in three-dimensional (3D) prototyping capability, and it also may be utilized for producing fine structures from hard-processing transparent materials due to the high-field feature of a femtosecond laser. A natural question is how nanoscale fabrication accuracy may be achieved since the light-solid matter interactions are generally violent. Here we report several new findings that we prove valid to minimize interaction volume, including optical far-field induced near-field breakdown (O-FIB) effect, surface plasmon polariton imprinting effect, and combinative usage of multi-photon and threshold effect. As a result, we improve the fabrication spatial resolution of transparent solid materials from the conventional optical-diffraction limit (hundreds of nanometers) to a new limit, quantum limit, which is material dependent (several nanometers).

BIOGRAPHY

Hong-Bo Sun, received the B.S. and the Ph.D degrees in electronics from Jilin University, Changchun, China, in 1992 and 1996, respectively. He worked as a postdoctoral researcher in Satellite Venture Business Laboratory, the University of Tokushima, Japan, from 1996 to 2000, and then as an assistant professor in Department of Applied Physics, Osaka University, Japan. In 2004, he was promoted as a full professor (Changjiang Scholar) in Jilin University, and since 2017 he has been working in Tsinghua University, China. His research interests have been focused on laser precision manufacturing. He has published over 500 papers, which have been cited for over 30000 times, and H factor is 90, according to ISI search report. He is currently the executive editor-in-chief (EEIC) of Light: Science and Applications and co-editor-in-chief of PhotoniX (Both from Nature Publishing Group). He is IEEE, OSA and SPIE fellow

KEYNOTE ABSTRACTS

INTRIGUING CONNECTIONS BETWEEN OPTICS AND NUMBER THEORY: FROM NUMBER FACTORIZATION TO ZEROES OF RIEMANN ZETA FUNCTION

Sergey A. Ponomarenko

Dalhousie University, Halifax, Canada

ABSTRACT

Number factorization plays a prominent role in network systems and cyber security. It has also become a crucial ingredient to a host of promising physics-based protocols for information encoding, optical encryption, and all-optical machine learning. Moreover, intriguing prime number links have emerged between optical physics and number theory. Here we present a theory of axial correlation revivals of structured random light at pairs of points and derive a remarkably simple analytical relation between the normalized intensity autocorrelation function of structured paraxial random light fields at a pair of points on an optical axis of the system and an incomplete Gauss sum, thereby establishing a fundamental link between statistical optics and number theory. The discovered link makes it possible to develop and experimentally implement a robust protocol to decompose even fairly large numbers into prime factors using random light which is inherently insensitive to phase noise. We show that our protocol is capable of factoring numbers as large as a few million, but it is rather time-consuming to work with large statistical ensembles to accurately determine the speckle statistics. To mitigate this issue, we also propose and implement a couple of conceptually simple, time-efficient alternatives. First relies on the orbital angular momentum content of coherent light beams and a carefully engineered prime number sieve, while the second makes use of the celebrated Young interference experiment with classical random light beams and a newly established connection between the transverse degree of spatial coherence of light and an appropriate incomplete Gauss sum. We stress that our protocols, although implemented with light, can also be extended to x-rays, acoustic and matter waves. We will present our theory and experimental results and show their excellent quantitative agreement.

BIOGRAPHY

Sergey Ponomarenko earned his Ph.D. degree in theoretical optical physics from the University of Rochester, USA under the tutelage of late Prof. Emil Wolf, the pioneer of optical coherence theory. After a prestigious Director's postdoc at Los Alamos National Laboratory, USA, Dr. Ponomarenko joined the faculty of Dalhousie University, Canada as a prestigious and fiercely competitive Canada Research Chair in 2006. Prof. Ponomarenko had held his Canada Research Chair from 2006 to 2016. Prof. Ponomarenko has published over a 120 journal papers in leading peers review journals in physics optics, and photonics, including such prestigious and highly selective physics and photonics journals as Physical Review Letters and APL Photonics; several of his Optica journal publications have been selected as Editor's Picks. Prof. Ponomarenko is an Associate Editor of Frontiers in Physics and a member of numerous Editorial Boards, including that of Journal of European Optical Society-Rapid Publications.

LIGHTFIELD3D DISPLAY WITH HIGH PERFORMANCE

Qiong-Hua Wang and Yan Xing

Beihang University, China

Light field 3D display is an import true 3D display technology. However, the performance of the traditionallight field 3D display needs to be improved. We proposed and developed a large-viewing angle tabletop light field 3D display based on integral imagingtechnology and a high-resolution light field 3D dis-playbased on super-view technology. The structure, principle and performance of the light field 3D displays will be introduced in the talk.

TITLE: OPTICAL AND SPIN PROPERTIES OF INDIVIDUAL MODIFIED DIVACANCY COLOR CENTERS IN SILICON CARBIDE

ABSTRACT

Color centers in silicon carbide (SiC) have emerged as promising candidates for quantum information processing, particularly due to their exceptional optical and spin properties. In this presentation, we will discuss our recent work on the preparation and manipulation of single divacancy color centers in 4H-SiC. We observed bright single modified divacancy PL6 with high spin readout contrast at room temperature, showing properties comparable to NV centers in diamond. Furthermore, we found long-term emission stability of individual PL6 divacancies and their robustness against photoionization effects at low temperatures. These findings underscore the significant potential of modified divacancies in SiC for on-chip quantum photonics and their crucial role in developing highly efficient spin-to-photon interfaces.

TITLE: ORGANIC SINGLE-CRYSTAL SEMICONDUCTORS FOR LIGHT-EMITTING APPLICATIONS

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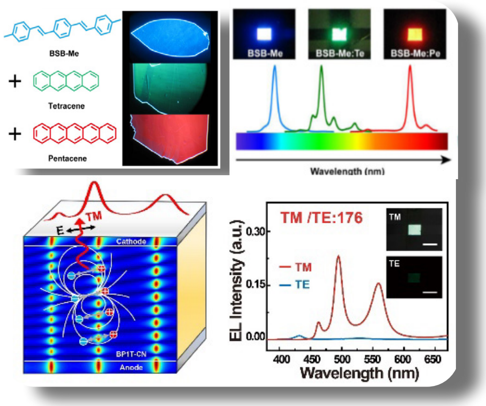
Keywords: organic single crystals, Organic light-emitting devices, High efficiency, Polarized emission.

Organic single-crystal semiconductors have attracted much attention for the potential applications in electronic and optoelectronic devices,due to their high thermal stability, highly ordered structure and high carrier mobility. This talk will introduce our systematic investigations on the growth and manipulation of optoelectronic properties for the organic single crystals and their applications in light-emitting devices.



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APPLICATIONS OF AES, XPS AND TOF SIMS TO PHOSPHORNANOMATERIALS

Hendrik C. Swart
Department of Physics, University of the Free State, Bloemfontein, South Africa

ABSTRACT

Surface characterization and optical characterization techniques play a vital role in the complete understanding of the luminescent properties of phosphor nanomaterials. Auger electron spectroscopy (AES), X-ray photo electron spectroscopy (XPS), time of flight scanning ion mass spectrometry (TOF SIMS), Photoluminescence (PL) and cathodoluminescence (CL) are used to characterize different phosphor materials. The crystal field that is determined by the environment in the host material in combination with the various dopant ions with the correct valence state can be used to obtain emissions from the Ultraviolet (UV) to the infra-red (IR) wavelength ranges. Phosphor materials have been successfully used to improve the efficiency of various applications. Nanoparticles both undoped and doped with different rare earth elements were synthesized by several synthesized techniques. The defects incorporated into the bulk material play an important role in the emission efficiency and colour scheme. XPS in combination with PL can be used to identify some of these defects in the material. Degradation of the different phosphors during prolonged electron/photon bombardment also played a vital role in their possible applications. The combination of CL, PL, AES and XPS techniques helps to determine the mechanisms behind the degradation. A small number of impurities in the chemicals used during synthesis can play a large role in the final emission intensity and colour of the phosphor materials. TOF SIMS can point out these impurities. Examples of different phosphor materials with different applications such as Solid-State Lighting will be shown.

Keywords: Surface characterization, phosphors, luminescence materials, degradation, defects

ACKNOWLEDGMENT

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INVITED ABSTRACTS

TITLE:SPATIAL NONLINEAR CONVERSION OF STRUCTURED LASER IN TRANSVERSE MODE LOCKING STATES

ABSTRACT

Complex modes can be generated from laser resonators with large Fresnel number. The coupling among the cavity eigenmodes are studied, to show that transverse mode locking (TML) is one special state for the self-organizations of multiple eigenmodes. Perfect TML is a spontaneous locking of both phase and optical frequency, to generate stable spatial phase singularities. And nonlinear frequency conversion of structured beams is of great interest recently. Here we present an intra-cavity second harmonic generation (SHG) of laser beams in transverse mode locking (TML) states with a specially designed sandwich like microchip laser. The intra-cavity nonlinear frequency conversion process of laser beam in TML state to its second harmonicis theoretically and experimentally investigated, considering different relative phase and weight parameters between the basic modes in the TML beam. Comparison between the far field SHG beam patterns of fundamental frequency transverse modes in incoherently superposed and locked states is made, to show that the SHG of TML beams can carry more information. Various of rarely observed far field SHG beam patterns are obtained to show good agreement with the theoretical analysis and numerical simulations. With the obtained SHG beam, one can also conversely investigate or predict the characteristics of the input structured beams. This work may have important applications in optical 3D printing, optical trapping of particles, and free-space optical communication areas.

DIFFRACTIVE GRATINGS USED IN HIGH PEAK POWER LASER SYSTEM

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ABSTRACT

High power lasers and their applications have become a major strategic research direction for international competition. Chirped Pulse Amplification(CPA) technology proposed by the 2018 Nobel Prize has increased the peak power of ultra-short lasers to the order of 10 pw, however, further increasing the power output mainly depends on increasing the pulse energy and reducing the pulse width[1]. However, regardless of which route, the power improvement is mainly limited by the grating performance[1], such as aperture and laser induced damage threshold, so the multi-beam coherent combinedtechniquehas been developed to get the 100 pw peak power. Our team's work pay much attention to the damage threshold, aperture and spectral bandwidth of the grating, and make some progress including of metal pulse compression gratings for femtosecond laser applications and all-dielectric pulse compression gratings for picosecond / sub-picosecond laser applications[2][3][4][5].

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SINGLE-FRAME SPATIAL LIGHT INTERFERENCE MICROSCOPY TECHNIQUE

Feng Yueshu,Huang Weinan,Deng Youwei, Liu Liwei
Center for Biomedical Photonics, Shenzhen University, 518060, China.

ABSTRACT

Spatial Light Interference Microscopy (SLIM) technology holds significant application value in the field of biological imaging due to its structural stability, insensitivity to environmental disturbances, high phase sensitivity, and low spatial noise. However, SLIM technology requires the combination of a four-step phase-shifting method to eliminate the effects of zero-order and conjugate images, achieving quantitative phase measurement through the acquisition of four interference images. This four-step phase-shifting method is extremely sensitive to vibrations and other external environmental conditions, and the imaging temporal resolution is relatively low, making it difficult to observe dynamic processes within cells. This limitation undoubtedly restricts the application of SLIM technology. Therefore, our team proposes the use of a parallel beam-splitting synchronous phase-shifting scheme, combined with image registration algorithms, to achieve single-frame spatial light interference microscopy. This approach increases the imaging speed by four times without reducing image quality. This high-resolution, high-sensitivity, label-free, real-time quantitative phase imaging scheme has significant importance in the biomedical field.

Key words:spatial light interference microscopy;four-step phase shifting; parallel beam splitting; image registration

HIGH-RESOLUTION PATTERNING OF FLUORESCENT FILMS BY FEMTOSECOND LASER-INDUCED FORWARD TRANSFER

Yue-Feng Liu, Shu-Yu Liang, Jing Feng, Hong-Bo Sun
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State Key Laboratory of Precision Measurement Technology and Instruments, Department of Precision Instrument, Tsinghua University, Haidian, Beijing 100084, China

High-resolution patterning techniques for fluorescent thin films are in extremely important demand in multiple application fields. Of particular concerns are displays, image sensor arrays, and fluorescent anti-counterfeiting labels. To date, several methods have been proposed to fabricate patterned fluorescent, such as photolithography, micro/ nanoimprinting, and inkjet printing. However, the organic components in perovskite materials are sensitive to the chemical reagents in photolithography. Therefore, photolithography is not an ideal method for patterning perovskites. The micro/ nano-imprinting method suffers from the template deformation during the pressure process, which deteriorates the repeatability and fidelity. Inkjet printing is the most widely used patterning technique for organic and perovskite materials. However, it has a limitation in producing high-resolution patterning. A high-resolution of 5 μm has been successfully demonstrated using electrohydrodynamic printing. However, the further improved resolution is difficult to realize because the nozzle capacity and a single injection volume of solution cannot be indefinitely reduced. Therefore, developing a suitable technique for high-resolution patterning of fluorescent film remains challenging.

Here, we present a femtosecond laser-induced forward transfer (FsLIFT) technology, which enables the programmable fabrication of high-resolution full-color fluorescent film arrays and arbitrary micropatterns. The FsLIFT process integrates transfer, deposition, patterning, and alignment in one step without involving a mask and chemical reagent treatment, guaranteeing the preservation of the photophysical properties of fluorescent film. A full color PQD array with a high resolution of 2 μm has been successfully achieved. We anticipate that our facile and flexible FsLIFT technology can facilitate the development of diverse practical applications based on patterned fluorescent films.

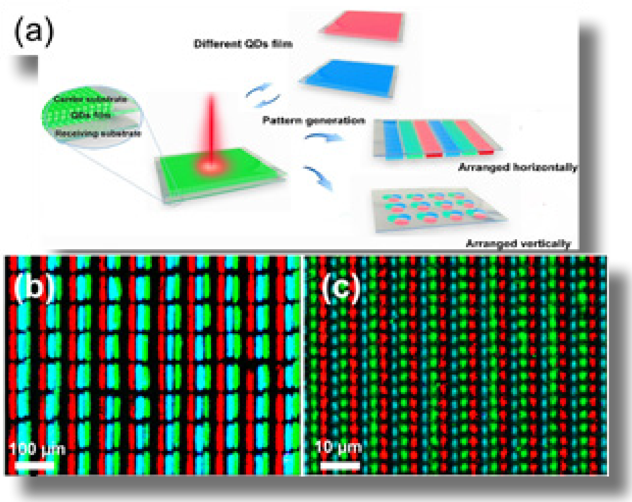

Fig. 1. Fluorescence images fabricated by femtosecond laser-induced forward transfer

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OPTICAL METASURFACES INDUCED LIGHT MANIPULATION IN OPTOELECTRONIC DEVICES

Yan-Gang Bi, Shi-Rong Wang, Mu Lin, Hao Yang, Qian-Su Wang, Jia-Shuo Zhang, Cong-Fang Wang, Hong-Bo Sun, and Jing Feng
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Organic light-emitting devices (OLEDs) have been widely used in flat panel displays and solid-state lightings,benefiting from their excellent characteristics ofself-emitting, wide viewingangle, high luminous efficiency associated with low powerconsumption, high contrast and fast switching speed.OLEDswithpolarized and directional light emissionhave many practical applications, however, beam shaping of these devices isfundamentally challenging because they are Lambertian light sources. On the other hand, low light extraction efficiency of OLEDs is alsoa main bottleneck. Around 80% of internallygenerated photons is trapped in forms of waveguidemodes, surface plasmon-polaritonmode, and substratemode. Optical metasurfaceswith micro/nano patternshave provided new opportunities in designingultrathin and compact optical and optoelectronic devices due totheir capabilities for unprecedented control over the wavefront, phase,polarization,and amplitude properties of light in a desiredmanner. Here, we proposed meta-electrodes by integrating metallic metasurfaces with electrodes to manipulate photons in OLEDs. Non-radiative modes in OLEDs have been effectively excited and outcoupled with obvious improvements in luminance and external quantum efficiency. In addition, the linearly polarized emission with ahigh polarization ratio anddirectional emission at a desired angle have been demonstrated in OLEDs based on light manipulation induced by the optical metasurfaces.

COAXIAL BRIGHT AND DARK FIELD ADAPTIVE OPTICAL COHERENCE TOMOGRAPHY

YUKUN WANG

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ABSTRACT

Optical coherence tomography (OCT) has been widely used in biomedicine. However, the signal collection efficiency of the standard OCT is sub-optimal since only the direct scattered light in the bright field is used. Almost 75% of multiple scattered light in the dark field is wasted. Here, we demonstrate a novel coaxial optical design that simultaneously collects bright and dark field signals. We implemented a wavefront-division beam splitter in the sample arm with a 45-degree rod mirror, which reflects the illumination. We detected light within its circular aperture in a way similar to the standard OCT and allowed the dark-field light of the annular-shaped aperture to pass and be collected by the dark-field detection channel. Based on the extended Huygens-Fresnel model, the heterodyne efficiency of different spatial position ballistic photons and multiple scattering photons in class I and class II were derived, considering the effects of illumination and detection offsets, and the difference in optical path length between class I and class II scattering on the scattering distribution. An imaging method combining adaptive optics (AO) and synchronized bright-field OCT with dark-field imaging of deep layers of the fundus was proposed. AO was used to improve the resolution and signal-to-noise ratio of the bright-field and dark-field images, achieving high-resolution imaging from the superficial to deep layers of the fundus. With this scheme, multiple scattered light can be collected; the signal collection efficiency is improved by ~3dB for typical biological tissues. We demonstrate that the dark-field OCT images provide higher resolution and more information than the standard bright-field OCT, and compounding of bright and dark field images suppresses the speckles by ~√2. We validated these advantages with Teflon phantoms, chicken breast ex vivo, and human skin in vivo. We believe that this new configuration will greatly promote the OCT technique for biomedical applications.

Key words high snr imaging, adaptive optics, optical coherence tomography, bright and dark field.

BIOGRAPHY

Yukun Wang, Associate Researcher of Changchun Institute of Optics, Fine Mechanics, and Physics (CIOMP), Chinese Academy of Sciences. I obtained a doctoral degree (PhD) in Optical Engineering from CIOMP in 2019 and finished two years' research fellow position in Nanyang Technological University, Singapore. I have been engaged in adaptive optics (AO), optical coherence tomography (OCT) and its application research for a long time, and has presided over the National Natural Science Youth Project, Jilin Province Excellent Youth Fund, and the Chinese Academy of Sciences strategic leading technology special catgory A projects, and published 45 papers, Among them, the first author/corresponding author has 15 articles, and he has cited them more than 300 times; Published one book titled "Principles and Applications of Adaptive Optics" . The developed AO real-time control software has been applied to 6 sets of AO systems, including telescopes, laser communication, and fundus retina, with rich experience in optoelectronic instrument development. I also conduct some research on ultra-high resolution OCT technology at Nanyang Technological University in Singapore, combining adaptive optics and optical coherence tomography, including blood cell counting micro-OCT, line scan wide field of view OCT, and bright and dark field synchronous AO-OCT.

Email: wangyukun@ciomp.ac.cn

TITLE: THE CRADLE OF CHINA'S OPTICS: A BRIEF INTRODUCTION OF CIOMP

BIOGRAPHY

WANG Hui is the Deputy Director of the Office of Graduate Education at the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS). She currently works on internationalization of graduate education for the CIOMP and was a founding member of the journal Light: Science & Applications, which is a joint publication of Nature Publishing Group and CIOMP. She has published more than 40 articles in Light: Science & Applications, International Talent, Acta Editologica, etc., and was invited to contribute an article to SPIE Women in Optics in 2015. She is the initiator of the Rose in Science and the co-sponsor and moderator of the iCANX Story. She has interviewed Donna Strickland, Nobel Laureate in Physics; Jean-Marie Lehn, Stefan Hell, and Eric Betzig, Nobel Laureates in Chemistry; Chennupati Jagadish, President of the Australian Academy of Science; Johanna Stachel, the first female president of the German Physical Society and academician of the German Academy of Sciences;

Carmen Menoni, former president of the IEEE Society for Optics; Lin Li, Academician of the Royal Academy of Engineering; Zhonglin Wang, the first Chinese to receive the Eni Prize and the first Chinese winner of the Albert Einstein World Award of Science, etc.

TITLE: MODELING OF ADVANCED OPTICAL SURFACES WITH LOCALIZED AND SEGMENTED APPROACHES

Site Zhang, PhD, Professor
Key Laboratory of Advanced Manufacturing for Optical Systems (CAS),
Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Science (CAS)

ABSTRACT

Nowadays, advanced optical surfaces with functional micro-/nanostructures on top find their applications in various cases, such as diffractive-/metasurfaces for light manipulation, photomasks and surfaces with complex coatings for lithography, etc. Surfaces with fine structures comparable to the wavelength must be simulated with electromagnetic-field-based solvers so to include the effects like diffraction and polarization. But the high computational complexity of rigorous electromagnetic solvers strongly limited their application within the size of only tens (3D) or hundreds (2D) of wavelengths, despite of the rapid development of high-performance computing technologies. We discuss the modeling of advanced optical surfaces with high diameter-feature ratio and aim to find good balance between accuracy and efficiency by introducing localized and segmented approaches for selected applications.

BIOGRAPHY

Site Zhang obtained his PhD in 2018 from Abbe School of Photonics, Friedrich Schiller University Jena. Subsequently, he joined LightTrans International UG and took the role of CTO (Chief Technology Officer). From June 2021 on, Site Zhang returned to China and now is the deputy director at the Key Laboratory of Advanced Manufacturing for Optical Systems (KLAMOS) at Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP). For over 10 years, Site Zhang has worked on the development of physical-optics simulation technologies and many of his research outputs have been implemented in optical simulation software. His research interests includes but not limited to micro-/nano-structured optical surfaces, interferometric/metrology systems and optical lithographic systems with novel concepts.

TITLE: RESEARCH ON THE THERMAL BLOOMING OF LASER PROPAGATION IN THE INNER CHANNEL.

BIOGRAPHY

Shuai Shao is a professor at Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China. Her research interests include analysis of thermal effect on beam quality and research on the thermal blooming of laser propagation in the inner channel.
So far, she has published more than 30 articles and trained more than 10 graduate students.

TITLE: EFFICIENT LOW-DIMENSIONAL PHOTODETECTORS

BIOGRAPHY

Shaojuan Li is a professor at Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China. She received her Ph.D. degree (2013) from Peking University (China) in Microelectronics and Solid Electronics. She has acquired multidisciplinary expertise in materials science, photonics, and nanotechnology. So far, she has published over 70 peer-reviewed journal articles, including Nature, Nature Communications, ACS Nano, Advanced Functional Materials, ACS Photonics, etc. She is a co-inventor on more than 20 patents. Her current research interests include plasmonic, detectors and optical sensors based on low-dimensional materials. She has awarded the Outstanding Youth Fund of the National Natural Science Foundation of China. Her research has been recognized as “Ten advances in Chinese optics –fundamental research”.

TITLE: FREEFORM BEAM-SHAPING SYSTEM DESIGN WITH MONGE-AMPÈRE EQUATION METHOD

Freeform surfaces are optical surfaces without linear or rotational symmetry. Their flexible surface geometry offers high degrees of freedom, which can be employed to avoid restrictions on surface geometry and create compact yet efficient designs with better performance. Therefore, freeform surfaces can endow beam shaping with more new functions and satisfy the ever-growing demand for advanced beam-shaping systems. The Monge-Ampère (MA) equation method converts the design of freeform beam-shaping optics into an elliptic MA equation with a nonlinear boundary condition. The MA method is considered as the most advanced point source algorithm, because it can satisfy the integrability condition automatically and can be implemented efficiently. In this talk, we will introduce the principles behind the MA method, and reveal the mathematical essence of illumination design based on ideal source assumption. Also, several interesting beam shaping systems will be given to show the effectiveness of the MA method in a wide variety of applications

RESEARCH ON DESENSITIZATION DESIGN METHOD OF OPTICAL SYSTEMS

MENG Qingyu
Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences

BIOGRAPHY

Qingyu Meng received his Eng.D degree from Harbin Institute of Technology, China. He is an associate professor at Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China. He is mainly engaged in optical system design theory and design methods and research on the design and development of space optical remote sensors.

ABSTRACT

Imaging optical design is a process of searching for the optimal solution within an extensive solution space, which encompasses all the variables required to describe an optical system. Most optical designs still focus on improving imaging performance, that is, achieving the optimal solution for aberration correction. A solution with the best "as-designed" performance is not necessarily the solution with the best "as-built" performance. Whether the optical system can be successfully manufactured and integrated, that is, sensitivity to errors, is a critical factor that determines the final realizability of high-performance optical systems. Therefore, reducing the sensitivity of the optical system is an important part of the optical system design process. In order to obtain an optical system with low sensitivity, we have proposed a series of innovative approaches, including the angle-optimized desensitization design method based on optical path difference variation and the local curvature control desensitization design method based on wavefront error variation. These research endeavors have led to the evolution of low sensitivity design theories and methods, shifting gradually from reflective systems to refractive systems, and from conic to freeform surfaces. Based on our previous research and inspired by some excellent studies, we further analyze how to reduce the refractive index sensitivity of glass and how to use freeform surfaces to reduce the sensitivity of the optical system. These methods have been applied in the design process of some optical cameras successfully.

中文报告题目：光学系统降敏设计方法研究
中文作者姓名：孟庆宇
中文单位名称：中国科学院长春光学精密机械与物理研究所

TITLE OF THE REPORT: HYPERSPECTRAL OBSERVATIONS AND RADIOMETRIC CALIBRATION OF SOLAR SPECTRAL IRRADIANCE

Dr. LI Yue is an associate professor at the Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences. His research areas include the development and calibration technology of spaceborne spectrometers, and weak signal detection technology. He is the electronics system leader for the solar spectral irradiance monitor payloads (SSIM) on the Fengyun-3 Meteorological Satellites 05 and 10. Dr. Li holds a Ph.D. from Jilin University in China and has been a visiting scholar at the Max Planck Institute for Solar System Research in Germany.

NON-POLARIZING AND TUNABLE OPTICAL BAND PASS FILTER BASED ON PLANAR OPTICAL WAVEGUIDE

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Optical bandpass filters (OBFs) are important optical devices that have been widely used in many fields of optics and laser spectroscopies. Good performance OBFs, sharp band edges for example, usually need tens or even hundreds of film layers piled up on the substrate, making it complex and costly in device fabrication [1].Comparatively, OBF with only a few numbers of film layers can be realized in form of prism pair coupled planar optical waveguide (POW) [2]. OBFsin form of multiple optical thin films usually work at zero incident angles where optical polarizations are degenerated. At oblique incidence, passbands of transverse magnetic (TM) and transverse electric (TE) polarization states are generally separated spectroscopically.In those fields that require high optical efficiency, OBFs with non-polarization dependency, where passbands for TM and TE waves coincide with each other, are highly desirable. Inthiswork,weproposeapolarizationindependentOBFwithonly5-layeredfilmstack working in oblique incident mode.Experimentally measured transmission spectra demonstrate that the pass bands for both TM and TE polarized wavessustainably overlap on each other from 623 to 852 nm as the beam incident angle adjusted within 2 °, demonstrating its angular tenability of its polarization independency. This is agreeable with our theoretical predictions.With further optimizations in device design and fabrication, as well as in spectral measurement, this type of OBF can be potentially applicable in many fields of optics and spectroscopies.

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LOW POWER CONSUMPTION POLYMER VARIABLE OPTICAL ATTENUATOR ARRAY AND ITS APPLICATION

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A variable optical attenuator (VOA) is a critical component in optical communication systems, particularly in devices such as variable multiplexers (VMUX) and reconfigurable optical add-drop multiplexers (ROADM). As the demand for increased capacity grows, large-port-count, low-power-consumption and broadband VOA arrays are essential for on-chip optical systems. We demonstrate a 16-channel VOA array based on a polymer/silica hybrid waveguide. The proposed array operates across both the C and L bands, making it suitable for standard telecommunication wavelengths. The array achieves an average attenuation of over 15dB, which satisfies the requirements for applications such as dense wavelength division multiplexing (DWDM) systems, ROADM systems, long-haul or ultra-long-haul transmission networks, and metropolitan area networks. Additionally, the VOA array demonstrates low power consumption, with each channel consuming only 15mW, making it feasible for integration into large-scale, on-chip systems. We also address the challenges of optical and electrical packaging, making it a promising candidate for future commercialization in advanced optical communication networks. This design offers scalability and efficiency, making it suitable for next-generation optical systems.

FIBER-BASED LASER INTERFEROMETRY FOR HIGH-SPEED RAILWAY HEALTH MONITORING USING TELECOM CABLE ALONG THE LINE

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ABSTRACT

A variable optical attenuator (VOA) is a critical component in optical communication systems, particularly in devices such as variable multiplexers (VMUX) and reconfigurable optical add-drop multiplexers (ROADM). As the demand for increased capacity grows, large-port-count, low-power-consumption and broadband VOA arrays are essential for on-chip optical systems. We demonstrate a 16-channel VOA array based on a polymer/silica hybrid waveguide. The proposed array operates across both the C and L bands, making it suitable for standard telecommunication wavelengths. The array achieves an average attenuation of over 15dB, which satisfies the requirements for applications such as dense wavelength division multiplexing (DWDM) systems, ROADM systems, long-haul or ultra-long-haul transmission networks, and metropolitan area networks. Additionally, the VOA array demonstrates low power consumption, with each channel consuming only 15mW, making it feasible for integration into large-scale, on-chip systems. We also address the challenges of optical and electrical packaging, making it a promising candidate for future commercialization in advanced optical communication networks. This design offers scalability and efficiency, making it suitable for next-generation optical systems.

POSTER PRESENTATION ABSTRACTS

TRANSFER-IMPRINTING-ASSISTED GROWTH OF 2D/3D PEROVSKITEHETEROJUNCTION FOR EFFICIENT AND STABLE FLEXIBLE INVERTED PEROVSKITESOLAR CELLS

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ABSTRACT

Flexible perovskite solar cells (FPSCs) have gained significant attention due to their potential applications in next-generation electronics. To improve the efficiency of FPSCs, interfacial passivation is essential as the density of surface defects is two orders of magnitude higher than that within the bulk perovskite films. Herein, a solvent-free transferimprinting-assisted growth (TIAG) method is employed to in situ grow 2D/3D perovskite heterojunctions. The solid-state transfer of spacer cation by the TIAG process enables a spatially confined growth of the 2D perovskite interlayer with uniform morphology between the 3D perovskite and charge transport layer. Meanwhile, the pressure associated with the TIAG process promotes the crystalline orientation, which is beneficial to carrier transport. As a result, the inverted PSC achieved a power conversion efficiency (PCE) of 23.09% (with certified 22.93%) and maintained 90% of their initial PCE after aging at 85 for 1200 h or operating for 1100 h under continuous AM1.5 illumination. Flexible inverted PSCs achieved a PCE of 21.14% with mechanical robustness by maintaining above 80% of their initial PCE after 10000 bending cycles under a 3 mm bending radius.

SINGLE-CRYSTALLINE HOLE-TRANSPORTING LAYERS FOR EFFICIENT AND STABLE ORGANIC LIGHT-EMITTING DEVICES

ABSTRACT

OLED technology has made incredible progress in the past few decades and has already stepped intocommercialization for flat-panel displays and solid-state lighting sources.Among the various functional layers in the OLED structure, charge-transporting layers (CTLs) as the key component for charge-carrier injection/transport play a vital role in determining the device performance. The CTLs deposited by conventional vapor or solution process are usually in amorphous forms, and their low charge-carrier mobilitiesin the range of 10−3~10−6 cm2 V−1 s−1, defect-induced high trap densities, and inhomogeneous thickness with rough surface morphologies have been obstacles to high performance of the OLEDs. In contrast to the amorphous films, organic single-crystalline semiconductors (OSCs) have long-range ordered molecular arrangement and low impurity content, leading to their superior charge-transport property, and as well as ultrasmooth surfaces with uniform thickness.The unique features of the OSCs propose their great potential as the CTLs to provide an alternative method to realize thicker OLEDs with high efficiency and high stability,however, it has not been fully explored yet. Here,OSC filmswere employed as the hole-transporting layers (HTLs) instead of the conventional amorphous films tofabricate highly efficient and stable OLEDs. The high-mobilityand ultrasmooth morphologies of the SC-HTLs facilitate superiorinterfacial characteristicsof both HTL/electrode and HTL/emissive layer interfaces,resulting in a high Haacke's figure of merit (FoM) of the ultrathin top electrode and low series-resistance joule-heat loss ratio of the SC-OLEDs.Moreover, the thick and compact SC-HTL can function as abarrier layer against moisture and oxygen permeation. The SC-HTLs are feasible to the OLEDs based on various emitters, and anEQE of 12.64% is obtained for the SC-OLEDs with a phosphorescent emitter, which is the highest value for SC-OLEDs reported so far.To our knowledge, this is the first report using organic single-crystalline semiconductors as the CTLs, suggesting anewstrategy to construct high-efficiency and high-stability OLEDs.

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