# International Conference on Optics, Electronics, and Optoelectronics (ICOEO)

**Time:** Dec 3-4, 2022

## Hosting Organizations

International Science and Technology Conference Institute (ISTCI)

## Operating Organization

FLC Event Co., Ltd.

## Supporting Organizations

- School of Mechanical and Electronic Engineering, ECUT, China
- School of Materials Science and Engineering, Harbin Institute of Technology

## Media Partnership

IOP Publishing
Organizing Committee

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Dr. Mohamad Sawan, Chair Professor of Westlake University, Emeritus Professor of Polytechnique Montreal. Fellow of the Canadian Academy of Engineering, a Fellow of the Engineering Institutes of Canada, a Fellow of the IEEE, VP Publications, IEEE-CAS Society. a Fellow of the Asia-Pacific Artificial Intelligence Association (AAIA), and an “Officer” of the National Order of Quebec.

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Dr. Yang Xu, Professor, Zhejiang University, China
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Dr. Almas Sadreev, Principal Investigator, Federal Research Center, Russia
Dr. Ali Ben Ahmed, Professor, University of Sfax, Tunisia
Dr. Luigi Santamaria, Associate Professor, CNR-National Institute of Optics, Italy
Dr. Seçkin Akın, Associate Professor, Karamanoglu Mehmetbey University, Turkey
Dr. Yanguang Yu, Associate Professor, University of Wollongong, Australia
Dr. Shaoqing Hu, Lecturer, Brunel University London, UK
Dr. Osamu Wada, Professor, Kobe University, Japan
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Dr. A Seteikin, Associate Professor, Amur State University, Russia
Dr. Shahrel Azmin Suandi, Professor, Kyusu Institute of Technology, Japan
Dr. Anahit S.Nikoghosyan, Associate Professor, Yerevan State University, Armenia
Dr. Izzet Parug Duru, Assistant Professor, Gedik Vocational School, Turkey
Dr. John Zhou, Professor, University of Technology Sydney, Australia
Dr. Sergey M. Aldoshin, Academician, Institute of Problems of Chemical Physics of Russian Academy of Sciences (IPCP RAS), Russia
Dr. Oleg V. Tolochko, Professor, Peter the Great St.Petersburg Polytechnic University, Russia
Dr. M. Abdelkarim, University of Bechar, Algeria
Dr. T.M. Razykov, Professor, Uzbekistan Academy of Science, Uzbekistan
Dr. Paul Cain, Strategy Director, FlexEnable Ltd, UK
Dr. R. Masrour, Professor, Sidi Mohamed Ben Abdellah University, Morocco
Dr. Suleyman OZCELIK, Professor, Gazi University, Turkey
Dr. Abu Zaharin Ahmad, Professor, University of Malaysia Pahang, Malaysia
Dr. YaoChun Shen, Professor, The University of Liverpool, UK
Dr. Sergey A. Ponomarenko, Professor, Enikolopov Institute of Synthetic Polymeric Materials, Russian Academy of Sciences, Russia
Dr. Abderrazak Boutramine, Teacher, Ibn Zohr University, Africa

Conference Secretariat

Ms. Kelly Wang
Ms. Amy Guo
Ms. Emily Liu
Mr. Zhi Lee
Ms. Sally Guo
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## Event Schedule

Time: December 3-4, 2022

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<th>Day 1 (Dec 3, 2022)</th>
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<td>8:30-12:30</td>
<td>Opening Ceremony &amp; Plenary Forum</td>
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<td>Session 2-1</td>
<td>N/A</td>
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<tr>
<td>12:00-13:30</td>
<td>Lunch</td>
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<tr>
<td>13:30-18:30</td>
<td>Session 1-5</td>
<td>Session 1-7</td>
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<td>Session 1-6</td>
<td>Session 3-3</td>
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<tr>
<td></td>
<td>Young Scientist Forum</td>
<td>Session 3-4</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Program

Time: December 3-4, 2022

Opening Ceremony & Plenary Forum

Time: 08:30-09:00, Dec. 3, 2022 (Saturday)
Moderator: Dr. Jinbao Zhang, College of Materials, Xiamen University, China

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
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</tr>
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<tbody>
<tr>
<td>08:30-09:00</td>
<td>Title: Biosensors to Screen Neural Activities Belonging to Brain Disorders</td>
<td>Dr. Mohamad Sawan, Westlake University, China</td>
</tr>
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</table>

Day 1: Dec. 3, 2022 (Saturday), Morning
Session 1-1: Preparation and Application of Optical Materials

Time: 09:10-10:40, Dec. 3, 2022 (Saturday)

| Chair                     | Dr. Tong Zhu, School of Mechanical Engineering, Beijing Institute of Technology, China |
| Co-Chair                  | Dr. Ping Liu, South China University of Technology, China |
| Time                      | 9:10-9:30
| Title                     | Flexible Organic Electrochromic Devices Having Multicolored, Low-Voltage-Driven and High Contrast Based on Oligomers and Viologen Derivatives |
| Dr. Ping Liu, South China University of Technology, China |
| Time                      | 9:30-9:50
| Title                     | 1D & 2D Bi202Se Based Photodetector |
| Dr. Chao Chen, University of Electronic Science and Technology of China, China |
| Time                      | 9:50-10:10
| Title                     | Probing Charge Carrier Dynamics and Transport in Optoelectronic Materials |
| Dr. Tong Zhu, School of Mechanical Engineering, Beijing Institute of Technology, China |
| Time                      | 10:10-10:30
| Title                     | Optical Spin-orbital Coupling in Organic Microcrystal Cavities |
| Dr. Qing Liao, Department of Chemistry, Capital Normal University, China |
| Time                      | 10:30-10:40
|                           | Coffee Break |

Day 1: Dec. 3, 2022 (Saturday), Morning
Session 1-2: Nano-Optics and Nano-Photonics

Time: 10:40-12:40, Dec. 3, 2022 (Saturday)

<p>| Chair                     | Dr. Kehan Tian, Uphoton Technology, China |
| Co-Chair                  | Dr. Weiqi Huang, College of Materials and Metallurgy, Institute of Nanophotonic Physics, Guizhou University, China |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:40-11:00</td>
<td>Title: Ultra-sensitive Optofluidic Microcavity Sensors</td>
<td>Dr. Xiang Wu, School of Information Science and Technology, Fudan University, China</td>
</tr>
<tr>
<td>11:00-11:20</td>
<td>Title: Micro-Nano-Optics and Its applications in AR/VR</td>
<td>Dr. Kehan Tian, Uphoton Technology, China</td>
</tr>
<tr>
<td>11:20-11:40</td>
<td>Title: Surface Plasmonic Lasing in Micro-Nanostructures of Silicon Excited by Using Pulsed Infrared Lasers</td>
<td>Dr. Weiqi Huang, College of Materials and Metallurgy, Institute of Nanophotonic Physics, Guizhou University, China</td>
</tr>
<tr>
<td>11:40-12:00</td>
<td>Title: Exploring Valley Exciton Excited by Plasmonic Spin Lattice</td>
<td>Dr. Huanli Zhou, School of Electronic Science and Engineering, Southeast University, China</td>
</tr>
<tr>
<td>12:00-12:20</td>
<td>Title: An Ultrasensitive Photoluminescent Immunosensor Based on Nitrogen Doped Graphene Quantum Dots for Detection Lipovitellin of Paralichthys Olivaceus</td>
<td>Dr. Ailing Yang, Ocean University of China, China</td>
</tr>
<tr>
<td>12:20-12:40</td>
<td>Title: Nanophotonic Component Characterization by Dual-tip Near-field Optical Microscopy</td>
<td>Dr. Thomas Pertsch, Abbe Center of Photonics, University of Jena, Germany</td>
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</table>

**Day 1: Dec. 3, 2022 (Saturday), Morning**  
**Session 1-3: Laser Technology and Application**  
*Time: 9:10-11:00, Dec. 3, 2022 (Saturday)*

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>Chair</td>
<td>Dr. Wei Liang, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, China</td>
<td></td>
</tr>
<tr>
<td>Co-Chair</td>
<td>Dr. Pu Zhang, Xi’an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China</td>
<td></td>
</tr>
<tr>
<td>9:10-9:30</td>
<td>Title: Development of Narrow Linewidth External Cavity Lasers for Sensing Applications</td>
<td>Dr. Wei Liang, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, China</td>
</tr>
<tr>
<td>9:30-9:50</td>
<td>Title: Time-gated Stand-off Raman Spectroscopy for the Detection and Identification of Explosives and Hazardous Chemicals</td>
<td>Dr. Pu Zhang, Xi’an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China</td>
</tr>
<tr>
<td>9:50-10:10</td>
<td>Title: Research on Spatial Generalized Relative Pose Measurement Method Based on SLAM Method</td>
<td>Dr. Yuan Gao, Shanghai Institute of Aerospace Control Technology, China</td>
</tr>
</tbody>
</table>
### Day 1: Dec. 3, 2022 (Saturday), Morning
**Session 2-1: Electronic Materials, Dielectric Materials and Devices**

*Time: 11:00-12:40, Dec. 3, 2022 (Saturday)*

<table>
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<tr>
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<tr>
<td>11:00</td>
<td>Title: Negative Photoconductance Effect: An Extension Function of the TiOx-based Memristor</td>
<td>Dr. Guangdong Zhou, College of Artificial Intelligence, Southwest University, China</td>
</tr>
<tr>
<td>11:20</td>
<td>Title: Hybrid PSO-GSA for Optimal Distribution Networks Automation Considering Uncertainties</td>
<td>Dr. Abu, School of Electrical Engineering and Automation, Wuhan University, China</td>
</tr>
<tr>
<td>11:40</td>
<td>Title: Self-Powered Memristive Systems for Storage and Neuromorphic Computing</td>
<td>Dr. Ye Tao, Northeast Normal University, China</td>
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<tr>
<td>12:00</td>
<td>Title: Rapid Energy Dissipation in Graphene Electronics Probed by In Situ Scanning Thermal Microscopy</td>
<td>Dr. Chuyun Deng, Department of Physics, National University of Defense Technology, China</td>
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<tr>
<td>12:20</td>
<td>Title: Biaxially (3D) Formed Active LC Optical Films for AR/VR Optics</td>
<td>Dr. Paul Cain, FlexEnable Ltd, UK</td>
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### Day 1: Dec. 3, 2022 (Saturday), Afternoon
**Session 1-5: Breaking Research of Optical Technology**

*Time: 13:30-16:55, Dec. 3, 2022 (Saturday)*

<table>
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<tr>
<th>Time</th>
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<tr>
<td>13:30</td>
<td>Title: A Novel Quantum Random Number Generator Constructed from a Single Photon GaN Emitter</td>
<td>Dr. You Wang, University of Electronic Science and Technology of China, China</td>
</tr>
</tbody>
</table>

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### Day 1: Dec. 3, 2022 (Saturday), Morning
**Session 2-1: Electronic Materials, Dielectric Materials and Devices**

*Time: 11:00-12:40, Dec. 3, 2022 (Saturday)*

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<td>Dr. Guangdong Zhou, College of Artificial Intelligence, Southwest University, China</td>
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<td>Dr. Chuyun Deng, Department of Physics, National University of Defense Technology, China</td>
</tr>
<tr>
<td>12:20</td>
<td>Title: Biaxially (3D) Formed Active LC Optical Films for AR/VR Optics</td>
<td>Dr. Paul Cain, FlexEnable Ltd, UK</td>
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### Day 1: Dec. 3, 2022 (Saturday), Afternoon
**Session 1-5: Breaking Research of Optical Technology**

*Time: 13:30-16:55, Dec. 3, 2022 (Saturday)*

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<td>Dr. You Wang, University of Electronic Science and Technology of China, China</td>
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<tr>
<td>Time</td>
<td>Title</td>
<td>Speaker</td>
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<tr>
<td>13:55-14:15</td>
<td>Title: Research Progress of Rare Earth Laser Single Crystal Fiber Materials</td>
<td>Dr. Shuyan Song, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China</td>
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<tr>
<td>14:15-14:35</td>
<td>Title: Comparison Study of Laser Vibration Measurement and Quantum Vibration Measurement</td>
<td>Dr. Ruibo Jin, Laboratory of Optical Information Technology, Wuhan Institute of Technology, China</td>
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<tr>
<td>14:35-14:55</td>
<td>Title: Advances in Fiber Integrated Optical Devices for Ultrafast Optics</td>
<td>Dr. Bo Guo, Harbin Engineering University, China</td>
</tr>
<tr>
<td>14:55-15:10</td>
<td>Title: Sensitive and label-free biosensing based on terahertz metamaterial</td>
<td>Dr. Rui Zhang, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China</td>
</tr>
<tr>
<td>15:10-15:20</td>
<td><strong>Coffee Break</strong></td>
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<tr>
<td>15:20-15:40</td>
<td>Title: Study of Serval Specific Frequency-selecting Procedures for All-fiber Single-frequency Lasers</td>
<td>Dr. Dongdong Wang, Norla Institute of Technical Physics, China</td>
</tr>
<tr>
<td>15:40-15:55</td>
<td>Title: Simulation and Experimental Research of Identification of Topological Charges for Vortex Beams</td>
<td>Dr. Qing Luo, Norla Institute of Technical Physics, China</td>
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<tr>
<td>15:55-16:15</td>
<td>Title: Optimized and learning-based Fringe projection profilometry</td>
<td>Dr. Jing Xu, Department of Mechanical Engineering, Tsinghua University, China</td>
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<td>16:15-16:35</td>
<td>Title: Mirrorless Terahertz-Wave Parametric Oscillator and its Imaging Applications</td>
<td>Dr. Kouji Nawata, Department of Information and Communication Engineering, Tohoku Institute of Technology, Japan</td>
</tr>
<tr>
<td>16:35-16:55</td>
<td>Title: 2-dim displacement optical sensor</td>
<td>Dr. Luigi Santamaria, Italian Space Agency, Italy</td>
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**Day 1: Dec. 3, 2022 (Saturday), Afternoon  
Session 1-6: Photonic Technologies and Devices**

*Time: 13:30-14:50, Dec. 3, 2022 (Saturday)*

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<tr>
<th>Chair</th>
<th>Dr. Yuan Li, School of Materials Science and Engineering, HUST, China</th>
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</table>
| 13:30-14:00 | Keynote Speech  
Title: Photonics for Orbital Angular Momentum Communications  
Dr. Yang Yue, Xi’an Jiaotong University, China |
### Day 1: Dec. 3, 2022 (Saturday), Afternoon

**Young Scientist Forum**

*Time: 14:50-16:50, Dec. 3, 2022 (Saturday)*

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<tr>
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<th>Title</th>
<th>Presenter</th>
</tr>
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<tbody>
<tr>
<td>14:50-15:05</td>
<td>Title: Tailoring Crystallographic Orientation of Sb2S3 Thin Film for Efficient Photoelectrochemical Water Reduction</td>
<td>Dr. Minji Yang, Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China, China</td>
</tr>
<tr>
<td>15:05-15:20</td>
<td>Title: AlGaN Quasi-Vertical Schottky Barrier Diode with Excellent Breakdown Characteristics</td>
<td>Dr. Xiufeng Song, Xidian University, China</td>
</tr>
<tr>
<td>15:20-15:35</td>
<td>Title: Novel High Electron Mobility Transistors Using the AlGaN Material Channel and Irradiation Application</td>
<td>Dr. Shuang Liu, Xidian University, China</td>
</tr>
<tr>
<td>15:35-16:00</td>
<td>Title: Laser Irradiation Modifying Two-Dimensional MoS2 for Self-powered Photoelectric Detection</td>
<td>Dr. Pu Feng, School of Materials science and engineering, Shanghai Jiao Tong University, China</td>
</tr>
<tr>
<td>15:50-16:05</td>
<td>Title: Photoluminescence Properties and Site Occupation of Transition Metal and Rare Earth Ion Doped Phosphors</td>
<td>Mr. Yuhui Chen, Hubei University, China</td>
</tr>
<tr>
<td>16:05-16:20</td>
<td>Title: Rare Earth and Transition Ions Codoped Double Perovskite Type Phosphors</td>
<td>Mr. Xiao He, Hubei University, China</td>
</tr>
<tr>
<td>16:20-16:35</td>
<td>Title: Preparation of Polydodecyl Phenylsulfonic Acid/ Polyaniline Composite and its Electrochemical Properties</td>
<td>Mr. Shuai Shi, Xi’an Polytechnic University, China</td>
</tr>
<tr>
<td>16:35-16:50</td>
<td>Title: The Fulfillment of the Sum Rule in Copper Optical Films</td>
<td>Dr. Julie Riabenko, V. N. Karazin Kharkiv National University, Ukraine</td>
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Day 2: Dec. 4, 2022 (Sunday), Morning
Session 1-4: Optical Communications Technology
Time: 8:30-9:50, Dec. 4, 2022 (Sunday)

<table>
<thead>
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<tbody>
<tr>
<td>8:30-9:00</td>
<td><strong>Keynote Speech</strong>&lt;br&gt;Title: Evaluation of Environmental Factors Impacts to Underwater Wireless Optical Communication&lt;br&gt;Dr. Shien-Kuei Liaw, Department of Electronic and Computer Engineering, Taiwan Tech, Taiwan</td>
</tr>
<tr>
<td>9:00-9:20</td>
<td><strong>Title:</strong> Night Background Light Noise Model of Visible Light Communication System in Vehicle Networking Environment&lt;br&gt;Dr. Xizheng Ke, Xi’an University of Technology, China</td>
</tr>
<tr>
<td>9:20-9:40</td>
<td><strong>Title:</strong> Indoor Visible Light Communication and Positioning Cooperative Systems&lt;br&gt;Dr. Changyuan Yu, Department of Electronic and Information Engineering, The Hong Kong Polytechnic University, China</td>
</tr>
<tr>
<td>9:40-9:50</td>
<td><strong>Coffee Break</strong></td>
</tr>
</tbody>
</table>

Day 2: Dec. 4, 2022 (Sunday), Morning
Session 2-2: Thin Films and Devices
Time: 9:50-10:50, Dec. 4, 2022 (Sunday)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:50-10:10</td>
<td><strong>Title:</strong> Perpendicular Exchange Bias in Ultrathin Hard/Soft Rare-earth Transition Metal Bilayers with Perpendicular Magnetic Anisotropy&lt;br&gt;Dr. Ke Wang, School of Mechanical and Electronic Engineering, ECUT, China</td>
</tr>
<tr>
<td>10:10-10:30</td>
<td><strong>Title:</strong> Si Based Infrared Detector with High Speed and High Efficiency&lt;br&gt;Dr. Jun Gou, University of Electronic Science and Technology, China</td>
</tr>
<tr>
<td>10:30-10:50</td>
<td><strong>Title:</strong> Self-assembled Organic Semiconductors for Various Electronic Thin Film Devices&lt;br&gt;Dr. Sergey A. Ponomarenko, Enikolopov Institute of Synthetic Polymeric Materials, Russian Academy of Sciences, Russia</td>
</tr>
</tbody>
</table>

Day 2: Dec. 4, 2022 (Sunday), Morning
Session 3-1: Optoelectronic Imaging and Display, Lighting Related Technologies
Time: 08:30-10:40, Dec. 4, 2022 (Sunday)

<table>
<thead>
<tr>
<th>Time</th>
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<tr>
<td>8:30-10:40</td>
<td><strong>Chair</strong>&lt;br&gt;Dr. Yang Xu, School of Mico-Nano Electronics, Zhejiang University, China</td>
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<tr>
<td>Time</td>
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<tr>
<td>8:30-8:50</td>
<td>Investigating the Light Emission of Mini-LEDs and Micro-LEDs by Using Microscopic Hyperspectral Imaging</td>
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<tr>
<td>8:50-9:10</td>
<td>Polarization Super-resolution Spatial Resolution Restoration Technology Based on Micro-scanning</td>
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<tr>
<td>9:10-9:30</td>
<td>A Novel Plasma-based Physical Vapor Film Deposition Technology with Adjustable Ion Energy</td>
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<tr>
<td>9:30-9:50</td>
<td>Broadband Graphene-Silicon Integrated Field-Effect Coupled Detectors</td>
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<td>9:50-10:10</td>
<td>Optimization of Spectral Sensitivity for Multispectral Imaging</td>
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<tr>
<td>10:10-10:30</td>
<td>Energy transformations accompanying a shock wave distortion and disappearance during the interaction with thermally stratified plasma</td>
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<tr>
<td>10:30-10:40</td>
<td>Coffee Break</td>
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**Day 2: Dec. 4, 2022 (Sunday), Morning**

**Session 3-2: Solar Cells**

**Time: 10:40-12:00, Dec. 4, 2022 (Sunday)**

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<thead>
<tr>
<th>Time</th>
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<tr>
<td>10:40-11:00</td>
<td>Low-dimensonal Electrode Materials in Photovoltage Devices</td>
<td>Dr. Jinzhong Wang, Harbin Institute of Technology, China</td>
</tr>
<tr>
<td>11:00-11:20</td>
<td>Compositional Engineering and Stability of Organic Hole Transport Materials for Perovskite Solar Cells</td>
<td>Dr. Jinbao Zhang, College of Materials, Xiamen University, China</td>
</tr>
<tr>
<td>11:20-11:40</td>
<td>Stabilizing Perovskite Precursor for High-efficiency Perovskite Solar Cells</td>
<td>Dr. Cong Chen, School of Materials Science and Engineering, Hebei University of Technology, China</td>
</tr>
<tr>
<td>11:40-12:00</td>
<td>SbxSey Thin Film Deposition by CMBD from Sb and Se Precursors and Characterization for Photovoltaic Applications</td>
<td>Dr. T.M. Razykov, Uzbekistan Academy of Science, Uzbekistan</td>
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</table>
Day 2: Dec. 4, 2022 (Sunday), Afternoon
Session 1-7: Quantum Optics & Nonlinear Optics

Time: 13:30-15:05, Dec. 4, 2022 (Sunday)

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<tr>
<th>Time</th>
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<tr>
<td>13:30-13:55</td>
<td>Experimental Studies of Non-Hermitian Quantum Physics with Light-Atom Interactions</td>
<td>Dr. Le Luo, Sun Yat-Sen University, China</td>
</tr>
<tr>
<td>13:55-14:15</td>
<td>Application of Weak Measurement in Quantum Information Processing</td>
<td>Dr. Ya Xiao, Ocean University of China, China</td>
</tr>
<tr>
<td>14:15-14:35</td>
<td>Self-organization of ultracold atomic gases led by photon-mediated interactions</td>
<td>Dr. Yongchang Zhang, Xi’an Jiaotong University, China</td>
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Day 2: Dec. 4, 2022 (Sunday), Afternoon
Session 3-3: Optical Sensor & Fiber Optic Sensor

Time: 14:45-16:05, Dec. 4, 2022 (Sunday)

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<tr>
<th>Time</th>
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<tr>
<td>14:45-15:05</td>
<td>Polymeric Waveguide Temperature Sensor Based on Asymmetric Mach-Zehnder Interferometer</td>
<td>Dr. Xibin Wang, Jilin University, China</td>
</tr>
<tr>
<td>15:05-15:25</td>
<td>Design and Realization Separable Observation Sensors of Tianwen-1 Mars Probe</td>
<td>Di Wu, Shanghai Aerospace Control Technology Institute, China</td>
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<tr>
<td>15:25-15:45</td>
<td>A Photoelectric Integrated Chip with a Gain up to 107, a Dynamic Range Over 160dB, and a Spectroscopic Response from 254nm to 1.46μm</td>
<td>Dr. Kai Wang, Sun Yat-Sen University, China</td>
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Day 2: Dec. 4, 2022 (Sunday), Afternoon
Session 3-4: Semiconductor and Optoelectronic Materials Technology
<table>
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<th>Time: 13:30-14:30, Dec. 4, 2022 (Sunday)</th>
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<tr>
<td>Chair</td>
<td>Dr. Xiaojian She, Zhejiang University, China</td>
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<tr>
<td>Co-Chair</td>
<td>Dr. Jinbo Pang, Institute for Advanced Interdisciplinary Research (iAIR), University of Jinan, China</td>
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</table>
| 13:30-13:50 | Title: Device Physics and Design for Thin Film Transistor Electronics  
Dr. Xiaojian She, Zhejiang University, China |
| 13:50-14:10 | Title: Thermodynamic and Kinetic Regulation for Controlled Growth of Two-dimensional Materials  
Dr. Jinbo Pang, Institute for Advanced Interdisciplinary Research (iAIR), University of Jinan, China |
| 14:10-14:30 | Title: MoS2/WSe2 vdW Heterostructures Decorated with PbS Quantum Dots for the Development of High-Performance Photovoltaic and Broadband Photodiodes  
Dr. Zhangting Wu, Hangzhou Dianzi University, China |
Plenary Forum

Moderator: Dr. Jinbao Zhang, College of Materials, Xiamen University, China
Title: Biosensors to Screen Neural Activities Belonging to Brain Disorders

Prof. Mohamad Sawan, FRSC, FIEEE, FCAE  
Director, CenBRAIN Neurotech, School of Engineering, Westlake University, China

Abstract

Nowadays, emerging neurotechnology is spread to implement smart medical biosystems (sensors and actuators) intended to enhance or recover lost vital functions, mainly due to brain disorders. To build such expected efficient biodevices, smart biosensors to screen neural activities, and monitor and manipulate cells and study neural diseases, and links with brain diseases. Also, learning algorithms and corresponding neuromorphic hardware are becoming the main option of emerging neural network-based microchips to introduce needs tools for this above introduce purpose. This talk covers wearable and implantable microdevices dealing with multidimensional design challenges such as power management, low-power and high-data rate wireless communication methods, intended to implement brain interfaces. Case studies include various neurorecording types for several applications such as epilepsy, stroke, and addictions.

Biography

Mohamad Sawan is Chair Professor in Westlake University, Hangzhou, China, and Emeritus Professor in Polytechnique Montreal, Canada. He is founder and director of the Center of Excellence in Biomedical Research on Advanced Integrated-on-chips Neurotechnologies (CenBRAIN Neurotech) in Westlake University, Hangzhou, China. He received the Ph.D. degree from University of Sherbrooke, Canada. Dr. Sawan was Editor-in-Chief of the IEEE Transactions on Biomedical Circuits and Systems (2016-2019). He is founder of the Polystim Neurotech Laboratory. He hosted the 2016 IEEE International Symposium on Circuits and Systems, and the 2020 IEEE International Medicine, Biology and Engineering Conference (EMBC). He was a Canada Research Chair in Smart Medical Devices (2001-2015), and was leading the Microsystems Strategic Alliance of Quebec, Canada (1999-2018). Dr. Sawan published more than 1000 peer reviewed papers and many books and patents. He received the Zhejiang Westlake Friendship Award, the Qianjiang Friendship Ambassador Award, the Shanghai International Collaboration Award, the Queen Elizabeth II Golden Jubilee Medal. Dr. Sawan is Fellow of the IEEE, Fellow of the Canadian Academy of Engineering, and “Officer” of the National Order of Quebec.
Session 1-1: Preparation and Application of Optical Materials

Chair: Dr. Tong Zhu, Beijing Institute of Technology, China
Co-chair: Dr. Ping Liu, South China University of Technology, China
Title: Flexible Organic Electrochromic Devices Having Multicolored, Low-Voltage-Driven and High Contrast Based on Oligomers and Viologen Derivatives

Liu Ping \(^{1a}\), Zeng Jinming \(^{1a}\), Wan Zhijun \(^1\), Zhang Xuejian \(^1\), Zhu Mimi \(^1\), Ye Weijie, Guo Xu \(^1\), Jiang Chuanyu \(^2\)

\(^1\)Key Laboratory of Luminescent Materials and Devices, Research Institute of Materials Science, South China University of Technology, China
\(^2\)Zhuhai Kaivo Optoelectronic Technology Co., Ltd, China

Abstract

In this paper, a series of organic conjugated oligomers and viologen derivatives are synthesized. Using these oligomers and viologen derivatives as active materials, flexible organic electrochromic devices are fabricated. The device structure is indiumtin oxide-PET plastic slide (ITO-PET)/active layer/conductinggel/ITO-PET, and the electrochromic properties of oligomers and viologen derivatives are investigated. These oligomers and viologen derivatives exhibit reversible color changes upon electrochemical doping and dedoping. The highest optical contrast is 75.2\% at 700 nm.

Fig. 1 The images of flexible ECDs based on the oligomers (left) and viologen derivatives (right)

Biography

Ping Liu is a professor in the School of Materials Science and Engineering and the Institute of Materials Science in South China University of Technology (SCUT). He received his PhD in materials chemistry from Osaka University, Japan in 2000. He joined the Institute of Materials Science, South China University of Technology (SCUT) in 1991, and became a full professor in 2005. His research focuses on organic/polymer functional materials, including: organic/polymer optoelectronic materials and devices, organic/polymer flame retardant and flame retardant materials, adhesives for automotive, pressure sensitive adhesives for power batteries, etc.
Title: 1D & 2D Bi2O2Se Based Photodetector

Dr. Chao Chen
Associate Researcher, School of Optoelectronic Science and Engineering, University of Electronic Science and Technology of China, China

Abstract

The unique electronic, optical, and mechanical characteristics of 2D materials make them play significant roles in the field of electronics and optoelectronics. And for the various bandgaps corresponding with widely wave length, new 2D materials are being explored in roles in the field of photodetection. The extraordinary electronic, optical, and mechanical characteristics of 2D materials make them promising candidates for optoelectronics, specifically in infrared (IR) detectors owing to their flexible composition and tunable optoelectronic properties. Due to the high carrier mobility, the large current on/off ratio (>106), moderate energy bandgap(≈0.8eV), and high air-stability of 2D bismuth oxyselenide (Bi2O2Se), Bi2O2Se nanosheets have received increasing attention in Visible-NIR detection. Here, high-quality 1D nanobelt and 2D nanosheet were synthesized by chemical vapor deposition (CVD) method, as well as the preparing condition and synthetic method were investigated. To study the photoelectric properties of the Bi2O2Se nanobelt and nanosheets, the photodetectors based on 1D Bi2O2Se nanobelt and 2D Bi2O2Se nanosheet were fabricated. The values of the responsivity(R), response time(τ), and specific detectivity (D*) were obtained, which shown great potentiality on the application of Visible-NIR detection and imaging.

Biography

Dr. Chen Chao received his bachelor degree of electronic information engineering and master degree of optical engineering degree in 2004 and 2008 respectively in Electronic Science and Technology of China (UESTC). He completed his doctorate in optical engineering with the Computer Aided Design (CAD) on microbolometer at UESTC in 2015. During the past ten years, Dr Chen has been engaged in infrared detector and CAD technology on MEMS device. After his analytical study of uncooled infrared focal plane arrays, he conducted his research on low dimension photodetectors.
Title: Probing Charge Carrier Dynamics and Transport in Optoelectronic Materials

Dr. Tong Zhu*
Professor, Beijing Institute of Technology, China

Abstract

Energy Flow mechanisms of the photophysical and photochemical processes have vital importance in guiding rational design and boosting efficiencies of optoelectronic devices. However, these processes usually take place on ultrafast timescale and in ultrasmall space, which make it challenging to directly visualize. We built ultrafast transient absorption/reflection microscopy (TAM) and simultaneously achieved 200fs temporal resolution and 50nm spatial precision. We directly visualized triplet exciton transport and revealed a new singlet-mediated triplet transport mechanism in a series of singlet fission single crystals, providing new guidance towards energetic engineering of singlet fission materials. We probed electron transfer and energy transfer of a mixed-dimensional organic-inorganic hybrid VdW heterostructure interface and a “trapping-detrapping” mechanism of interlayer CT exciton has been proposed to benefit charge separation at D-A interface. Recently, we directly studied coherent exciton transport in 1D organic supramolecular aggregates by TAM. It is demonstrated that the exciton transport behavior could be well controlled by molecular engineering, which is promising for achieving long-range exciton diffusion of organic semiconductors and corresponding devices. We also employed TAM to directly visualize carrier transport in MXenes. We revealed that band transport propagates over 400nm within 200fs after excitation. Through morphological and carrier transport TAM imaging, we showed that the hopping transport is limited by energetic disorder due to overlapping grain boundaries over a few nanoseconds. By controlling the carrier density, we reported a controllable superballistic diffusive rate up to 25000cm$^2$s$^{-1}$ by tuning carrier density in MXenes films.

Biography

Prof. Tong Zhu is a full professor at Lab of Laser Micro/Nano Fabrication, School of Mechanical Engineering, Beijing Institute of Technology. Her research orientation focused on ultrafast laser micro/nano fabrication, electron dynamics control and electron level observation by high spatial-temporal resolution imaging techniques. She earned her Ph.D. at Purdue University, United States in 2017, followed with postdoctoral experience before joining the BIT faculty. She won the High-level Overseas Talent Program in 2019. Prof. Zhu first authored high quality academic articles such as Science Advances, Advanced Materials, Accounts of Chemical Research, Annual Review of Physical Chemistry, etc. She is now serving as reviewer of science and technology project of Winter Olympic Organizing Committee, as well as guest editor of the journal Materials.
Title: Optical Spin-orbital Coupling in Organic Microcrystal Cavities

Teng Long and Dr. Xinyuan Liu*
Beijing Key Laboratory for Optical Materials and Photonic Devices, Department of Chemistry, Capital Normal University, Beijing, China

Abstract

Organic semiconductor materials have shown important applications in the fields of organic solid-state lasers and molecular photonics due to their high optical gain, molecular tailoring, easy tuning of optical properties, and flexible integration. Optical microcavities can confine the light field in a very small space area, which greatly enhances the interaction between light and matter. We have designed the optical microcavities filled with organic microcrystalline, such as double-layer metal thin film structure. Based on this sandwich-type flat microcavity, the Bose-Einstein condensation of exciton-polaritons at room temperature and engineering spin-orbit coupling are realized. In recent works, we demonstrate room-temperature exciton-polariton condensation in organic microcrystal cavities and helical polariton lasing from topological valleys in an organic anisotropic microcrystalline cavity.

Biography

Dr. Liao completed his doctorate in physical chemistry with the ultrafast spectrometry and laser study at Institute of Chemistry Chinese Academy of Sciences in 2007. After his organic materials and laser devices in Institute of Chemistry Chinese Academy of Sciences as a post doctorate, he joined the photochemistry key laboratory at Institute of Chemistry Chinese Academy of Sciences in 2009, where he started his research to organic microcrystals and their optical properties. Dr. Liao is also joining department of Chemistry at Capital Normal University from 2013. He was studying the optical spin-orbit coupling in organic microcrystal cavities from 2008.
Session 1-2: Nano-Optics and Nano-Photonics

Chair: Dr. Kehan Tian, Uphoton Technology, China
Co-chair: Dr. Weiqi Huang, Guizhou University, China
Title: Ultra-sensitive Optofluidic Microcavity Sensors

Dr. Xiang Wu* and Xuyang Zhao
Professor, Department of Optical Science and Engineering, School of Information Science and Engineering, Fudan University, China

Abstract

Optofluidic microcavities can realize ultra-sensitive physical, chemical as well as biological sensing due to the strong light-medium interaction, high quality factor, and high sensitivity. Accurately and rapidly detection of molecules (e.g. biomarkers, gas, ions et al.) with different optofluidic microcavities has played an important role in the process of environment monitoring, and disease prevention and diagnosis. Moreover, optofluidic microcavities can realize specific detection of molecules with low sample consumption. However, the optofluidic microcavities still have some problems, such as poor system stability, low sensitivity, large environmental noise, not available for clinical detection, sensitivity limit, and complex operations. We proposed two different optofluidic microcavities sensors based on whispering gallery mode and Fabry-Pérot microcavities, respectively. By combining with the whole packaged technology and external referencing method, the microbubble resonator can realize ultra-high signal to noise ratio, making the specific detection of small biomolecules D-biotin with the concentration as low as 4.1 fM possible. Furthermore, a thin-walled microbubble resonator was theoretically analyzed and fabricated to improve its sensitivity, which can realize an ultra-low concentration (0.02aM) of cardiac troponin-I (cTnI) detection in the simulated serum. The feasibility of cTnI detection in the simulated serum indicating the clinical application potential of thin-walled microbubble resonator. To overcome the sensitivity limit, an optofluidic coupled Fabry-Pérot capillary sensors was proposed with ultrahigh sensitivity of 51709.0nm/RIU, which experimentally demonstrated to have ultra-low refractive index detection limit of 2.84 × 10^{-5} RIU. Furthermore, the incoherent light source and spectrometer used during the measurement facilitate the development of a low-cost sensing system. The optofluidic microcavities technologies provide a feasible technical route for the rapid and highly sensitive detection of molecules (biomarkers, gas, ions et al.).

Biography

Prof. Xiang Wu received his BS degree on Physics at Hunan University in 1999 and received his PhD degree on Optical Engineering at Zhejiang University in 2004, respectively. He is currently a professor of Department of Optical Science and Engineering at Fudan University. Furthermore, He is the head of the Department of Optical Science and Engineering at Fudan University. His research interests include biomedical photonics, optofluidic microcavity sensors and integrated optics. The related research works have been published in Nature communications, Analytical chemistry, small, ACS nano, Advanced optical materials and et al.
Title: Micro-Nano-Optics and Its applications in AR/VR

Dr. Kehan Tian
Professor, Founder & CEO, U photon Technology, China

Abstract

As the development of technologies in semiconductor fabrication area, the applications of micro-nano photonics have been extensively explored in many areas of consumer electronics, intelligent security, automobile, etc., especially in augmented reality (AR) and 3D sensing. This report will mainly introduce the industry research and progress of the applications of micro-nano photonics in these areas.

Biography

田克汉博士长期从事微纳衍射光学，三维光学系统和半导体精密制造的最前沿研究。田博士于清华大学精密仪器系获得学士和硕士学位，于美国麻省理工学院获得博士学位。田博士曾任职于美国 IBM 公司 TJ Watson 研究中心和半导体研发中心，担任资深科学家 / 研究员（教授级）。田博士回国创立驭光科技，致力于微纳衍射光学器件和三维传感器的研发和产业化工作；为客户提供完整的定制化解决方案，广泛用于智能 3D 传感识别、机器视觉、AR/VR、智能安防、自动驾驶等众多领域。
Title: Surface Plasmonic Lasing in Micro-Nanostructures of Silicon Excited by Using Pulsed Infrared Lasers

Dr. Wei-Qi Huang
Professor, Department of Physics, Hainan Normal University, China
College of Materials and Metallurgy, Institute of Nanophotonic Physics, Guizhou University, China
§ wqhuang@gzu.edu.cn

Abstract

Surface plasmon is a possible candidate to break the diffraction limit and open the door for developing nanolasers on silicon chips. A new step in this development involves the choice of the structures and compositions for better surface plasmonic emission. The micro-nanostructures were fabricated by using a nanosecond pulsed laser on silicon surface, in which the surface plasmonic emission is stronger. The group of emission peaks with multiple-longitudinal-mode occurs in the optical gain curve. Interestingly, the quantum energy of surface plasmon with 140 meV has been measured at first, which is related to the peak interval (about 62 nm) of longitudinal modes in the surface plasmonic lasing spectra. The surface plasmonic lasing near 865 nm was observed in the Purcell cavity with Si-Cr-Si layers excited by using pulsed lasers at 1064 nm. Surface plasmonic structure induced with photons was observed by using the reflection Talbot effect image, in which the mechanism of the surface plasmonic lasing can be explored. The physical model of the surface plasmonic laser has been built on the energy levels of the micro-nanostructures of Si.

Biography

Prof. Weiqi Huang is a professor in Guizhou University and Hainan Normal University. He has been a guest professor in Aarhus University, and an advanced scholar in Niels Bohr Institute of Modern Physics. He has engaged on condensed matter physics, nanophysics and laser physics from 1986.
Title: Exploring Valley Exciton Excited by Plasmonic Spin Lattice

Huan-Li Zhou and Tong Zhang
PhD student, Joint International Research Laboratory of Information Display and Visualization, School of Electronic Science and Engineering, Southeast University, China

Abstract

Manipulating valley electrons and photons in two dimensional (2D) materials have attracted numerous attentions, towards the selective control valley states by vertical illumination with helicity are one of the most convenient. However, this method usually required electrical signals, magnetic fields and/or cryogenic facilities that are not applicable for integrated valleytronic devices. These limitations have hindered the development of emerging all-optical devices, 2D material optoelectronics and quantum computing.

Herein, we demonstrate the state-of-art remote excitation and near-field modulation of valley states by three-beam, surface plasmon interference (SPI) in a coupled gold nanostructure-2D material device platform. In nanofabrication methods, we demonstrated a bottom-up fabrication strategy to design and construct the multi-layer heterostructure plasmonic waveguide using chemically synthesized nanostructures. Chemical synthesis methods provide promising nanotechnology for fabricating complex nanostructures with high uniformity and designable morphologies with low cost and short time-consumption alternative to lithographic process for the building of morphology engineered crystal structures. In addition, we embedded boron nitride-tungsten disulfide-boron nitride (hBN-WS2-hBN) heterostructure into a compact plasmonic nanogap nanocavity to achieve extremely confined mode volume whether during SPPs propagating or in nanogap cavity. Due to the periodic pattern of SPI, we also showed an excitonic array light source (ALS). This ALS could be modulated collectively, which has great potential for multiple qubits encoding. Our experiment may lay the groundwork for designing new types of integrated valleytronic circuits for quantum information and communications.

Biography

Huan-Li Zhou is a PhD student at the School of Electronic Science and Engineering, Southeast University (China). His research interests include the spectrum technology and optoelectronic properties for nanostructures and nano-materials, and the interface engineering of nano-devices.
Title: An Ultrasensitive Photoluminescent Immunosensor Based on Nitrogen Doped Graphene Quantum Dots for Detection Lipovitellin of Paralichthys Olivaceus

Dr. Ailing Yang* and Huaidong Wang
Professor, College of Physics & Optoelectronic Engineering, Ocean University of China, China

Abstract

Because the increasing levels of environmental estrogens (EEs) have caused negative effects on the environment, wildlife and human beings, research on the sensitive detection method of (EEs) is appealing much attention. For intrinsic high specificity and sensitivity, immunosensing technique is a good choose for estrogenous chemicals test in complex environmental conditions. As the main cleavage composition of vitellogenin (Vtg), a biomarker of EEs, lipovitellin (Lv) was proved to have same immunogenicity as Vtg, while better thermal stability than Vtg, thus Lv is more suitable than Vtg to be used as standard matter to establish standard test curve. At present, the main detection methods for Lv including in immune diffusion method, chemiluminescence method, enzyme-linked immunoassay, surface enhanced Raman scattering (SERS) and optical waveguide lightmode spectroscopy immunosensing. These methods have good sensitivities and specificities, however, some weak points, such as complex operation, long time consuming, large amount of antibody consuming, high price, large deviation, etc., need to be improved.

Based on the fluorescence resonance energy transfer (FRET) between nitrogen-doped graphene quantum dots (N-GQDs) conjugated with anti-lipovitellin monoclonal antibody (anti-Lv-mAb/N-GQDs) and reduced graphene oxide (rGO), we developed an ultrasensitive fluorescent free-label immunosensor for detection of Lv of Paralichthys olivaceus. This sensor possesses the advantages of simplicity, rapidity, high specificity and anti-interference for the test of Lv.

Biography

Dr Ailing Yang completed her master degree in optics at Sichuan University in 1998. She finished her doctorate in marine geophysics in 2010 at Ocean University of China, where she began research in the field of nanoscience and nanotechnology. Her research interests are photophysical properties of nanomaterials and its applications in sensors and solar cells.
Title: Nanophotonic Component Characterization by Dual-tip Near-field Optical Microscopy

Dr. Thomas Pertsch
Professor, Abbe Center of Photonics, Institute of Applied Physic, Friedrich Schiller University Jena, Germany

Abstract

Scanning Near-field Optical Microscopes (SNOMs) deliver sub-diffraction images of optical nearfields. While SNOMs usually operate with a single scanning tip, near-field optical microscopes with two independent scanning tips for simultaneous excitation and detection can be used for studying near-field interaction phenomena on the sub-wavelength scale. Here we report on our recent advances in the development of a fully automated and robust dual-tip near-field scanning optical microscope (dSNOM), which allows for simultaneous scanning of an excitation tip, through which near-field effects can be excited, and a detection tip, which measures near-field information from a different position. In our measurements, the excitation tip is navigated to the point of interest, where it excites the near-field phenomenon of interest. While the excitation tip is kept stationary at this position, the detection tip automatically scans the surrounding area. Subsequently, the excitation tip is shifted to the next position of interest and scanning of the detection tip is restarted. Ultimately, both tips can sequentially scan a continuous area by which giving rise to measuring the entire near-field point-spread or Green’s function. During scanning, mechanical interactions due to shear forces between both tips are used to monitor and control the distance between the two probes. Using this additional feedback channel, we show that the dSNOM can operate stably over a wide range of parameters. To demonstrate the potential of dSNOM and the new opportunities arising from the instrument, we also report about several application examples, where dSNOM is used for nanophotonic component characterization.

Biography

Thomas Pertsch is Professor for Applied Physics and director of the Abbe Center of Photonics at the Friedrich Schiller University in Jena, Germany, where he heads the Nano and Quantum Optics group at the Institute of Applied Physics. He studied electrical engineering at the Technical University Dresden, Germany and Rensselaer Polytechnic Institute, Troy, USA. Afterwards he worked as a researcher at the Fraunhofer Institute for Applied Optics and Precision Engineering Jena. In 2003 he received his PhD from the Friedrich Schiller University Jena. His research focusses on the generation and interaction of light in nanostructured matter, including optical metamaterials and photonic crystals as well as ultrafast dynamics and quantum photonics.
Session 1-3: Laser Technology and Application

Chair: Dr. Wei Liang, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, China
Co-chair: Dr. Pu Zhang, Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences, China
Title: Narrow Linewidth External Cavity Laser for Various Sensing Applications

Dr. Wei Liang
Professor, Suzhou Institute of Nano-Tech and Nano-Bionics (SINANO), CAS, China

Abstract

Narrow linewidth laser (NLL) of low size-weight-and-power (SWAP) are the key elements for space coherent communication, long range sensing, and quantum technology etc. In the past, single frequency fiber laser, solid state laser and external cavity diode laser (ECDL) have fulfilled the market needs and recently ECDL using on chip ring cavities have also attracted intensive studies. Compared with aforementioned technologies using solid cavity, hollow Fabry Perot cavity possesses much lower thermal effect, nonlinear effect and frequency drift, which determines the lasers frequency noise, stability and output power. In the past high performance narrow linewidth laser (NLL) realized by injection lock to a large FP cavity has been demonstrated in the lab, however it has never matured into a viable product due to the large FP cavity and optic bench used in the experiments. Here we report our recent progress in developing 1550nm NLL using miniature FP cavities. Meanwhile this platform is very versatile and can be applied to many other wavelengths. We aim to quickly commercialize this technology and support the deployment of various sensing and quantum applications.

Biography

Dr. Wei Liang completed his doctorate in applied physics at Caltech in 2008. Afterwards he joined OEwaves, where he had studied high Q Whispering Gallery Mode (WGM) resonators and led the development of a series of applications and products based on the WGM resonator such as the ultra-low noise NLL, optoelectronic oscillator, which have won the “PRISM Award” of SPIE. In 2019 he joined Suzhou Institute of Nano-Tech and Nano-Bionics and has led a team to develop NLL using high Q Fabry Perot resonator. His group has worked with and provided NLL samples to leading laser chip company and fiber sensing companies.
Title: Stand-off Detection of Explosive Hazards Based on Time-gated Laser Raman Spectroscopy

Dr. Pu Zhang*
Professor, Xi’an Institute of Optics and Precision Mechanics of Chinese Academy of Sciences (CAS), China

Abstract

There are currently lots of research activities concerning explosive hazards detection, and stand-off detection of explosives is in main focus. The reason for this interest is the occurrence of terrorist attacks on the civilian society involving improvised explosives devices IED. Laser-based spectroscopies are the only viable techniques that can be utilized to sense trace amounts of explosives at stand-off distances. In particular, Raman spectroscopy has been shown to be effective for stand-off detection and has the ability to both detect and identify explosive materials. Raman spectroscopy is virtually instantaneous, non-destructive in nature and provides high selectivity. The traditional Raman spectrometer utilizes continuous lasers and CCDs to detection the scattering signal, which greatly limits the application of Raman spectroscopy in the stand-off detection of explosive hazards due to the weak signal, strong background fluorescence, ambient light interference, and long analysis time.

Time-gated Raman spectroscopies are based on ultrafast pulsed lasers and time-resolved single-photon detection technologies. Through the time-gated method, the Raman signal intensity can be greatly improved, and the influence of fluorescence and environmental light can be effectively suppressed. In this work, the time-gated Raman system utilizing quadruple frequency of Nd: YAG lasers was developed. The Cassegrain telescope was coupled to the Raman spectrometer using a fiber optics cable, and Notch filter was used to reject Rayleigh scattering light. The Raman scattered light was collected by a telescope and then transferred via fiber optic to spectrometer and finally directed into intensified CMOS detector. The applications of time-gated Raman spectroscopy in stand-off detection of hazardous explosives have been performed. We measure the Raman spectra of solid potassium nitrate at a stand-off distance of 50m.

Biography

Pu Zhang received the Ph.D. degree from Department of Chemical Physics, University of Science and Technology of China, Hefei, China, in 2010. He joined Xi’an Institute of Optics and Precision Mechanics of Chinese Academy of Sciences (CAS) in 2010. He is professor in State Key Laboratory of Transient Optics and Photonics of Xi’an Institute of Optics and Precision Mechanics of Chinese Academy of Sciences. His research field focuses on high power lasers, laser spectroscopy. He has published more than 50 papers in journals or conferences and owns15 patents.He hosted and participated in research projects of the National Natural Science Foundation, Major scientific research equipment project of CAS, etc.
Abstract

With the continuous promotion and upgrading of human space exploration, the complexity and difficulty of space missions are increasing. Space manipulation, rendezvous and docking, and situation awareness of non-cooperative targets have become important components of space missions. Relative position and attitude navigation system is an important part of space rendezvous and docking and space manipulation system. High precision relative position and attitude measurement is the key link of such tasks. At present, the commonly used space relative pose measurement methods include binocular camera, laser rangefinder and solid-state laser radar. With the iterative upgrading of technology, the space relative position and attitude measurement will inevitably move towards a diversified development direction. With its unique technical characteristics and advantages in many aspects, solid-state laser radar is destined to be an indispensable part of it.

In many important space missions that have been launched, its advantages have appeared. However, there are still problems with the solid-state lidar measurement system:
1) The accuracy is unstable and the depth measurement accuracy is low;
2) Due to poor universality, algorithms need to be redeveloped for different target characteristic models;
3) On orbit autonomy is poor, and the ability to identify unknown targets is limited;

This report introduces the relative position and attitude measurement methods of solid state lidar for cooperative and non-cooperative targets in space respectively. At the same time, it proposes an idea of real-time on orbit 3D reconstruction methods for solving complex non-cooperative target models.

Biography

Gao Yuan received his master degree in Control Science and Engineering in Shanghai Academy of Spaceflight Technology in 2018, and currently studying for his PhD degree at Harbin Institute of Technology. His main research direction is space photoelectricity and detection. The nano star sensor he once developed has been widely used in the commercial aerospace field at home and abroad. At present, he is engaged in the research of space relative pose measurement and 3D reconstruction of non-cooperative objects.
Title: Optoelectronic tweezers for cell manipulation and antibody discovery

Dr. Shuailong Zhang
Professor
1. School of Mechatronical Engineering, Beijing Institute of Technology, China.
2. Beijing Advanced Innovation Center for Intelligent Robots and Systems, Beijing Institute of Technology, China.

Abstract

Optoelectronic tweezers (OET) is a useful opto-electro-fluidic technology utilizing light-induced dielectrophoresis (DEP) for fine and non-invasive control and actuation of micro-objects. In the first part of this presentation, I will introduce an OET-driven microrobotic system, which can be programmed to carry out sophisticated, multi-axis operations. The microrobotic system described here was demonstrated to be useful for single-cell isolation, clonal expansion, RNA sequencing, controlling cell-cell interactions, and isolating precious microtissues from heterogeneous mixtures. In the second part of the presentation, I will introduce the use of OET to drive multi-component micro-machines such as micro-gear trains and micro-rack-pinion systems, which were demonstrated for different applications in micromanipulation, microfluidics and microrobots. In the third part of this presentation, I will introduce the use of OET to isolate B cells for antibody discovery and how this technology is commercialized for biopharmaceutical applications. These results demonstrated that OET is a versatile toolbox that can be used for many applications in the microscopic work for physics, engineering, and biomedical studies.

Biography

Shuailong Zhang completed his Ph.D. in 2015 at the University of Strathclyde (UK) and worked as a postdoc at the University of Glasgow (UK). In 2017, Shuailong joined the University of Toronto (Canada) as a postdoctoral fellow. Shuailong’s research mainly focus on optoelectronic tweezers, digital microfluidic technologies, and their applications for biomedical engineering. Shuailong Zhang has published over 40 papers on peer-reviewed journals including in Nature Communications, PNAS, Science Advances, Chemistry Society Reviews, Small, etc. In 2021, Shuailong joined the School of Mechatronical Engineering, Beijing Institute Technology as a full professor under the “National Outstanding Talent Abroad Program”.
Title: Mechanistic Study of Charge Separation in the Organic Donor/Acceptor Blends Using Multispectral 2D Spectroscopy

Dr. Yin Song  
Professor, School of Optics and Photonics, Beijing Institute of Technology, China

Abstract

Multidimensional spectroscopy (MDS) in the visible and infrared (IR) regimes has already enabled respective advances in our understanding of photosynthesis and the structural rearrangements of liquid water. A frontier of ultrafast spectroscopy is to combine multidimensional techniques and extend frequency ranges, which have been largely restricted to operating in the distinct visible or IR regimes. We have recently developed a multispectral multidimensional spectrometer with an unprecedented spectral window spanning ultraviolet to mid-infrared, and a time window from femtosecond to seconds, all of which are often relevant to the most important energy conversion and catalysis problems in chemistry, physics, and materials sciences. We have applied this powerful tool to study charge separation—the key energy-conversion process in organic photovoltaics (OPVs). We uncovered the hidden but efficient charge separation mechanism via hole transfer in a fullerene-based organic OPV blend. Taking advantage of visible and IR probes, we captured the intermediate state for the hole-transfer pathway in a non-fullerene OPV blend. These studies provide useful insight into how to further improve the power conversion efficiency in OPVs.

Biography

Prof. Yin Song obtained his Bachelor of Science degree from the College of Chemistry and Molecular Engineering at Peking University in 2009 and his doctorate in Chemical Physics from the University of Toronto in 2015. He was an ICAM and NSERC Post-doctoral Fellow at the University of Michigan from 2015 to 2019 and was promoted to Assistant Research Scientist then. In 2021, he joined the Beijing Institute of Technology as a full professor. His research interest focuses on developing multidimensional spectroscopy to study light-matter interaction and dynamical processes in artificial and natural light-harvesting systems. He has developed a multispectral multidimensional spectrometer with a wide spectral window from ultraviolet to mid-infrared and a time window from femtosecond to second. Taking advantage of this powerful spectrometer, he studied the energy-conversion processes in a variety of systems including photosynthetic reaction centers, semiconducting materials, and polaritons.
Session 2-1: Electronic Materials, Dielectric Materials and Devices

Chair: Dr. Guangdong Zhou, Southwest University, China
Title: Negative Photoconductance Effect: An Extension Function of the TiOx-based Memristor

Dr. Guangdong Zhou*, Wenhua Wang, Yuchen Wang
Professor, College of Artificial Intelligence, Southwest University, China

Abstract

Negative photoconductance (NPC) effect known as an increase resistance under illumination shows a great potential for application in photoelectric devices. Memristor with the structure of Ag(Graphene quantum dots (GQDs)|TiOx|F-doped SnO$_2$ exhibits typical bipolar resistive switching (RS) memory behavior. The NPC effect is impressively observed in the high resistance state (HRS) branch of the RS memory, for that, both memory logic display and multistate data storage as the memristor extension function are developed. Excitation, migration and compensation of oxygen vacancy at the GQDs/TiOx interface, where the electron transportation is efficiently restricted because of the variation of charge distribution and electrostatic potential under illumination, are responsible for the NPC effect. Experimental result, theoretical calculation and physical model provide an interface engineering to build the NPC effect in the memristive device as well as open a new horizon on the memristor extension function.

Biography

In the year of 2018, Guangdong Zhou, a Professor with the title a Han-Hong Scholar and Postdoctor Innovative Talent, in the College of Artificial Intelligence, Southwest University.  He received the Ph.D. in the College of Materials and Energy, Southwest University, Chongqing, China. During the 2018.6-2020.08, he conducted postdoctoral research in the College of Mathematics and Statistics, Southwest University, Chongqing, China. His research mainly focuses on the memristor preparation, memristor array integration technology, neuromorphic computing and sensory chips. More than 80 peer-reviewed works were published in the authoritative journals, for instance, Advanced Science, Nano Energy, Nano Letters, ACS Nano, Materials Horizons, Materials Today Physics, Advanced Electronic Materials, Journal of Physical Chemistry Letters, and Applied Physics Letters. 4 papers enter the ESI 1% and 7 projects are provided by China to support his research.
Title: Hybrid PSO-GSA for Optimal Distribution Networks Automation Considering Uncertainties

Dr. Ghamgeen Izat Rashed* and Shafeq Muhammed
Associate Professor, School of Electrical Engineering and Automation, Wuhan University, China

Abstract

Around the world, automation is transforming work, business, and the economy as one of the Pillars of a smart grid. The vital role behind utilizing the automation system into distribution networks is to achieve grid self-healing and improve the reliability level. Distributed Automation can be achieved via Smart secondary substations at each load point with installed automatic switches that needs large investment. Therefore, this paper provides a long term plan based on a cost/benefit study to define the optimal automation level of Distribution networks. DA planning is categorized as a non-linear Mixed Integer optimization problem with multi-dimensions. Thus, it is not possible to apply numerical algorithms for direct searching of all possible automation scenarios. To solve that problem; Hybrid Particle Swarm Optimization and Gravitational Search Algorithm (HPSO-GSA) technique provides a binary coded procedure to handle all the controlled variables to provide the best solution within the permissible constraints. The effectiveness of the proposed methodology is demonstrated by applying it to Bus 4 of the standard reliability (RBTS) considering uncertainty in Cost Damage Function (CDF), Investment Cost (IC) and Failure Rate (FR). Simulation results indicate a significant reduction in system reliability cost and with comparative results to those in literary studies.

Biography

Ghamgeen I. Rashed was born in Sulaimani-Iraq, on Sept. 16, 1974. He received his B.Sc. in Electrical Engineering in Salahaadin University-Iraq at 1995, his M.Sc. in Sulaimani University-Iraq in 2003, and his Ph.D. degree from Huazhong University of Science and Technology (HUST) in power system and its automation, China in 2008. Now he is associated professor in Wuhan university, School of Electrical Engineering and Automation, Wuhan University, China. His special research of interest in AI and its application in the power system, Smart Grid, FACTS devices specially TCSC and its control. Rashed already published more than 40 SCI and EI papers, he already take part in more than 25 international conference and invited as keynote speakers and paper presenters. He is member of IEEE, Cigre and Kurdistan Engineering Union.
Title: Self-Powered Memristive Systems for Storage and Neuromorphic Computing

Dr. Ye Tao*, Ya Lin, Xiaoning Zhao, and Zhongqiang Wang
Lecturer, Key Laboratory of UV Light-Emitting Materials and Technology of Ministry of Education, Northeast Normal University, China

Abstract

A neuromorphic computing chip that can imitate the human brain’s ability to process multiple types of data simultaneously could fundamentally innovate and improve the von-neumann computer architecture, which has been criticized. Memristive devices are among the best hardware units for building neuromorphic intelligence systems due to the fact that they operate at an inherent low voltage, use multi-bit storage, and are cost-effective to manufacture. However, as a passive device, the memristor cell needs external energy to operate, resulting in high power consumption and complicated circuit structure. Recently, an emerging self-powered memristive system, which mainly consists of a memristor and an electric nanogenerator, had the potential to perfectly solve the above problems. It has attracted great interest due to the advantages of its power-free operations. We give a systematic description of self-powered memristive systems from storage to neuromorphic computing, which also proves a perspective on the application of artificial intelligence with the self-powered memristive system. In addition, we have developed a novel moisture-powered memristor. The reversible oxygen migration across the interface formed between the memristor layer and the nanogenerator layer occurs in this integrated device, which allows simultaneous modulation of resistance state and open circuit voltage (Voc). This device not only presented the reversible characteristics of resistive switching and moisture-powered reading through human breath, but also further demonstrated the capability of the selective reading of multiple memory states for the first time.

Biography

Ye Tao received the B.S. and M.S. degree from Tianjin University in 2010 and 2014. Then he was with Final Test Team, Freescale Semiconductors, China, as a Test Process Engineer in 2014. And he received his Ph.D. degree from Northeast Normal University in 2018. He is now a lecturer in Northeast Normal University. His current research interests include electrical characterization and function development of carbon-based memristors.
Title: Rapid Energy Dissipation in Graphene Electronics Probed by In Situ Scanning Thermal Microscopy

Dr. Chuyun Deng
Associate Professor, College of Science, National University of Defense Technology, China

Abstract

Graphene is considered as potential thermal management material for novel electronics due to its ultra-high thermal conductivity. The precise thermal measurement on graphene and other two-dimensional materials is very important and challenging towards their future applications. However, it is difficult to characterize the nanoscale heat transport due to the optical diffraction limit and metallic coatings. In this paper, the energy dissipation process of graphene FET is studied by in situ scanning thermal microscopy (SThM), and a super-fast energy dissipation process (7.8ms) has been uncovered in graphene FET. This paper provides new insights into nanoscale heat transport and energy dissipation in time scale, which is crucial for the thermal management of graphene-involved electronics.

Biography

Dr. Deng received her bachelor and doctor degree on Physics at Tsinghua University from 2004 to 2013. She is working as an associate professor in Department of Physics, National University of Defense Technology, Changsha, China. The major interest of her research is two-dimensional (2D) material physics and related functional devices. In recent years, her lab is focusing on electron transport and phonon transport in 2D materials, heterostructures and devices. They have achieved precise characterization to electron/phonon transport based on kelvin force probe, micro-Raman and scanning thermal microscopy, and developed effective modulation approaches through symmetry engineering, van der Waals interlayer coupling, twistronics, etc.
Title: Biaxially (3D) Formed Flexible Active LC Optics for AR/VR

Dr. Paul Cain*
Strategy Director, FlexEnable, United Kingdom

Abstract

Liquid Crystal Optics (LC cells) are devices that actively manipulate the path of light passing through them via a variety of mechanisms. Depending on the selection of LC material and architecture, LC optics can steer, modulate and even focus light passing through the cell, either globally or locally. Conventional LC cells are built onto glass substrate, and whilst their optical performance often meets the requirements for several AR/VR use cases, glass-based LC-cells are often too heavy, too thick, or too flat to meet product requirements.

An overriding goal in AR/VR development is to create virtual objects that are indistinguishable from the real world. In the context of AR/VR, this is sometimes described as passing the visual Turing Test. As well as the display and optical performance advancements needed to come close to this goal, it is critical that the headset be as light as possible so that the wearer is unaware of its presence, a key part of passing the visual Turing test.

We will describe an LC Optics platform based on ultra-thin bioplastic films resulting in films that can focus and modulate light (local pixelated and global ambient dimming). Weighing as little as a gram and just 100 microns thick, uniquely these films can be biaxially formed to follow the contours of visors, fixed optics and other surfaces of complex curvature.

Biography

Dr Cain has 20 years’ experience in the flexible and organic electronics industries, in both technical and strategic management roles. He has a deep technical and industry knowledge of flexible display and LC Optics technologies and companies. Paul has taken new flexible electronics technologies from lab to fab to commercial product and has 25 patents relating to processes and architectures that enable the high yield manufacture of flexible large area electronics. Paul has a PhD in Quantum Physics from the University of Cambridge and an MBA from London Business School.
Session 1-5: Breaking Research of Optical Technology

Chair: Dr. You Wang, University of Electronic Science and Technology of China, China
Title: A Novel Quantum Random Number Generator Constructed from a Single Photon GaN Emitter

Dr. You Wang* and Qing Luo
Professor, National distinguished professor, Southwest Institute of Technical Physics, China

Abstract

In recent years, quantum random number generators (QRNGs) with the single-photon detection have been becoming the branching path generator, where the randomness entropy can be constructed by detecting the path superposition of a single photon. Generally, a traditional quantum random number generator is usually based on a process of attenuating the pulsed laser energy, in which a high photon counting rate and the single high single-photon performance cannot be achieved at the same time. In this study, we experimentally realized a real-time branching path generator, which was constructed by means of the bright room-temperature single-photon emission from a single-defect light source of gallium nitride (GaN). The 2 MHz single photon emission rate has been reached with the second-order auto-correlation of \(-0.36 \pm 0.01\) in the experiment. The raw-bits generation rate has been demonstrated as 1.8 MHz. Additionally, the von Neumann’s procedure has been employed to extract the unbiased random bits in real time, and the unbiased bit generation rate of 420 kHz has been achieved successfully. It has been proved that defective gallium nitride might be a suitable material with great potential for the development of an integrated high-speed quantum random number generator.

Biography

Prof. You Wang is currently a national distinguished professor of China with Southwest Institute of Technical Physics (SWITP), China. He is also involved in various aspects of theory and practice of several types of lasers as well as their industrial applications. His current research interests include kinetic processes, molecular and atomic physics, solid-state lasers, semiconductor lasers, gas lasers, image processing, micro laser processing, special waveguides and optoelectronic technology. These works have been published in more than 200 refereed scientific papers (reviews) in the scientific journals and academic conferences. He has also applied more than 40 patents in the Unite States, Japan, China, and Europe Union. He is a member of several national special committees belong to the Optical Society of China (OSC), Chinese Society for Optical Engineering (CSOE), China Instrument and Control Society (CIS), the Optical Society of America (OSA), the Laser Society of Japan (LSJ), and Optics and Photonics Society of Singapore (OPSS). He is the chief editor of Laser Technology of China (in Chinese). He is also the members of the Editorial Board for the International Journal of Optics and Applications, SAP.
Title: Research Progress of Rare Earth Laser Single Crystal Fiber Materials

Dr. Shuyan Song*
Professor, State Key Laboratory of Rare Earth Resource Utilization, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China

Abstract

Single-crystal fiber (SCF) is a fiber-shaped monocrystalline material, which possesses broad application prospects in the fields of national defense and people’s livelihood due to its excellent physical and chemical properties and large aspect ratio. It shows significant potential applications in solid-state lasers, scintillation detectors, high temperature sensors, etc. Recently, numerous researches have been focused on the crystal growth, the fabrication of cladding structure as well as applications of SCFs. With the maturity and development of the edge-defined film-fed growth technique, laser-heated pedestal growth technique and micropulling down technique, SCF ushers in a boom period with various materials and diversified applications. In recent years, researchers have combined optical and acoustic sensing technologies with SCF to broaden the operating temperature of conventional glass fiber sensors while maintaining the structural flexibility, and to compensate for the low lifetime of traditional contact temperature sensing techniques such as thermocouples in harsh environments. The investigation of applications of SCFs in high-power laser systems, mid-infrared lasers as well as scintillation detectors are analyzed. The strategies of cladding fabrications are also introduced briefly.

Biography

Shu-Yan Song received his BSc degree in Chemistry in 2003 and MSc degree in Inorganic Chemistry in 2006, both from Northeast Normal University. He joined the group of Prof. Hongjie Zhang at Changchun Institute of Applied Chemistry, Chinese Academy of Sciences (CAS), where he received his PhD degree in Inorganic Chemistry in 2009. He is working as a full professor at Changchun Institute of Applied Chemistry, CAS. He is now deputy director of State Key Laboratory of rare earth resources utilization and deputy director of China Belarusian advanced materials and manufacturing the Belt and Road joint laboratory. His research focus is primarily on the development of functional rare-earth materials.
Title: Comparison Study of Laser Vibration Measurement and Quantum Vibration Measurement

Dr. Rui-Bo Jin*
Professor, Hubei Key Laboratory of Optical Information and Pattern Recognition, Wuhan Institute of Technology, China
Email: jin@wit.edu.cn

Abstract

Vibration measurement plays an important role in the process of industrial production. How to measure the vibration with a high resolution is an important topic for the study of traditional laser Doppler vibrometers. With the development of quantum technology, it is possible to improve the measurement resolution to a higher level using the quantum entangled state. We built an experimental setup and measured a vibration source using a classical laser Doppler vibrometer. We also proposed an experimental scheme for quantum vibrometer using the NOON state. We compared the advantages and disadvantages of both schemes. As far as we know, this is the first quantum Doppler vibrometer scheme so far.

Biography

Rui-Bo Jin, Professor of Wuhan Institute of Technology. He received his PhD degree from Tohoku University in 2011, and then worked as a postdoctoral fellow at Tohoku University and the National Institute of Information and Communication Technology (NICT). He has been engaged in the experimental and theoretical research of quantum optics and quantum information for more than 15 years. He has published more than 60 articles in Optica, Phys. Rev. Lett., Phys. Rev. Appl., Phys. Rev. A, Opt. Express and other journals. He is the review editor of Frontiers in Quantum Science and Technology and the editorial board member of Scientific Reports. He was awarded the NICT "Excellence Award".
Title: Advances in Fiber Integrated Optical Devices for Ultrafast Optics

Dr. Bo Guo*
Professor, Key Lab of In-Fiber Integrated Optics of Ministry of Education of China, Harbin Engineering University, China

Abstract

Ultrafast photonics has become a research hot-spot of many scientists in the laser field because of its important application value in many fields such as optical fiber communication, optical fiber sensing, laser radar and biomedicine. In this report, we will briefly review the research progress in all-fiber ultrafast lasers in recent years, including the introduction and laser application of novel fiber devices such as 2D material fiber integrated devices, nonlinear Brillouin all-fiber loop mirror, nonlinear polarization evolution device, ultra-long period fiber gratings and 3D rotatable polarization beam splitter; Meanwhile, the latest research progress in ultrafast photonics based on hot-spot materials will also be introduced.

Biography

Bo Guo, Professor of Harbin Engineering University. He received his M. S. in Optics in 2011 and Ph. D. in physics electronics from the Harbin Institute of Technology in 2015. His research interests include ultrafast optics, 2D material photonics and ocean optics. He is author of more than 30 peer-reviewed journal papers in the field of laser including Laser & Photonics Reviews, 2018 Editor-in-Chief Choice Award and 2021 Outstanding Paper Award of Chinese Optics Letters, 2 ESI Hot papers/3 Highly-Cited papers and 4 invited papers. At present, he has undertaken many national key R&D projects and National Natural Science Foundation. He is a senior member of China Optical Society and a director of Heilongjiang optical society and served as more than 40 international journal reviewers and chairman of IEEE special sessions. He also won the Heilongjiang Provincial Science and Technology Award in 2021.
Title: Sensitive and Label-free Biosensing Based on Terahertz Metamaterial

Dr. Rui Zhang ¹, Cunlin Zhang ², and Liangliang Zhang ²
¹Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China
²Key Laboratory of Terahertz Optoelectronics (MoE), Department of Physics, Capital Normal University, China

Abstract

Terahertz (THz) spectroscopy has been widely applied in the quantitation and recognition of various biological samples. In particular, metamaterial biosensors are further introduced for the sensitive detection of bacterial, DNA, glucose and various proteins. Here, we present a novel multi-microfluidic-channel metamaterial biosensor for highly sensitive THz sensing of small volume liquid samples. The multi-channels are set mostly in the strong electric field enhancement area of the bow-tie array metamaterial, which significantly decreases the liquid amount and enhances interaction between the sensing targets and the THz wave (thus increasing the sensitivity). Moreover, the specific terahertz sensing results of epidermal growth factor receptor (EGFR) are demonstrated by introducing the EGFR antibody and GNPs of different diameters to further enhance the sensitivity. Our proposed technique provides a robust route for metamaterial assisted THz label-free biosensing of various biological samples with high speed and high sensitivity.

Biography

Dr. Rui Zhang received the B.Eng. degree in Electronic Information Engineering from Xidian University, China, in 2010. He received his Ph.D. degree in Mechanics from Peking University, China, in 2016. From 2016-2018, he was a Postdoctoral Fellow in the Department of Electronic Engineering, The Chinese University of Hong Kong. He is now an Associate Professor at Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences. His research interests include terahertz spectroscopy and imaging, biomedical applications of terahertz technique, terahertz wave generation and detection.
Title: Study of Several Specific Frequency-selecting Procedures for All-fiber Single-frequency Lasers

Dongdong Wang\textsuperscript{1, 2}, Li Li\textsuperscript{2}, Qi Wang\textsuperscript{2}, Saiyu Luo\textsuperscript{2}, He Cai\textsuperscript{1}, Guofei An\textsuperscript{1}, Xiaoxu Liu\textsuperscript{1}, You Wang\textsuperscript{1}\textsuperscript{*}

\textsuperscript{1}Southwest Institute of Technical Physics, China
\textsuperscript{2}School of Electronic and Optical Engineering, Nanjing University of Science and Technology, China
\textsuperscript{*}youwang_2007@aliyun.com

Abstract

At present, the frequency-selection for all-fiber single-frequency lasers is mainly realized by using a Mach-Zehnder interferometer (MZI), multi-ring cavity (MRC), and dynamic grating (DG) established inside an unpumped doped fiber (UDF). Although these procedures have been proven to be effective in the frequency selection and lock-in, there is still a key issue that the difference among them in laser performance should be paid further attention.

In this paper, we present a detailed study of three specific frequency-selecting procedures for all-fiber single-frequency lasers. Firstly, the frequency-selecting principles of each procedure are simply summarized, and the influences of the difference in optical path between two arms of a MZI, the sub-ring length of a MRC, the length and rare earth ion doping concentration of an UDF on single-frequency lasers are analyzed in detail. Then, the 1064 nm single-frequency emission with the linewidth $< 10$ kHz in the same Yb-doped fiber laser has been achieved by employing three proposed procedures, respectively. Finally, the pump power thresholds of single-frequency fiber lasers based on MZIs, MRCs, and DGs are measured as 65, 60, and 70 mW, the slope efficiencies are 5.3, 6.5, and 5.1\%, and the side-mode suppression ratios are 48, 45, and 41 dB, respectively. The experimental results show that the MZIs have the best performance in mode stability, the MRCs have the highest energy efficiency, and the DGs are conducive to further narrow the emission linewidth by combining another frequency-selecting procedure. Our work could be beneficial to select the optimum frequency-selecting procedures for all-fiber single-frequency lasers in practice.

Biography

Dongdong Wang is currently an Engineer at Southwest Institute of Technical Physics, Chengdu, China. He received the B.Sc. degree in electronic science and technology and the Ph.D. degree in optical engineering from the Nanjing University of Science and Technology, Nanjing, China, in 2016 and 2022, respectively. His fields of research interest are fiber lasers, sensors, phase-sensitive amplifiers, and vortex beams. He is the author or coauthor of more than 12 journal papers in these fields.
Title: Experimental Research of Identification of Topological Charges for Vortex Beams

Qing Luo¹, He Cai¹, Hao Xing¹, Guofei An¹, Dongdong Wang¹, Xi Yang¹, and You Wang¹*
¹Southwest Institute of Technical Physics, China

Abstract

The optical vortex beam carrying orbital angular momentum (OAM) has attracted more and more attention in several fields such as optical communication and quantum information. Generally, the vortex beam is characterized by a phase singularity at its beam axis. Measuring and identifying the topological charges (TCs) of vortex beams is a key issue in many applications.

In this study, the polarization status has been introduced into the interferometric procedure for identifying TCs of vortex beams. The influence of polarization states on the TC identification has been demonstrated experimentally. Furthermore, we demonstrate the satisfactory robustness for the interferometric method during identifying the TCs of vortex beams. When the reference and signal beam do not perfectly overlap in a Mach-Zehnder (M-Z) interferometer, i.e. there is a small tilt angle between two beams, a petal-like interference pattern can still be maintained with good visibility and be used for estimating the magnitude and sign of the TC. Our results might provide reference significance for the long-distance optical communication using vortex beams in the near future.

Biography

Qing Luo got her master’ degree in optical engineering at Southwest Institute of Technical Physics in 2020. And she has been working at Southwest Institute of Technical Physics since then.
Title: Optimized and learning-based Fringe projection profilometry

Dr. Jing Xu
Associate Professor, Department of Mechanical Engineering, Tsinghua University, China

Abstract

Fringe projection profilometry has been widely used due to high resolution, high accuracy, and high speed. However, the measurement accuracy would significantly decrease for the measured object with the complex geometrical and optical property in the manufacturing industry. To this end, first, the model of the optimal measurement accuracy and defocus kernel is established and the nonlinear relation between optimal frequency of fringe pattern and the object distance is obtained; then, the depth-driven optimized variable-frequency sinusoidal fringe pattern is proposed to improve measurement accuracy. Second, the 3D reconstruction method based on the fusion of fringe pattern and deep learning is also proposed to solve the underexpose problem for the measured object with low reflectivity. Third, the fringe projection profilometry-based visual servoing method is proposed to realize the high-accuracy robot control for the texture-less object.

Biography

Dr Xu received the B.E. degree in mechanical engineering from Harbin Institute of Technology in 2003, and Ph.D. degree in mechanical engineering from Tsinghua University in 2008. He was a Postdoctoral Researcher in the Department of Electrical and Computer Engineering, Michigan State University. He joined the Department of Mechanical Engineering, Tsinghua University in 2010. He is currently an associate professor and his research interests include 3D vision, robotics and intelligent manufacturing. He has won several awards in teaching and research, including First Prize for Beijing Teaching Achievement Award of Higher Education, First prize of China machinery industry science and technology award. He served as an Associate Editor at the journal of Robotica and the Associate Vice President at IEEE Robotics and Automation Society.
Title: Mirrorless Terahertz-Wave Parametric Oscillator and its Imaging Applications

Dr. Kouji Nawata*
Associate Professor, Information and Communication Technology, Faculty of Engineering, Tohoku Institute of Technology, Japan

Abstract

Due to the valuable terahertz (THz)-wave applications in communications, security, and sensing, it is normally required to make efficient THz-wave generation and detection in order to develop those applications. Nonlinear parametric down conversion is a promising way to generate high peak power THz-wave. Especially, frequency tunable range exceeds other methods based on electrical devices and is suitable for spectroscopy, optical coherent tomography, and heterodyne detection. To discover novel scheme of nonlinear wavelength conversion between optical and THz-wave, therefore, is challenging in nonlinear optics.

Here, we develop tunable backward THz-wave parametric oscillation (BW-TPO). The quasi-phase-matching condition in a periodically poled lithium niobate (PPLN) satisfies energy and momentum conservation between pump, idler, and counter-propagating THz waves. The unique QPM automatically establishes BW-TPO without cavity mirrors and provides wide frequency tunability in the sub-THz-wave range by mere rotation of the crystal. The developed BW-TPO can allow us to generate over 200 W peak power at 0.3 THz. Calculated frequency tunability can cover the sub THz region, promising for various applications.

Biography

Dr. Nawata completed his doctorate in development of high average power solid state laser by a phase-conjugate mirror with the theoretical and practical combination at the Chiba University in 2010. After his graduation, he joined the Teraphotonics Research Team at RIKEN in 2010, where he directed his research to terahertz (THz)-wave generation, detection, and applications, with nonlinear photonics. This led to the development of ultrabright THz-wave sources with bulk and periodically poled lithium niobate (LN) crystals. The ultrabright THz-wave source based on injection-seeded THz-wave parametric generation with bulk LN exceeds brightness of large facility such as THz FEL. Another THz-wave source based on backward THz-wave parametric oscillation with PPLN also generates gyrotron-level peak-power THz-wave with compactness and room temperature operation. Dr. Nawata joined in Tohoku Institute of Technology, Japan in 2022. He is also joining the Teraphotonics Research Team as guest researcher.
Title: 2-dim displacement optical sensor

Dr. Luigi Santamaria Amato* and Davide Bianco
1Italian Space Agency (ASI), Matera Space Centre, Contrada Terlecchia snc, Italy
2Italian Aerospace Research Centre (CIRA), Via Maiorise, Italy

Abstract

Position sensing is a cornerstone for a multitude of applications in applied and fundamental science. Here we developed a sensor able to measure displacement \( d = (dx, dy) \) in two transverse dimensions independently and simultaneously with good resolution and exceptional repeatability using a commercial Hermite Gauss (HG) mode demultiplexer. The demultiplexer decomposes a 550 nm free space radiation in Hermite Gauss modes (\( \text{HG}_{n,m} \)), where \( n(m) \) represents the number of nodes in horizontal(vertical) direction, converts them in \( \text{HG}_{0,0} \) and couples them to single mode fiber (demultiplexing mode).

By using the device in reverse mode it can, by injecting one of the single mode fiber (i.e.: \( ij \)) with the \( \text{HG}_{00} \) mode, convert the injected radiation in a \( \text{HG}_{i,j} \) mode and then couple it to free space output.

We, using a fiber beam splitter, injected the fiber corresponding to \( \text{HG}_{00} \) mode with a low coherence radiation. The radiation exits from free space output and, after passing a lens, impinges on a mirror in a perpendicular way. The reflected beam, after passing the lens in opposite direction, is coupled again with device in demultiplexing mode and we monitor the power of fiber outputs. In this way the beam forms the waist on the mirror and, after reflection, overlaps with itself. With this setup the mode matching is as high as possible and the crosstalk between modes is minimum. By monitoring the intensities of modes we can measure the lens-device displacement with good resolution in 2 transverse dimensions.

Biography

Luigi Santamaria Amato after PhD in Physics was postdoctoral researcher at University Milano Bicocca and Institute of Complex Systems in Rome. In 2012 joined Italian Institute of Optics (INO-CNR) as temporary researcher where he worked on high resolution spectroscopy. From 2017 he is permanent researcher at Italian Space Agency where works on several projects of optical metrology and quantum optics. He is responsible of two projects of optical spectroscopy and quantum optics for quantum physics tests. He is author of many papers on peer-reviewed journals.
Session 1-6: Photonic Technologies and Devices

Chair: Dr. Yuan Li, School of Materials Science and Engineering, HUST, China
Title: Photonics for Orbital Angular Momentum Communications

Dr. Yang Yue*
Professor, School of Information and Communications Engineering, Xi'an Jiaotong University, China

Abstract

Optical communications, as the backbone of today’s telecommunications infrastructure, supports voice, video and data transmission through global networks. One critical issue in its research is the challenge of meeting the needs of increasing the data capacity. As another newly explored dimension, spatial division multiplexing (SDM) has been demonstrated with great potential to tremendously increase the data capacity. This talk presents free-space and fiber optical communications using orbital angular momentum (OAM) multiplexing.

First, the basics of OAM and its traditional applications will be introduced. The building blocks of OAM-based SDM system will be discussed. Next, we will list several typical scenarios for free-space optical OAM communications. Moreover, we will discuss the potential of using OAM modes for spatial multiplexing in a ring fiber. Several types of ring-core optical fibers for OAM modes will be presented, including multi-core ring fiber supporting thousands of OAM modes, coupled ring-core fiber with large negative dispersion, non-zero dispersion-shifted ring fiber to balance the chromatic dispersion and nonlinearity. Finally, we will review wavefront-phase-tailoring methods to reconfigurably manipulate and perform different networking functions on multiplexed OAM beams. Specifically, the optical functions of add/drop multiplexing, selective switching and multicasting will be reported for OAM beams.

Biography

Dr Yue is a Professor with the School of Information and Communications Engineering, Xi'an Jiaotong University, China. His current research interest is intelligent photonics, including optical communications, optical perception, and optical chip. He has published over 200 peer-reviewed journal papers (including Science) and conference proceedings with >9,000 citations, five edited books, two book chapters, >50 issued or pending patents, >200 invited presentations (including 1 tutorial, >20 plenary and >30 keynote talks). Dr. Yue is a Senior Member of IEEE and Optica. He is an Associate Editor for IEEE Access, Editor Board Member for three other scientific journals, Guest Editor for >10 journal special issues. He also served as Chair or Committee Member for >90 international conferences, Reviewer for >60 prestigious journals.
Title: Large-area Chemical Vapor Synthesis of Two-dimensional Metal Chalcogenides for Optoelectronic Image Sensors

Dr. Yuan Li  
Professor, School of Materials Science and Engineering, Huazhong University of Science and Technology, China

Abstract

Two-dimensional (2D) metal chalcogenides have the advantages of superior planar structure, high electron mobility, and tunable energy band structure, which can effectively make up for the deficiencies of silicon-based semiconductor materials in contemporary micro-nano electronic devices. To realize the industrial application of 2D metal chalcogenides, the key issue at present lies in the wafer-level and large-area quantitative production of materials. This report introduces a large-area growth strategy of 2D metal chalcogenides based on induced chemical vapor deposition, and the development of optoelectronic integrated device construction and image sensor studies. Using maskless laser lithography, electron beam etching and reactive ion etching technologies, we have successfully achieved the localized growth and large-area arrangement of the induced source. By developing the induced chemical vapor deposition process, we have realized the pre-design, large-area preparation and array processing of a serious of 2D metal chalcogenides, which were further used to construct optoelectronic integrated devices and image sensors based on micro-nano transistor arrays. In conclusion, we achieved the large-area controllable growth of a series of 2D metal chalcogenides, understood their key growth mechanisms, and advanced the application of 2D metal chalcogenides in future functional devices such as optoelectronic image sensors.

Biography

Prof. Dr. Yuan Li received his B.S. and M.S. from Central South University in 2009 and 2011, respectively. He then received his Ph.D. of Materials Science from The University of Alabama in 2015. Afterward he joined Northwestern University as a UNANCE postdoctoral research associate. He is currently a professor in the School of Materials Science and Engineering in Huazhong University of Science and Technology. His research interest is mainly focused on nanofabrication of 2D materials for optoelectronic imaging and intelligent recognition systems. Prof. Li has published more than 70 peer-reviewed papers in Advanced Materials, Advanced Energy Materials, Advanced Functional Materials, ACS Nano, Nano Letters, Materials Horizons and so on. He was elected for National High-level Young Talent Program of China and Chutian Young Scholar in Hubei province.
Title: High-Performance Electro-Optic Modulator on Thin-Film Lithium Niobate Platform

Yan-Yan Qin and Tong Zhang*
PhD student, Joint International Research Laboratory of Information Display and Visualization, School of Electronic Science and Engineering, Southeast University, China

Abstract

Lithium niobate (LN) is a popular material for electro-optic modulators used in long-haul communication for decades, based on its high electro-optic coefficient, wide transparency range in electromagnetic spectrum, stable physical and chemical characteristics. Conventional LN modulators are bulky, which can't meet the integration requirements of the fast-developing optical communication and microwave photonic system. The development of thin-film LN technology injects new vitality to the existing material and promotes the miniaturization process of LN-based electro-optic modulators. Herein, we propose and design a Mach-Zehnder electro-optic modulator working at 1550 nm on x-cut thin-film LN platform. The structural parameters of the LN waveguide and the coplanar waveguide such as the etch depth, separation distance between adjacent electrodes, width and thickness of the electrodes are discussed and optimized. The performance parameters of the modulator include the mode field distribution, optical and radio-frequency loss, voltage-length products, effective indices, characteristic impedance of the coplanar waveguide and 3-dB electro-optic bandwidth are calculated and analyzed using COMSOL and HFSS. The simulated half-wave voltage of 2.52 V and 3-dB electro-optic bandwidth greater than 130 GHz is obtained for a 7-mm-long modulator.

Biography

Yan-Yan Qin is a PhD student in physical electronics at School of Electronic Science and Engineering, Southeast University (China). Her advisor is Prof. Tong Zhang. She graduated from Nanjing University of Science and Technology with a bachelor's degree in electronic science and technology. Her research areas include integrated optical devices and microwave photonics.
Young Scientist Forum

Chair: Dr. Shuang Liu, Xidian University, China
Co-Chair: Dr. Xiufeng Song, Xidian University, China
Title: Tailoring Crystallographic Orientation of Sb₂S₃ Thin Film for Efficient Photoelectrochemical Water Reduction

Minji Yang and Prof. Yanbo Li*
PhD student, Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China, China

Abstract

Antimony sulfide (Sb₂S₃) has recently emerged as a promising photocathode material for photoelectrochemical (PEC) water reduction due to its appropriate band gap (~1.7 eV) and band position, satisfying the fundamental requirement for achieving high efficiency in PEC water splitting application. However, the reported applied bias photon-to-current efficiency (ABPE) of Sb₂S₃ photocathode is still very low (0.64%). Due to its unique quasi-1D crystal structure, the optoelectronic properties of Sb₂S₃ strongly depend on its crystallographic orientation. In general, the photogenerated carriers transfer more efficiently along the [hk1] orientation than along the [hk0] orientation. Therefore, tremendous efforts have been devoted to orientation engineering of Sb₂S₃ films for solar cell and PEC applications. However, it is still lacking an effective strategy to completely suppress the grain growth along the [hk0] orientation and achieve [hk1]-oriented Sb₂S₃ films.

We demonstrate that a completely [hk1]-oriented Sb₂S₃ film is prepared by sulfurizing an Ag/Sb bimetallic precursor film. A silver-induced crystal growth model is proposed to elucidate the formation mechanism of [hk1]-oriented Sb₂S₃ film. Based on the [hk1]-oriented Sb₂S₃ film, a Mo/Ag : Sb₂S₃/CdS/Pt photocathode delivers a high photocurrent density of 9.4 mA cm⁻² at 0 V versus RHE and a record-high ABPE of 1.2% under AM 1.5G illumination, which is almost two times higher than the previously reported ABPE of Sb₂S₃-based photocathodes. Mechanistic studies reveal that the completely [hk1]-oriented Sb₂S₃ film has lower defect density, higher conductivity and faster carrier mobility than that of randomly oriented Sb₂S₃ film, thereby contributing to higher separation and injection efficiency of photogenerated carriers. Our work not only demonstrates the effectiveness of crystal orientation of Sb₂S₃ film for PEC water splitting, but also provides a new strategy for crystal orientation engineering of stibnite-type semiconductors for solar energy conversion applications.

Biography

Minji Yang is a PhD student in the University of Electronic Science and Technology of China, under the supervision of Prof. Yanbo Li. He obtained his master’s degree from Southwest University of Science and Technology in 2019. He received the bachelor’s degree from the Chongqing University of Arts and Sciences in 2016. His research interests include photoelectrochemistry water splitting and synthesis of nanostructured materials.
Title: AlGaN Quasi-Vertical Schottky Barrier Diode with Excellent Breakdown Characteristics

Xiufeng Song, Jincheng Zhang*, Shenglei Zhao, Shuang Liu, Zhihong Liu and Yue Hao
PhD Student, Key Laboratory of Wide Band Gap Semiconductor Materials and Devices, Xidian University, China

Abstract

Ultrawide bandgap (UWBG) materials including Ga_2O_3 (4.8eV), diamond (5.5eV), Al_xGa_1-xN and AlN (6.2eV) are attractive for various optoelectronic and electronic applications. Among these materials, the bandgap of Al_xGa_1-xN alloys varies from 3.4 to 6.2eV, making them particularly suitable for the fabrication of high-voltage and high-power electronic devices, and ultraviolet (UV) detectors and emitters. AlGaN materials have been demonstrated for the optoelectronic applications, such as the solar-blind photodetectors and deep UV light-emitting diodes (LEDs). For the power electronics, the lateral Al_{0.25}Ga_{0.75}N SBDs and Al_{0.85}Ga_{0.15}N SBDs have been investigated. Although relatively high breakdown voltages have been achieved for these lateral SBDs, the extremely low forward current density below 1 A/cm^2 limits the practical application of the lateral Al_xGa_1-xN SBDs. In contrast, the vertical electronic devices can obtain large current density owing to the wide conducting channels, and dynamic current collapse can be neglected in vertical structure. Therefore, the vertical Al_xGa_1-xN devices demonstrate excellent potential in power applications.

In this work, a systematic study of the electrical and thermal properties of the Al_{0.3}Ga_{0.7}N quasi-vertical Schottky barrier diode was carried out for the first time. A high performance Al_{0.3}Ga_{0.7}N SBD with low turn-on voltage of 1.03 V, high on/off ratio of ~10^9 and low ideality factor of 1.22 was demonstrated. A record high average breakdown electric field of 2.13 MV/cm was obtained, which is much higher than the state-of art value for vertical GaN, Al_xGa_1-xN and AlN SBDs. The specific on-resistance will be significantly reduced from 6.8 to 0.5 mΩ·cm^2 by increasing the sheet resistance of n^+ Al_{0.3}Ga_{0.7}N layer according to the TCAD simulation results. In addition, the devices also exhibit an excellent thermal stability and maintain a low leakage at high temperature.

Biography

Xiufeng Song received the B.S. degree from Xidian University, Xi’an, China, in 2018, where he is currently pursuing the Ph.D. degree in GaN power devices. His current research interest includes the fabrication, characterization, and reliability analysis of GaN-based power devices.
Title: Novel High Electron Mobility Transistors Using the AlGaN Material Channel and Irradiation Application

Dr. Shuang Liu*, Shenglei Zhao, Jincheng Zhang and Yue Hao
The Key Laboratory of Wide Bandgap Semiconductor Materials, School of Microelectronics, Xidian University, China

Abstract

AlGaN materials have the ability to continuously adjust the band gap between GaN and AlN materials, which makes AlGaN channel high electron mobility transistors (HEMTs) become more attractive candidates for the next generation of power electronic applications. Wider band gap and higher critical breakdown electric field ensures that AlGaN channel HEMTs have better advantages and reliability in the high temperature and radiation environment. We have demonstrated high performance HEMTs with Al$_{0.1}$Ga$_{0.9}$N channel and AlN/GaN composite superlattice channel based on the silicon substrate, and systematically studied irradiation characteristics of AlGaN channels HEMT under total ionization dose and single event burnout. The fabricated Al$_{0.1}$Ga$_{0.9}$N channel HEMTs exhibited performances with a threshold voltage of -2.5V, a peak field-effect channel electron mobility of 437 cm$^2$/V·s, a specific on-resistance of 13.7 mΩ·cm$^2$ and a breakdown voltage of 1730 V with LGD=21μm. By introducing a novel cross ohm/schottky terminal structure into the drain electrode, the figure of merit (FOM) of the HEMT improved from 133 MW/cm$^2$ of the traditional ohm drain to 219 MW/cm$^2$ of the novel HEMT. Furthermore, the 20 cycles unit of AlN/GaN with a thickness of 1/5nm is innovatively used as the superlattice channel for the equivalent Al$_{0.2}$Ga$_{0.8}$N channel HEMT, realizing the highest peak electric field mobility of 510 cm$^2$/V·s for the AlGaN channel HEMT based on the silicon substrate.

In addition, the influence of trap state on HEMT performances and the possible mechanisms has been carried out through total ionization irradiation experiment. The negative drift of the threshold voltage of superlattice channel HEMT mainly comes from the hole trapping in the barrier layer or the interface between the channel layer and the barrier layer, which can also be equivalent to the increase of the channel 2DEG density. It can be found that the new trap states with shallower ET (0.22-0.23 eV) generated in channel are similar to the trap R2, which is related to the nitrogen vacancy with different cross section and activation energy barrier. Meanwhile, possible mechanisms of single event burnout (SEB) for AlGaN channel HEMT have been proposed for the first time from the perspective of electric field (E-field) based on back-channel effect. E-field near source and drain side after radiation would have a high peak E-field and that of p-GaN layer exceeds 3.3 MV/cm of critical E-field for GaN material, and the injection of an excess of holes in the AlGaN buffer layer into the gate with low potential, resulting in a sharp increase of the gate electrode current and occurrence of single event burnout.

Biography

Shuang Liu received the B.S. degree from the Xi’an University of Technology, Xi’an, China, in 2018. He is currently pursuing the Ph.D. degree in GaN power devices with Xidian University, Xi’an. His interests include the design and manufacture of GaN based power transistor devices, as well as the mechanism of total ionization dose and single event irradiation.
Abstract

CaSrGa₄O₈ phosphors co-doped with Eu³⁺ and Bi³⁺ were synthesized in air by high temperature solid-state method. The energy transfer from Bi³⁺ to Eu³⁺ was demonstrated by photoluminescence spectra and lifetime decay curves. The ⁵Dₒ⁻⁷F₄ anomalously strong emission of Eu³⁺ has been analyzed by Judd-Ofelt theory.

EU³⁺/EU²⁺/CE³⁺ co-existing wide-band dual-center emitting K₃YSi₂O₇ phosphors were synthesized in reductive atmosphere by high temperature solid-state method. Under the excitation of 330nm, its full width at half maxima is 211nm. The lattice occupancy of dopant ions has been analyzed using the theory of bond energy.

Biography

Mr. Chen received his bachelor's degree in Chemistry from Hubei University. He is now completing his master's degree in Chemistry at Hubei University.
Title: Laser Irradiation Modifying Two-Dimensional MoS₂ for Self-powered Photoelectric Detection

Mr. Pu Feng and Dr. Liming Gao*
Associate Professor, Institute of Electronic Materials and Technology, Shanghai Jiao Tong University, China

Abstract

Two-dimensional (2D) transition-metal dichalcogenides (TMDs) has the need of carrier transport modulation similar to silicon devices in semiconductor applications. Its photoelectric performance can be optimized by enriching doping methods, so that different functional devices can be constructed. For thinner 2D semiconductor materials, traditional doping methods are facing challenges, such as uneven diffusion, uncontrollable broken of ultra-thin 2D nanosheets and other problems. Chemical doping, plasma oxidation and other methods have been reported, however, these doping processes are complicated and uneconomical for selective patterning doping of small-scale two-dimensional semiconductors. Here, we proposed a simple method to use the photocurrent mapping test system to provide patterning laser radiation doping. Based on this system, local doping of 2D MoS₂ is achieved in one step without the process of mask or lithography. The 638nm laser spot with appropriate power density moves with the high-precision piezoelectric displacement table to irradiate MoS₂ point by point in the selective area. As a result, junction-type self-powered photodetectors can be implemented efficiently. Meantime, the doping induced by laser radiation was confirmed by photocurrent mapping and other measurements. The proposed laser radiation process provides an efficient local doping strategy, which is enlightening for the large-scale manufacturing of 2D semiconductor optoelectronic devices.

Biography

Dr. Gao received his Ph.D. in electrical engineering from the Technical University of Munich, Germany, in 2004. Then worked as a device research specialist in the Central Research Department of Infineon Technologies in Germany. 2011, joined the School of Materials, Shanghai Jiao Tong University, and engaged in the research of microelectronic devices and reliability analysis.
Title: Preparation of Polydodecyl Phenylsulfonic Acid/ Polyaniline Composite and its Electrochemical Properties

Shuai Shi, Mingming Ma* and Shuhui Cui
College of Environmental and Chemical Engineering, Xi'an Polytechnic University, China

Abstract

Poly dodecyl benzene sulfonic acid/polyaniline (PDBSA/PANI) composites were prepared by multiosweep cyclic voltammetry. The effect of concentration of dodecyl benzene sulfonic acid (DBSA) and other electrochemical parameters on the charge capacity of the composites was investigated. PDBSA/PANI composite with the largest charge capacity was obtained under the optimum condition. Compared with the electrochemical impedance of 3.77ohm of pure polyaniline and 3.256ohm of DBSA/PANI composite prepared by self-adsorption, the electrochemical impedance of PDBSA/PANI composite is only 1.694ohm, which indicates that the poly-dodecyl benzene sulfonic acid can remarkably enhance the conductivity of polyaniline. In addition, the specific capacitance of the PDBSA/PANI composite was 407.692 F/g, higher than that of the DBSA/PANI composite (339.307 F/g) and pure PANI (235.088 F/g). Therefore, the electrochemistry property of polyaniline can be improved to a greater extent by using polydialkylbenzenesulfonic acid. The density of the fiber adhesion substance on the surface morphology of the PDBSA/PANI and the DBSA/PANI is different, so that the electrochemical parameter of the polyaniline is improved. However, the process of single electron and single proton redox reaction of polyaniline was not changed by PDBSA, indicating PDBSA was not involved in the redox reaction of polyaniline.

Biography

Shuai Shi, undergraduate course graduated from Qiqihar University with a major in inorganic and non-metallic materials. During the school, he has won the gold medal of "CCB cup" college students innovation entrepreneurship competition in Heilongjiang province, the provincial silver prize of the fourth "Internet +" college students innovation-entrepreneurship competition. He was admitted to Xi 'an Polytechnic University for his Master degree. His instructor is professor Mingming Ma.
Title: The fulfillment of the Sum Rule in Copper Optical Films

Dr. Iuliia Riabenko\textsuperscript{1, 2*}, Beloshenko K. S.\textsuperscript{1}, Shulga, V. M.\textsuperscript{3}, Shulga S.\textsuperscript{1}
\textsuperscript{1}V. N. Karazin Kharkiv National University, Ukraine; \\
\textsuperscript{2}Leibniz University, Germany; \\
\textsuperscript{3}Jilin University, China.

Abstract

The need to detect biomolecules leads to the need to create resonant structures with controlled optical properties, on the one hand, and resistance to chemical and mechanical influences, on the other. In terms of optics, the biomolecule-high-quality resonator system can be considered as a system of coupled oscillators, which leads to an increase in the IR emission spectra and Raman scattering of the biomolecule. So, it is necessary to develop a technique for creating and controlling high-quality resonant systems which have field localization near the molecular groups related to the biomolecule under study. Such a technique was proposed in this work. The novelty of the technique is that the control over the obtained high-quality resonant structures was carried out not only based on the plasma resonance band, but also using the sum rule. It allows calculating the strength of the oscillators and predicting the distance at which the biomolecule and the resonant structure behave as coupled oscillators. The condition of a high-quality resonant system looks as follows: the film must be transparent in the IR region, and $f=1$ ($f$ is the oscillator strength) in the plasma resonance band. The data showed that the greatest oscillator strength was observed with a 15nm thick film placed in the near-surface layer of quartz at a depth of 10nm. This result allows to assume, on one hand, that this geometry will lead to the maximum enhancement of both the IR emission spectra and Raman scattering of biomolecules. On the other hand, we can calculate the density of electrons involved in copper interband transitions It was $n=4.8e27$ in our experiment.

Biography

Riabenko Iuliia defended her master's thesis in biophysics in 2011 in V. N. Karazin Kharkiv National University, after which she began working as an engineer as part of a scientific group at the Department of Theoretical Radiophysics of the Karazin University on the study and improvement of the SERS method. In 2018, she became a researcher as part of a scientific team that worked on the use of high-quality resonant systems at plasma resonance for the manufacture of highly sensitive biosensors, this work was carried out by the state order of Ukraine. In 2019, she entered graduate school, continuing her research in the field of Raman spectroscopy to detect biotoxin molecules in biological liquids at low concentrations, obtaining high-quality amplification of the spectra of molecules, taking into account the use of the technique of implanting high-quality metals into the near-surface layer of quartz. In 2022, she continued research on the SERS method using resonant structures in a dark mode in a national project to study the theology of neuropathic pain in patients with unclear theology.
Session 1-4: Optical Communications Technology

Chair: Dr. Xizheng Ke, Xi'an University of Technology, China
Title: Evaluation of Environmental Factors Impacts to Underwater Wireless Optical Communication

Dr. Shien-Kuei Liaw\textsuperscript{1*}, Shofuro Afifah\textsuperscript{1} and Chien-Hung Yeh\textsuperscript{2}
1. Graduate Institute of Electro-Optical Engineering, National Taiwan University of Science and Technology (NTUST), Taiwan
2. Department of Photonics, Feng Chia University, Taiwan

Abstract

An underwater wireless optical communication (UWOC) system was setup and demonstrated using a blue laser in 450nm with 1.25Gbps OOK modulation. The environmental effects such as turbulence, temperature and water density were measured in different transmission distance. The bit error rate (BER) performance which our study can reach in the 1.03 seawater density was $4.85 \times 10^{-6}$ at -7.4dBm. The water density may affect the system performance and result in a BER floor and eye diagram, while turbulence has little impact to BER performance than other parameters. Then, the UOWC transmission system was carried out by simultaneously changing two parameters among temperature, turbulence and water density which by adding salt into the water tank. Here, a submerged motor has an output up to 1200L/h is used to simulate the water turbulence. For thermal effect measurement, with an original temperature of 25°C, the temperature was varying from 10°C to 50°C with/without turbulence. An experimental result discussion is given. It is found that room temperature 25°C has the best BER then in either higher and lower temperature range. Water density is increased due to impure particles increases, the particles raise as submerged motor turns on, which may block the laser beam to destination and result in system performance degradation.

Biography

Shien-Kuei Liaw received double doctorate degrees from National Chiao-Tung University and National Taiwan University. Prof. Liaw has worked at National Taiwan University of Science and Technology since 2000. He was an academic visitor at the University of Oxford in 2011 and at the University of Cambridge in 2018. He authored or co-authored for more than 300 journal articles and international conference papers. He also holds more than 40 domestic and international patents. He has been actively contributing to various conferences as a keynote speaker and a program chair/co-chair. He serves as a Guest Editor for several journal papers and books. His research interesting is in optical communication, fiber sensing and fiber based devices.
Title: Night background light noise model of visible light communication system in vehicle networking environment

Dr. Xizheng Ke*
Professor, School of Automation and Information Engineering, Xi’an University of Technology, China

Abstract

The visible light communication of the Internet of vehicles is not only affected by atmospheric turbulence, but also disturbed by background lights such as traffic lights, street lights, front and rear lights of vehicles and high brightness billboards. The conventional light intensity flicker model cannot accurately describe the channel characteristics of the visible light communication system of the Internet of vehicles. A night background light noise model of vehicle network visible light communication system expressed by double Gaussian function superposition is proposed. Through the measured data in different regions and different weather, the model is numerically fitted to verify the effectiveness of the model. The results show that there is no obvious difference between the probability density distribution in rainy days and that in sunny days, and the intensity fluctuation of road light is less than that of other light sources. The model has certain research significance for the establishment of visible light channel model and noise removal of vehicle networking.

Biography

Ke Xizheng, male, born in 1962, received his Ph.D. from Chinese Academy of Sciences in 1996. He is now a professor and doctoral supervisor in Xi'an University of Technology, IEEE member, senior member of Chinese institute of electronics and China Instrument and Control Society. He has been awarded the outstanding young scholar award of Chinese Academy of Sciences in 2000 and 10 provincial awards on technology advancement. He has published 9 books, 300 papers indexed by SCI and EI, twenty patents for invention and software copyrights, undertaken dozens of National Natural Science Foundation Projects and military weapons and equipment demonstration projects. His main research area is wireless laser communication theory and technology.
Title: Indoor Visible Light Communication and Positioning Cooperative Systems

Dr. Changyuan Yu*
Professor, Photonics Research Institute, Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic University, China

Abstract

We review our recent work on the cooperative systems combining visible light communication (VLC) and visible light positioning (VLP): a location-based equalization (LBE) method is proposed for indoor VLC by utilizing receiver location information; then a VLP scheme based on the estimated channel state information (CSI) is investigated, where the distances information between transmitters and the receiver can be extracted from received signals to enable VLPs; finally a hybrid VLC and VLP architecture based on Code Division Multiplexing (CDM) is designed, which integrates VLC and VLP within a single system without breaking the existing VLC frame structure.

Biography

Prof. Changyuan YU received his Ph.D. in Electrical Engineering from the Univ. of Southern California, USA in 2005. He was a visiting researcher at NEC Labs America in Princeton, USA in 2005. He then joined the faculty of National Univ. of Singapore (NUS) in 12/2005, where he served as the founding leader of Photonic System Research Group in Dept. of Electrical and Computer Engineering till 12/2015. He was also a joint senior scientist with A*STAR Institute for Infocomm Research (I2R) in this period. And he was a visiting professor with Univ. of Melbourne, Australia in 2007. In 12/2015, he joined The Hong Kong Polytechnic Univ., where he is now a full professor in Dept. of Electronic and Information Engineering, while he also continues as an adjunct faculty member of NUS. His research focuses on photonic devices, optical fiber communication and sensor systems, and biomedical instruments. He has been the PI/co-PI/co-I of 50+ research projects with 10 million+ US dollars fund, and supervised 10+ postdocs and 20+ PhD students. He has authored/co-authored 6 book chapters and 500+ journal/conference papers (100+ keynote/invited, including OFC in USA). He served in organizing or technical program committee (TPC) for 100+ international conferences, and Telecommunications Standards Advisory Committee for Singapore government. His group won 8 best paper awards in conferences and the national championship in the 3rd China Innovation and Entrepreneurship Competition in 2014. He is an Optica/OSA fellow.
Session 2-2: Thin Films and Devices

Chair: Dr. Ke Wang, School of Mechanical and Electronic Engineering, ECUT, China
Title: Perpendicular Exchange Bias in Ultrathin Hard/Soft Bilayers Based on Rare-earth Transition Metal Alloys

Prof. Ke Wang
Dean, School of Mechanical and Electronic Engineering, East China University of Technology, China

Abstract

Rare-earth transition metal (RE-TM) alloy films have received considerable attention for their wide applications in ultrafast magnetism, magneto-optical isolator and magnonics. Among them, ternary TbFeCo and GdFeCo alloy films with strong perpendicular magnetic anisotropy (PMA), the conventional magnetic recording media, are currently attracting increasing interest for potential applications in high-density low-current spintronic devices, logic memories and skyrmion devices.

In this talk, we will present some of our works on bilayers consisting of magnetically hard TbFeCo and magnetically soft GdFeCo alloy films. Exchange-spring and sharp switching in a step-by-step fashion are observed in the TbFeCo/GdFeCo hard/soft bilayers with increasing GdFeCo thickness. Perpendicular exchange bias fields of several hundred Oersteds are observed from the shift of minor loops pinned by TbFeCo layer. The perpendicular exchange energy is derived to be in the range of 0.18–0.30 erg/cm². The perpendicular exchange energy is shown to increase with the thickness of GdFeCo layer in the bilayers, which can be attributed to the enhanced perpendicular anisotropy of GdFeCo layer. Our results provide some useful information for the applications of RE-TM alloy film materials used in device fabrication.

Biography

Prof. Ke Wang obtained his BS and Ph.D degrees from Huazhong University of Science and Technology. Currently, Prof. Ke Wang is heading the School of Mechanical and Electronic Engineering at the East China University of Technology. Previously, he received Alexander von Humboldt research award to carry out his work in RWTH-Aachen. Prof. Wang serves as the editorial board member for over ten scientific journals and as the Editor for publishing several international conference proceedings. He has published more than 70 peer-reviewed papers and holds several patents. His expertise lies in fabrication and characterization of nanomagnetism and spintronic devices.
Title: Si Based Infrared Detector with High Speed and High Efficiency

Dr. Jun Gou*
Associate Professor, School of Optoelectronic Science and Engineering, University of Electronic Science and Technology of China, China

Abstract

Monolithic infrared detectors with high speed and high efficiency have important applications in many fields including optical communication, signal measurement and processing. Silicon (Si) is the best candidate material for monolithic integrated photodetectors, but the absorption coefficient in near infrared band is significantly reduced. Aiming at the contradiction between high absorption (high efficiency) and high speed (large bandwidth) of Si-based photodetectors in the near-infrared band, a Si film based photodetector integrated with periodic photon-trapping microstructures is proposed, which can ensure ultra-fast response speed and significantly enhance the absorption of near-infrared light. The author introduces the research progress in photon-trapping mechanism, structure design, manufacturing process, and test verification of Si film based infrared detector. High speed (FWHM < 30 ps) and high efficiency (EQE > 60% @ 850 nm) Si based infrared detector is realized. It lays the theoretical and technical foundation for the development and application of monolithic integrated photodetectors with high performance.

Biography

Dr. Jun Gou completed his doctorate in optical engineering at the University of Electronic Science and Technology of China in 2014 and then worked at the same university. He did research on high-speed Si photodiodes as a visiting scholar at the University of California, Davis from 2017 to 2018. He is now dedicated to the research of uncooled infrared and terahertz detectors. In recent years, he has presided over and completed 1 national major project as sub-project leader, 1 national key project, 1 national 863 programs, 1 general program and 1 youth program supported by National Natural Science Foundation of China, published more than 30 papers in Nanophotonics, Acta Materialia, Carbon and other journals, co-authored 1 English monograph published by CRC Press, and won the second prize of Technological Invention Award of Ministry of Education in 2018, the second prize of National Defense Technology Invention Award in 2017, the first prize of Science and Technology Progress of Sichuan Province in 2012, and more than 20 national invention patents.
Title: Self-assembled Organic Semiconductors for Various Electronic Thin Film Devices

Prof. Sergey A. Ponomarenko*, Oleg V. Borshchev and Elena V. Agina
Director, Organic Electronics Division, Enikolopov Institute of Synthetic Polymer Materials of Russian Academy of Sciences, Russian Federation

Abstract

Organic semiconductors in are used in different organic electronic thin film devices, including various types of transistors and even memristors. Organic field-effect transistors (OFETs) require just a few nm-thick monolayer of organic semiconductor, since transport of charge carries in the OFET occurs on the interface between a dielectric and a semiconductor layer. The easiest way for fabrication of a monolayer of organic semiconductor is self-assembly of specially modified conjugated molecules.

We developed and synthesized a library of self-assembling organic semiconductors based on benzothieno[3,2-b][1]benzothiophene (BTBT) containing disiloxane anchor group, which can self-assembly on the water-air interface into a crystalline monolayer. Using a Langmuir technique, such monolayers were transferred onto different pre-structured substrates to form monolayer OFETs, electrolyte-gated OFETs (EGOFETs) or multilayer memristive devices. The monolayer OFETs were used as ultrasensitive gas sensors and, additionally modified with different receptor layers and arranged in an array, were successfully applied as an electronic nose capable to differentiate toxic gases at ultralow concentrations. The EGOFT was modified with a bioreceptor and used to detect influenza A virus. The memristive device showed high cyclic stability, while its resistance state can be programmed by different parameters of the applied voltage pulses. It is a very promising candidate for the realization of neuromorphic systems where synapse properties must be mimicked. This work was supported by the Russian Science Foundation (grant 19-73-30028).

Biography

Dr. Sergey A. Ponomarenko completed his doctorate (Ph.D.) in polymer chemistry with the synthesis and investigation of liquid crystalline dendrimers at the Lomonosov Moscow State University in 1999. After his synthetic work on organic semiconductors at the Electronic Chemicals Research Labs of Bayer AG, he joined the Enikolopov Institute of Synthetic Polymeric Materials of the Russian Academy of Sciences (ISPM RAS) in 2003, where he is leading the Laboratory of Functional Materials for Organic Electronics and Photonics since 2011. In 2010 he received his Doctor of Science degree in polymer chemistry in ISPM RAS. On 2011 he was elected as a Corresponding member of the Russian Academy of Sciences and since 2012 became a professor at Chemistry Department of the Lomonosov Moscow State University. Since 2018 he was elected as a director of ISPM RAS.
Session 3-1: Optoelectronic Imaging and Display, Lighting Related Technologies

Chair: Dr. Yang Xu, Zhejiang University, China
Title: Investigating the Light Emission of Mini-LEDs and Micro-LEDs by Using Microscopic Hyperspectral Imaging

Dr. Weijie Guo*, Yijun Lu, and Zhong Chen
National Innovation Platform for the Fusion of Industry and Education in Integrated Circuits, Department of Electronic Science, School of Electronic Science and Engineering, Xiamen University, China

Abstract

Mini-LEDs and micro-LEDs have emerged as the most promising light sources for next-generation self-emissive displays by continually demonstrating performance benefits in terms of high brightness, long-term stability, and dynamic response in versatile applications, such as larger-area display, digital signage, and augmented reality. By collecting the top-emitted light from the pad side of the micro-LEDs, one may not capture the light emitted from the area shielded by the metal pad itself. Due to the distorted distribution of the electroluminescence (EL) intensity caused by the shielding of the pad and by the lack of spatial mappings of wavelength and FWHM in the EL intensity images, the discussion on the current crowding or the mechanisms of light emission are limited.

By using microscopic hyperspectral imaging, we can collect the spatially resolved EL intensity emitted through the substrate of mini-LEDs and micro-LEDs and the corresponding spectra, facilitating the identification of the origin of inhomogeneous light emission. For the GaN-based flip-chip green micro-LEDs, position of current crowding and the bright-spot emission originating from the localized potential energy valleys have been identified. Furthermore, mapping FWHM could be an effective tool for the identification of localized clusters or defects in green micro-LEDs. For the AlGaInP-based flip-chip red light-emitting diodes, as the injected DC current exceeds the current corresponding to the maximum external quantum efficiency, the light emission from the current crowding region decreases due to the self-heating effect, whereas the emission of the region corresponding to the anode becomes dominant due to the low heat resistance. The comprehensive information about current crowding and the distribution of the light emission across the mesa of mini-LEDs and micro-LEDs can be obtained by capturing spatially resolved light emission from the side of the transparent substrate.

Biography

Dr. Guo completed his doctorate in Physical Electronics at Xiamen University in 2019. He joined the Department of Electronic Science at Xiamen University in 2020, served as a team member of semiconductor lighting and display laboratory and a team member of intelligent medical imaging and future display group in Institute of Artificial Intelligence. His research interests include device physics of mini-LEDs and micro-LEDs, mini-LED backlight, mini-LED self-emissive display, micro-LED transparent display for automotive intelligent cockpit, and micro-LED display for AR applications. He has won 5 provincial or ministerial science and technology awards. He also won the Committee of 100 scholars in 2019.


Title: Polarization Super-resolution Spatial Resolution Restoration Technology Based on Micro-scanning Technology

Dr. Dong Yao
Associate Research Fellow, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China

Abstract

To address the spatial resolution loss and information errors in division-of-focal-plane (DoFP) polarization remote sensing systems, this study proposes a new polarization super-resolution (PSR) remote sensing imaging device and a data recovery method. The system comprises three parts—a super-resolution polarization imaging camera, cooperative driving module, and data solving module. The PSR image solving algorithm is executed in the data solving module. We calibrated the relative displacement between image plane and detector in the laboratory, and verified the effectiveness of this method by actual external imaging. The experimental results demonstrate that the system can eliminate the spatial resolution loss caused by the DoFP technology, and the real image resolution is doubled in both the horizontal and vertical directions. Moreover, the system can simultaneously perceive multidimensional information, such as high-resolution intensity images and pixel-level polarization information of the target scene, and therefore, can potentially be applied in remote sensing systems.

Biography

Dr. Dong Yao, Ph.D. in Optical Engineering, Associate Research Fellow, Master Tutor, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences. Engaged in optical instrument design, presided over several scientific research projects such as National High Score Project (Pre-research), National Natural Science Foundation of China, Instrument and Equipment Development of Chinese Academy of Sciences, Jilin Science and Technology Development Fund, etc. According to the needs of optical accurate remote sensing measurement, the theory and implementation method of polarization spectroscopy remote sensing were studied. Various new instruments and equipment such as full polarization video camera, snapshot polarization camera, wide spectrum low distortion Ultra-high spatial resolution camera were designed and implemented successively, and flight test verification was completed. According to the requirements of ultra-high precision measurement of mesoscale parts, the key technologies of large field of view and high precision 3D topography measurement are researched from the aspects of optical system design, ultra-high precision phase control and topography calculation methods. In recent years, he has applied for/authorized more than 10 invention patents and published more than 10 academic papers in the field of optical instruments. He is a senior member of the Chinese Optical Engineering Society, a reviewer of journals of applied optics.
Title: A Novel Plasma-based Physical Vapor Film Deposition Technology with Adjustable Ion Energy

Dr. Mingyue Han, Yang Luo and Liuhe Li*
School of Mechanical Engineering and Automation, Beihang University, China

Abstract

Plasma-based physical vapor deposition processes are arguably the most employed low-temperature thin film deposition techniques especially with a higher plasma density and ionization fraction. Controlling the magnitude and direction of the ion energy and flux within the plasma processing environment is critical for tailoring the film nucleation, microstructure, and properties. Recently, a novel technology (BP-HiPIMS) by applying a reverse positive pulse right after the high-power impulse magnetron sputtering is proposed to enable the control over the nature of the ions extracted from the plasma, with the benefits of high-density plasma (10^{19} m^{-3}), high ionization fraction of sputtered target particles (90%) and adjustable ion energy. It is therefore fortunate that this emerging plasma source may have a wider range of industrial applications, especially for the insulating materials such as ceramic, semiconductor, and optical films.

For better regulation of ion energy and flux in BP-HiPIMS, we have investigated the complex plasma parameters and dynamics via experimental measurements, numerical simulation and theoretical model. From these comprehensive observations, we have understood the physical processes in BP-HiPIMS discharge such as the ion diffusion and acceleration mechanism, plasma density decay, establishment of double layer, and ion instabilities. Meanwhile, we have verified that the ions can be effectively extracted from the ionization region and accelerated to form ion beam. In addition, some efforts have also been made to adjust high-energy ion fraction in the deposited particle flow via external anode and coil with synergetic pulsed current. We have further verified the above statement by preparing the films on the floating Si substrate where the films microstructure becomes denser and surface become smoother.

Biography

Dr Mingyue Han completed his doctorate in BP-HiPIMS plasma physics with the practical plasma diagnosis, simulation, plasma kinetic theory and nonlinear effect, and film deposition at Beihang University from 2019 to 2022. His primary research interest is controlling the plasma diffusion and transport where he has made significant technical contributions both in plasma physics and advanced film deposition. He has over 20 honors including National scholarship for doctoral students and published over 20 journals and patents.

Prof. Liuhe Li joined Beihang University in 2009, who proposed the BP-HiPIMS when he served as the visiting scholar in the University of Sydney. He and his group of researchers focus on many innovative topics related to plasma physics and advanced materials. He has over 200 publications and numerous awards including New Century Elitist of China.
Title: Broadband Graphene-Silicon Integrated Field-Effect Coupled Detectors

Dr. Yang Xu
Professor, State Key Laboratory of Silicon Materials, School of Micro-Nano Electronics, Zhejiang University, China

Abstract

Charge-coupled devices are widely used imaging technologies. However, their speed is limited due to the complex readout process, which involves sequential charge transfer between wells, and their spectral bandwidth is limited due to the absorption limitations of silicon. Here, we report a broadband graphene-silicon field-effect coupled detector (FCD) sensitive to photons spanning from soft X-ray to Near-Infrared region [1-9]. Unlike traditional charge-coupled devices (CCD) relying on serial charge transfer between potential wells, the FCD integrates photo-sensing, charge integration, field-effect amplification, and random readout in one pixel. The devices have a deep-depletion silicon well for charge integration, single-layer graphene for non-destructive direct readout and multilayer graphene for infrared photo-charge injection. The charge integration in the potential well of the semiconductor substrate and field-effect coupled amplification in graphene transistor result in a highly sensitive broadband response. The photodetectors offer broadband imaging from X-ray to 1.2 μm infrared, a conversion gain of 700 pA per electron, a responsivity above 0.1 A W−1 in the infrared region and a fast response time under 1 μs. In the X-ray region, the device displays a sensitivity of 1088 CGyair−1cm−2 and a response time < ~5 ms. Linear array imaging reveals the potential of our devices for array-based broadband imaging. Our FCD offers a viable strategy to monolithically integrate 2D materials into conventional solid-state imaging technology, exploring the next-generation broadband silicon photodetectors for high-quality imaging and computing-in-vision technology.

Biography

Prof. Yang Xu is a Fellow of the Institute of Physics (FInstP, IOP Fellow) and IEEE NTC Distinguished Lecturer and IEEE Senior Member of the Electron Devices Society. He received his B.S. degree in Institute of Microelectronics at Department of ECE from Tsinghua University, M.S. and Ph.D. degrees in ECE from the University of Illinois Urbana-Champaign (UIUC), USA. He is now a full professor at the School of Micro-Nano Electronics, Zhejiang University, China. He was also a Fellow of Churchill College at the University of Cambridge, UK, and a visiting professor at the University of California Los Angeles (UCLA). He has published more than 120 papers including Nature Nanotechnology, Nature Electronics, Nature Photonics, Chemical Reviews, Advanced Materials, Chemical Society Reviews, Nature Communications, Nano Letters, ACS Nano, and IEDM with citations over 5000 times and H-index of 40. He holds over 30 granted patents and gave more than 50 talks in IEDM, MRS, APS, and ICPS conferences. He is also served as Associate Editor of IEEE Nanotechnology Magazine, Advisory Panel Member of IOP Nanotechnology, TPC and committee members of IEEE-EDTM, IEEE-IPFA, IEEE-EDAPS, AIP, and IOP conferences. His research interests include emerging 2D/3D integrated optoelectronic devices for Internet-of-Things and Post-Moore Ubiquitous Electronics.
Title: Optimization of Spectral Sensitivity for Multispectral Imaging

Dr. Peng Xu*
Lecturer, School of Engineering and Technology, Jiyang College of Zhejiang A&F University, China

Abstract

The spectral sensitivity of multispectral imaging system influences the accuracy of recovered spectral image and colorimetric image, so optimizing the spectral sensitivity is necessary to maintain the compact structure of multispectral imaging system and high performance. The existing optimization methods neglect the uniformity of the target samples, therefore the optimized channels are not applicable for any object. The uniform target samples are first selected in this paper, and the optimizing is implemented based on the uniform target samples through simulation. The real-coded genetic algorithm is adopted to optimize the spectral sensitivity of channels. The shape of the spectral sensitivity is formulated as the Gaussian curve, and the wavelength of peak sensitivity and the full width of half maximum of the spectral sensitivity is optimized with respect to different number of channels. The optimized spectral sensitivities achieving best spectral and colorimetric accuracy are obtained, respectively.

Biography

Dr. Peng Xu completed his doctorate in optical engineering with the color science and multispectral imaging at the Zhejiang University in 2017. He has been a lecturer in Jiyang College of Zhejiang A&F University since 2018. In 2019-2021, he carried out research in Carleton University as a visiting scholar in Canada. His research interests include optimization of multispectral imaging, ISP of multispectral imaging, display of spectral images, machine learning and deep learning based on multispectral imaging and hyperspectral imaging. He has published several research papers in filter selection for multispectral imaging as well as spectral reconstruction, and obtained some patents in his research field.
Title: Energy Transformations Accompanying a Shock Wave Distortion and Disappearance During the Interaction with Thermally Stratified Plasma

Prof. Olga Azarova*, Prof. Konstantin Krasnobaev, Dr. Tatiana Lapushkina and Oleg Kravchenko
Federal Research Center “Computer Science and control” of the Russian Academy of Sciences, Russia

Abstract

Experimental data on interaction of a plane shock wave with the striation region formed by ionization unstable gas discharge plasma are presented. For the experimentally obtained phenomena transformations of kinetic and internal energy have been studied numerically using Euler and Navier-Stokes approaches under the assumption that the discharge created plasma is characterized by stratified gas temperature. Energy transfer between a stratified energy source and the area behind the shock wave was considered. It has been established that a stratified energy source can provide the distortion and destruction of a shock wave front and in addition, to create the local zones of high internal and kinetic energy behind it. It was shown that the mechanism of the obtained phenomena is connected with multiple generation of the Richtmyer-Meshkov instability resulting from the interaction of thermal strata with a front of the shock wave.

Biography

Prof. Dr. Olga A. Azarova, PhD, DSci, AIAA Senior Member, Full Member of the Russian Academy of Natural Sciences, Leading Research Scientist, Department of Mathematical Modeling of Computer-Aided Design Systems, Federal Research Center “Computing Science and Control” of the Russian Academy of Sciences (FRS CSC RAS), Moscow, Russia.

Olga Azarova graduated from the Lomonosov Moscow State University. Olga Azarova received her PhD and DSci degrees in Mechanics of Fluids, Gases and Plasma at Dorodnicyn Computing Centre of RAS. Field of her research interests: fluid mechanics, computational fluid dynamics, numerical simulation, aerodynamics, flow control, CFD coding, Richtmyer-Meshkov instability, vortex dynamics, compressible turbulence, shock waves. Olga Azarova collaborated with Rutgers University, NJ, USA. She participated in 61 international conferences; list of her publications includes 141 names.
http://orcid.org/0000-0002-3896-2470
https://publons.com/researcher/976321
https://www.scopus.com/authid/detail.url?authorId=6602111264
https://www.researchgate.net/profile/O-Azarova
Session 3-2: Solar Cells

Chair: Dr. Jinzhong Wang, Harbin Institute of Technology, China
Co-Chair: Dr. Jinbao Zhang, College of Materials, Xiamen University, China
Title: Low-dimensionsal Electrode Materials in Photovoltaic Devices

Dr. Jinzhong Wang* and Zhi Zeng
Department head, Department of Optoelectronic Information Science, School of Materials Science and Engineering, Harbin Institute of Technology, China

Abstract

Dye-sensitized solar cell (DSSC) may become a promising solution for the rigorous challenge of energy crisis. The absorption ability of photoanode and catalytic ability of counter electrode (CE) are crucial to the performance of DSSC. However, low dye adsorption, slow electron transfer rate, carriers combination and stability in damp environment also hinders the subsequent application.

We investigated several path to optimize the performance of photoanode. The uniform dispersion of P25 was realized in the solution by absorbing acetic acid molecules to produce double charge layers. The dye adsorption capacity was enhanced, thus improving the light capture capacity. The photoelectric conversion efficiency (PCE) of the battery was increased from 6.15% to 8.07%. Meantime, considering the relatively weak double charge layers of rutile phase, we added strong electrolyte to settle rutile phase and realized the purification of anatase phase and the corresponding PCE of DSSC has increased to 10.1%. Subsequently, 3A molecular sieve was coated on the electrode surface to passivate surface. The DSSC represented improved recombination resistance and the tolerance of damp environment with other performance nearly the same. Finally, the novel structure Au@Ag@SiO2 core-shell nanorods were added into TiO2, of which the localized surface plasmon resonance effect lead to the enhanced light harvesting ability. So far, the performance of device has been greatly improved.

Instead of expensive Pt CE, we deposited high quality 3D graphene foam with Ni foam template and graphene nanosheets were attached to the foam network structure. In this way, the improved the contact opportunity between graphene boundary active point and the electrolyte solution reduced the electric charge transmission resistance. The conversion efficiency of foam CE DSSC was comparable to Pt CE, manifesting the improved catalytic efficiency.

Biography

Prof. Wang awarded doctor degree at Jilin University in 2002 and worked in CNRS-Meudon Lab, Universidade de Aveiro, Universidade de Lisboa, respectively. He mainly focused on the research of novel photoelectric materials and devices currently. Prof. Wang has been undertake many major project and published more than 120 papers in journals such as Energy & Environmental Science, including two ESI papers.
Title: Compositional Engineering and Stability of Organic Hole Transport Materials for Perovskite Solar Cells

Dr. Jinbao Zhang* and Dr. Li Yang
Professor, College of Materials, Xiamen University, China

Abstract

Hole transport materials (HTMs) play decisive roles in carrier dynamics and interfacial properties, determining the device efficiency and stability. However, organic molecules and polymer in their pristine states often show poor mobility and electrical conductivity, limiting the charge conducting capacity. Chemical doping has been shown to be an effective way to improve optoelectronic properties, but the involved dopants generate serious stability issues in solar cells. Balancing the charge conductivity of film and the reliability of devices represents a great challenge in the field of perovskite solar cells. Here we will summarize our recent advances in designing alternative HTMs by modifying the molecular structures, doping composition, and fabrication techniques. Specifically, we have revealed the individual and comprehensive roles of the chemical dopants in HTMs, and demonstrated their effects on the device performance. Moreover, a solvent assisted thermal evaporation technique (SATE) was developed to fabricate dopant-free HTMs for PSCs, and a remarkable efficiency of over 20% has been achieved. Besides, a profound light soaking phenomenon has been observed in this system and the physical mechanism will be discussed. This technique shows high promises in scalable application of PSCs.

Biography

Dr. Jinbao Zhang obtained his BS degree from Central South University in 2010 and PhD degree from Uppsala University in 2016 under the direction of Prof. Anders Hagfeldt. He then did his postdoctoral research in Prof. Udo Bach and Prof. Yi-Bing Cheng's group at Monash University. Later he worked at Stanford University as a Wallenberg Research Fellow in Prof. Dauskardt's group. His current research focuses on developing functional nanomaterials for energy conversion devices and fundamentally understanding the interfacial phenomenon in optoelectronic devices. In recent years, he has published more than 70 SCI academic papers in Chem, Advanced Energy Materials, ACS Energy Letters, ACS Nano, Nano Energy and other journals.
Title: Stabilizing Perovskite Precursor for high-efficiency Perovskite Solar Cells

Mengjia Li¹, Cong Chen¹,²,*
¹School of Material Science and Engineering, Hebei University of Technology, China.
²Macao Institute of Materials Science and Engineering (MIMSE), Macau University of Science and Technology, China
*E-mail chencong@hebut.edu.cn

Abstract

Perovskite solar cells suffer from poor reproducibility due to the degradation of perovskite precursor solution. Herein, we report an effective precursor stabilization strategy via incorporating 3-hydrazinobenzoic acid (3-HBA) containing carboxyl (-COOH) and hydrazine (-NHNH₂) functional groups stabilizer. The oxidation of I⁻, deprotonation of organic cations and amine-cation reaction are main causes of the degradation of mixed organic cation perovskite precursor solution. The -NHNH₂ can reduce I₂ defects back to I⁻ and thus suppress the oxidation of I⁻, while the H⁺ generated by -COOH can inhibit the deprotonation of organic cations and subsequent amine-cation reaction. The above degradation reactions are simultaneously inhibited by the synergy of functional groups. The inverted device achieves an efficiency of 23.5% (certified efficiency of 23.3%) with excellent operational stability, retaining 94% of the initial efficiency after maximum power point tracking for 601 hours¹³.

Figure 1. Stabilizing Perovskite Precursor by Synergy of Functional Groups for NiOx-Based Inverted Solar Cells with certified Efficiency of 23.3%

Biography

Title: Characterization of SbxSey Films fabricated by CMBD from Sb and Se precursors for Photovoltaic Applications

T.M. Razykov*a, I.Bekmirzoevb, B.A. Ergashevb, D. Isakovb, R. Khurramov*a, M.K. Kouchkarov*a, M.A. Makhmudov*a, M.S. Tivanovb, Sh.B. Utamuradovac, D.S. Baykoa, N.I. Poliakb, L.S. Lyashenkb, O.V. Korolikb

a Physical-Technical Institute, Uzbekistan
b Faculty of Physics, Belarusian State University, Belarus
c Institute of Semiconductors Physics and Microelectronics, Uzbekistan

Abstract

SbₓSeᵧ thin films were obtained by chemical-molecular beam deposition on soda-lime glass from Sb and Se precursors. By the precise control of the Sb/Se ratio we succeeded in obtaining stoichiometric SbₓSeᵧ films. It is also found out that we can control the conductivity by deliberately inducting deviation from stoichiometry. The elemental and phase composition, as well as the crystal structure of SbₓSeᵧ films, were studied by energy-dispersive X-ray microanalysis, X-ray diffraction, Raman spectroscopy, scanning electron and atomic force microscopy. The optical bandgap of the films was estimated from the absorption spectra acquired by a spectrophotometer. The physical properties of SbₓSeᵧ thin films differing in source composition during synthesis were investigated.

Biography

Professor Takhir Razykov completed his PhD in thin film CdS based solar cells at the Institute of Semiconductors, Kiev, Ukrain in 1977 and Dr. Sci. degree in physical processes in II-VI binary and multinary compounds based thin film heterostructures at the Physical Institute, Moscow, Russia. His research interests is thin film chalcogenide compounds based solar cells. He developed simple and low cost chemical molecular beam deposition method for fabrication of binary and multinary chalcogenides thin films. He worked at a number of research and education centers as Professor-Visitor. Currently, he is Head of Photovoltaics Laboratory at Physical-Technical Institute, Tashkent, Uzbekistan and fabricate and investigate thin film Sb₂Se₃, Sb₂S₃ and Sb₂(S, Se)₃ solar cells.
Session 1-7: Quantum Optics & Nonlinear Optics

Chair: Dr. Le Luo, Sun Yat-Sen University, China
Co-Chair: Dr. Ya Xiao, Ocean University of China, China
Title: Experimental studies of non-Hermitian quantum physics with light-atom interactions

Dr. Le Luo
Professor, Quantum Information Measurement and Control (QIMC), School of Physics and Astronomy, Sun Yat-sen University, China

Abstract

In recent years, we have studied the detection and control of non-Hermitian quantum states in open quantum systems through two types of atomic physics experiments, ultracold atoms and trapped ions. This report will present the preparation of parity-time (PT) and anti-parity-time symmetric Hamiltonians in trapped ions, including the dynamical evolution (non-unitary evolution) of non-Hermitian qubits with balanced gain and loss, PT symmetry breaking transitions (eigenvalue spectra), non-orthogonal eigenstates, quantum speed limits in open systems, and the simulation of anti-PT symmetric Hamiltonians by designing pulse sequences. Through high precision quantum control non-Hermitian time-dependent Hamiltonian, we realized two types of topological state transfer (non-reciprocal and chiral, non-reciprocal and nonchiral) under PT and anti-PT symmetry, and verification of the robustness of topological state transfer. In addition, based on the existing theoretical and experimental basis of the dynamic decoupling sequence in the Hermitian system, we introduce the dynamic decoupling method into the non-Hermitian PT symmetric system to protect the quantum evolution in the PT symmetric system. The scheme is theoretically simulated and experimentally verified.

Biography

Dr. Luo is a professor of physics in School of Physics and Astronomy at Sun Yat-sen University (SYSU), Guangdong, China. Dr. Luo received BSc in physics at SYSU in 1999, M.S. in Optics at Peking University, Beijing in 2002, and M.A. and PhD in Physics at Duke University, North Carolina in 2005 and 2008. From 2008 to 2011, he was a Postdoctoral Fellow at Joint Quantum Institute, University of Maryland and the NIST, Maryland. From 2011-2016, he was an assistant professor at Indiana University-Purdue University Indianapolis,Indiana. He is the Head of Quantum Information, Measurement, and Control Research Team SYSU since 2017, and is the founding director of Center Quantum Information Technology at SYSU Shenzhen Research Institute. Dr. Luo’s research interests and activities span a wide range of topics in atomic, molecular and optical physics and quantum information science, including cold atom physics, laser cooling and trapping, trapped ion quantum information, quantum network, nonlinear and ultrafast optics, and precision measurement.
Title: Application of Weak Measurement in Quantum Information Processing

Dr. Ya Xiao, Yong Jian Gu*, Jin Shi Xu* and Chuan Feng Li*
College of Physics and Optoelectroic Engineering, Ocean University of China, China
CAS Key Laboratory of Quantum Information, University of Science and Technology of China, China

Abstract

Weak measurement, the coupling strength between the measurement device and the measured quantum system is weak enough to prevent the state of quantum system collapse, which can be used to quantum correlation sharing. Here, we developed a series of sequential weak measurement methods, such as biased-strength weak measurement, both-side weak measurement and non-local weak measurement to increase the number of parties that can share the quantum correlation of a two-qubit entangled state. It is shown that the steering direction can be flexibly manipulated by changing the weak measurement strength. In addition, we also study the evolution of quantum correlation under amplitude damping channel, phase damping channel and depolarizing channel, respectively. The results shown that the fragility of quantum correlation due to decoherence can be protected to some significant amount using the correlated channels, and the disappeared quantum correlations can be revived by weak measurement and quantum measurement reversal.

On the other hand, when weak measurement is judiciously combined with pre-selection and post-selection, they lead to anomalous complex outcome, whose real part is regarded as a conditional average of the observable, which can be applied to reconstruct the Bohmian trajectory of photons. Here, we proposed a momentum weak measurement scheme, and experimentally demonstrated non-local steering of Bohmian trajectories. We further confirm a quantitative relation between the total momentum disturbance and the loss of visibility consequent on a which-way measurement in the double slit interferometer. Our results may promote a deeper understanding of the relationship among quantum measurement and quantum correlation and emphasize the role of weak measurement in giving an intuitive picture of wave-particle duality and complementarity.

Biography

HDR. Xiao is mainly engaged in the experimental research of quantum optics and quantum information based on linear optical system. She completed his doctorate at the University of Science and Technology of China in 2018. At the same year, she was employed by Ocean University of China as a "young talent" and joined the "ocean quantum technology" team. In the recent five years, she has been published dozens of research papers in international physics journals, such as Science Advances, Physical Review Letters and Optica.
Title: Self-organization of ultracold atomic gases led by photon-mediated interactions

Dr. Yongchang Zhang
Professor, School of Physics, Xi’an Jiaotong University, China

Abstract

This talk will present photon-mediated effective atom-atom long-range interactions via retro-reflecting mirrors. Such peculiar synthetic interactions appear a highly oscillatory behavior. These lead to a rich variety of nonlinear phenomena, e.g., patterns of self-bound droplet clusters of ultracold matter waves. By placing a quasi-2D Bose-Einstein condensate in front of a single mirror, we propose a simple scheme to generate this type of unusual long-range atom-atom interaction and show that this interaction can support quantum droplets with various unexpected structures. This offers a promising route to engineer the effective atom-atom interactions via photons and vice versa.

Biography

Dr. Zhang completed his PhD in optics with the theoretical research in the area of quantum simulation at the University of Science and Technology of China (Hefei, China) in 2015. After his theoretical study of quantum nonlinear and critical phenomena led by light-matter interactions in the Max-Planck Institute for the Physics of Complex Systems (Dresden, Germany) and Aarhus University (Aarhus, Denmark) as a postdoc, he joined Xi’an Jiaotong University (Xi’an, China) in 2021, where he continued his research on quantum many-body physics in light-atom interacting systems.
Session 3-3: Optical Sensor & Fiber Optic Sensor

Chair: Dr. Kai Wang, Sun Yat-Sen University, China
Title: Polymeric Waveguide Temperature Sensor Based on Asymmetric Mach-Zehnder Interferometer

Dr. Xibin Wang*, Donghai Niu and Daming Zhang
Professor, Jilin University, China; Researcher, State Key Laboratory of Integrated Optoelectronics, China

Abstract

It is very important to monitor the temperature in many fields, such as cell culture to produce enzymes, analytical chemistry, oil or gas exploration, environmental monitoring and food inspection. Optical waveguide sensors have been widespread studied owning to their many advantages, such as microscopic size, low-cost, easy fabrication process, competent integration, immunity to electromagnetic interference and high sensitivity for temperature monitoring. A number of waveguide sensor structures, including Mach-Zehnder interferometer (MZI), modal interference structure, Bragg grating and ring resonator have been studied and developed for temperature measurement. Due to the advantages of high sensitivity, low-cost, simple design and easy fabrication process, a series of waveguide temperature sensors based on the MZI structure have been studied.

We proposed and designed some polymeric waveguide temperature sensor based on asymmetric Mach-Zehnder interferometer which has different widths/lengths/materials in the two interferometer arms. Polymer with larger thermo-optic coefficient is employed to enhance the sensitivity of the waveguide temperature sensor. The influences of the widths/lengths/materials difference between the two arms with different TOCs on the sensitivity of the sensor were studied and experimentally demonstrated. The devices were fabricated by using the standard photolithography and simple all-wet etching process. The demonstrated sensors have the distinct advantages of high sensitivity, high resolution, easy fabrication, low cost and biological compatibility, which make them have the potential applications in temperature detections of organism, molecular analysis and biotechnology.

Biography

Xibin Wang received B.S. in Electronic Science and Technology, M.S., and Ph.D. in Microelectronics and Solid Electronics from Jilin University, Changchun, China, in 2008, 2010, and 2013, respectively. He is currently a Professor of College of Electronic Sci. & Eng, Jilin University, China and a Researcher of the State Key Laboratory of Integrated Optoelectronics, China. His current research interests include second-order nonlinear optical polymer materials, as well as active and passive polymer waveguide and PLC devices for optical interconnect and sensor applications. He has published more than 70 refereed papers, 14 issued patents. His significant contribution to polymer waveguide devices includes thermo-optic switches, electro-optic switches/modulators, waveguide sensors, mode-division (de)multiplexers, and graphene-integrated waveguide devices.
Title: Design and Realization Separable Observation Sensors of Tianwen-1 Mars Probe

Di Wu
Senior Engineer, Shanghai Aerospace Control Technology Institute, P.R, China

Abstract

The Tianwen-1 Mars exploration mission is a high-risk mission with long period, high communication delay, high product reliability and harsh deep space environment. There are two separable observation sensors on the Tianwen-1 probe. When Tianwen-1 on transfer orbit to Mars, the first separable observation sensor was separated from Tianwen-1 and observed Tianwen-1 probe surrounding status. On Mars orbit, the second one separated from Tianwen-1 probe and photoed photograph of Tianwen-1 obiter and Mars. This paper first introduces the mission expectation and deep space environmental constraints of separable observation sensors. Secondly, the composition of the separable observation sensor is introduced. Thirdly, the design meeting the corresponding indicators is introduced. Finally, the ground test and on orbit operating of separable observation sensors are introduced.

Biography

Wu Di, senior engineer. Master graduated from Chiba University, Japan. Since 2011, he has worked in Shanghai Aerospace Control Technology Institute. Mainly engaged in the design of space photoelectric sensor.
A photodetector with high gain and wide dynamic range is desirable for numerous applications including imaging, spectroscopy, human-machine interface such as augmented reality (AR) and virtual reality (VR), and machine vision. In addition to well-known photodiode which has no gain, phototransistor, photosensitive integrated circuits, photomultiplier tubes (PMTs), avalanche photodiodes (APDs), and silicon photomultipliers (SiPMs) with gain greater than unity have been used. Regarding photoelectric conversion mode, both energy integration that converts photon energy to current or voltage and photon counting which counts individual incoming photons, have been adopted. No matter which detector or mode were employed, signal to noise ratio (SNR) has been the most important performance factor to be considered together with others such as dynamic range and response spectrum. In order to improve the SNR, PMT and APD/SiPM utilize photomultiplication mechanism to boost signal while phototransistor and integrated photosensor chip use amplification effect of BJT or MOSFET. However, noise suppression has been a great challenge in those devices. Recently, a novel detector, namely quanta image sensor that reduces read noise down to sub-electron level was reported and paved the way to achieve high SNR by significantly reducing the noise. Obtaining both high gain and low noise has been always a mission for accomplishing. Since 2017, we have developed a new type of photodetector, so-called photodiode-body-biased MOSFET (PD-MOS) that enjoys both high gain and wide dynamic range, and it has superior performance characteristics as compared with other state-of-the-art detectors. More importantly, different from the above-mentioned, the strategy taken to boost the SNR is improving gain along with reducing noise by a photoelectric integrated chip which is a non-avalanche approach.

Biography

Kai Wang is currently a full professor at Sun Yat-Sen University in China and also an adjunct professor in the Department of Electrical and Computer Engineering at Carnegie Mellon University in the US. After earning his Ph.D. degree in Electrical & Computer Engineering from the University of Waterloo, Waterloo, Canada in 2008, he was appointed as a NSERC postdoctoral fellow in Thunder Bay Health Science Centre, Thunder Bay, Canada where he had been conducting research on biomedical X-ray imaging until he joined Apple Inc. in Cupertino, California in August 2011. At Apple Inc., he was involved in touch sensor development for various Apple products such as iPad and Apple Watch. His current research focuses on sensing and imaging devices for an intelligent society. He has published over 80+ journal papers/conference proceedings including 4 from International Electron Device Meeting (IEDM) and coauthored 30 patents (12 awarded). He served as an Associate Editor of IEEE/OSA Journal of Display Technology from 2013 to 2016 and Frontier in Physics.
Title: Research on the Influence of Co-phasing Errors for the Ultra-large Space Deployable Telescope

Dr. Huisheng Yang* and Xuejun Zhang
Associate Researcher, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, China

Abstract

Space-based space telescopes are the key to crack the cosmic code and explore the origin of life. The larger the telescope aperture, the faster we can crack these codes. In order to build telescopes with larger aperture and stronger observation ability in space, and break through the limitation of launch vehicle capability, the deployable space telescope using segment primary mirrors is proposed. The telescope is very sensitive to co-phasing errors stemming from segment position and attitude errors as well as aspheric parameter errors. These errors are random and therefore difficult to correct, which can result in image quality degradation. In order to investigate these co-phasing errors impacts, linear sensitivity matrices of the errors are derived based on the ray tracing. And a correction method using segment pose adjustment to compensate the aspheric parameter errors is presented based on correlation analysis. Considering the randomness of segments co-phasing errors, prediction formulas of the errors to system wavefront deformation are deduced using the statistics principle. Based on these formulas, the errors influence weights are analyzed, and a weighted tolerance allocation method is presented to establish the design baseline of the segment mirror system. All of this work has been validated by numerical simulations with better than 2% accuracy. We believe that these jobs can provide a theoretical basis for segmented telescope design and fabrication.

Biography

Dr. Yang completed his master in mechatronic engineering with the research on humanoid partial hand and its sensor system at the Harbin Institute of Technology in 2009. After graduation, he joined the Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, where he directed his research on optical-mechanical structure and precision mechanical technology of space remote sensor. He has presided over and participated in more than twenty national-level scientific research tasks. In the process of engineering task development, many key technical problems have been solved, which effectively guarantees the delivery of products on time. In 2020, he completed his doctorate in optical engineering with the research on key technologies of ultra large aperture deployable primary mirror system, and started the research on the structure of ultra large aperture telescopes and precision mechanics. So far, he has published more than ten papers and obtained more than thirty invention patents.
Session 3-4: Semiconductor and Optoelectronic Materials Technology

Chair: Dr. Xiaojian She, Zhejiang University, China
Co-Chair: Dr. Jinbo Pang, University of Jinan, China
Title: Device Physics and Design for Thin Film Transistor Electronics

Dr. Xiao-Jian She
Professor, State Key Laboratory of Modern Optical Instrumentation College of Optical Science and Engineering, Zhejiang University, China

Abstract

Filed-effect transistor (FET) as a key device platform for optoelectronic applications has drawn a great amount of research attention, where the tremendous research efforts of material science and device engineering have contributed greatly to the development of FET based optoelectronic devices such as light-emitting transistors, photodetecting transistors, photomemristor transistors and photosynaptic transistors.

Our research work in the recent years has been focused on device physics understanding and device structure engineering to pursue FET based electronics of better performance and low power consumption. In this conference, we will discuss our research work giving prospective on: i) operational stability enhancement of organic transistor in the two-layer structured dielectrics, ii) vertical organic transistor design for enabling fast nonvolatile memory performance, iii) probing the dynamics of ion-migration in perovskite electronics.

Biography

Dr. Xiao-Jian She obtained his PhD in Physics at the University of Cambridge, the Cavendish Laboratory. He is now a professor and principal investigator at Zhejiang University. His work has been published on Nature Electronics, Nature Photonics, Advanced Materials, ACS Applied Materials & Interfaces, Organic Electronics, Applied Physics Letters. In his work, he elucidates the device physics for enhancing the operational stability of organic transistors under low voltage operation, innovates a vertical organic transistor structure for fast nonvolatile memory with nanoseconds programming, and investigated solution processing techniques for suppressing ionic disorders within perovskite materials and making high-performance transistors. Dr. Xiao-Jian She has been invited as a guest researcher at institute of industrial science, the University of Tokyo, on the project of glucose sensor based on organic transistors. His current research interest includes device physics understanding and device structure engineering of FET based optoelectronic devices.
Title: Thermodynamic and Kinetic Regulation for Controlled Growth of Two-dimensional Materials

Dr. Jinbo Pang*
Professor, Institute for Advanced Interdisciplinary Research (iAIR), University of Jinan, China
Email: ifc_pangjb@ujn.edu.cn

Abstract

In the post Moore era, the size reduction seems to stop; besides, the rigid Si based technology faces difficulties in lightweight portable electronics and stretchable wearable electronics. The emerging graphene related 2D materials may serve as electronic functional components to fabricate quantum information devices and conventional transistors, photodetectors and digital logic circuits. Indeed, the 2D materials and their van der Waals heterostructure may provide solution for continuing the goal of size reduction. Therefore, the controlled growth of 2D materials become of vital importance. We have carried out systematic research on the controllable growth of two-dimensional materials, and have made a series of progress. (1) The direct growth of graphene over dielectric substrates remains attractive for device fabrication without transfer step. We apply thermodynamic and kinetic control to realize strictly monolayer graphene growth over dielectric substrate by chemical vapor deposition. (2) The strategy of pre-seeding layer is proposed to realize the thermodynamic control of nucleation. Hereby, the strict monolayer tungsten diselenide of sub-centimeter size is synthesized, which solves the problem of discontinuous film formation. (3) By regulating the symmetry matching in the interaction between substrate and two-dimensional materials, a wafer-level platinum sulfide thin film is synthesized, which improves the large-area homogeneity. The first-principles calculations predict the phase diagram of Pt-S versus the temperature and partial pressure of sulfur. In the past five years, we have published 32 papers as the first author or corresponding author (including co-authors) in journals such as Chem Soc Rev, ACS Nano, InfoMat (3), and Nano-Micro Lett (2). Our research may provide important guideline for research community and pave the way of wafer-scale growth of two-dimensional materials and their applications in electronics and optoelectronics.

Biography

Prof Dr. Jinbo Pang completed his doctorate in materials science with thermal deposition approaches for graphene growth at Technische Universität Dresden (Germany) in 2017. After his study of two-dimensional materials transition metal dichalcogenides in IFW Dresden as a post doctorate, he joined Institute for Advanced Interdisciplinary Research (iAIR), University of Jinan, China as an assistant professor (in 2018) and professor (since 2022), where he directed his research to wafer-scale controlled growth of two-dimensional materials and their electronic and optoelectronic device applications. This led to the award of Natural Science Fund for Excellent Young Scholars of Shandong Province. Dr. Pang served as a member of Youth Editorial Board of the journal eScience (published by Elsevier) since 2022. He has served in organizing and academic committee of several conferences. He has published over 70 journal paper with a total citation of 3950, an h index of 32 (to Nov 8, 2022).
Title: MoS2 /WSe2 vdW Heterostructures Decorated with PbS Quantum Dots for the Development of High-Performance Photovoltaic and Broadband Photodiodes

Dr. Zhangting Wu
Lab for Nanoelectronics and NanoDevices, Department of Electronics Science and Technology, Hangzhou Dianzi University, China

Abstract

van der Waals heterostructures (vdWHs) overcoming the lattice and processing limitations of conventional hetero-structures provide an opportunity to develop high-performance 2D vdWH solar cells and photodiodes. However, it is challenging to improve the sensitivity and response speed of 2D vdWH photovoltaic devices due to the low light absorption efficiency and electron/hole traps in heterointerfaces. Here, we design a PbS/MoS2/WSe2 heterostructure photodiode in which a light-sensitive PbS quantum dot (QD) layer combined with a MoS2/WSe2 heterostructure significantly enhances the photovoltaic response. The electron current in the heterostructure is increased by the effective collection of photogenerated electrons induced by PbS QDs. The device exhibits a broadband photovoltaic response from 405 to 1064 nm with a maximum responsivity of 0.76 A/W and a specific detectivity of $5.15 \times 10^{11}$ Jones. In particular, the response speed is not limited by multiple electron traps in the PbS QDs/2D material heterointerface, and a fast rising/decaying time of 43/48 μs and a −3 dB cutoff frequency of over 10 kHz are achieved. The negative differential capacitance and frequency dependence of capacitance demonstrate the presence of interface states in the MoS2/WSe2 heterointerface that hamper the improvement of the response speed. The scheme to enhance photovoltaic performance without sacrificing response speed provides opportunities for the development of high-performance 2D vdWH optoelectronic devices.

Biography

Dr. Zhangting Wu received her PhD degree in Physics from Southeast University (China) in 2017. She is currently an associate professor in the College of Electronics and Information at Hangzhou Dianzi University (China). Her research interests include electronic and optoelectronic properties of two-dimensional materials.
Poster & Paper
Poster ID: ICOEO-01

Title: Resonant Control of Elastic Collisions Between 23Na40K Molecules and 40K Atoms

Zhen Su
Ph.D student, University of Science and Technology of China, China

Abstract

This poster demonstrates the resonant control of the elastic scattering cross sections in the vicinity of Feshbach resonances between 23Na40K molecules and 40K atoms by the study of the thermalization between them. Magnetically tunable s-wave scattering length is essential to study the strongly interacting quantum gases and is helpful to understand the complex atom-molecule Feshbach resonance. We use a resonant laser pulse to heat the atom cloud without affecting molecules. The increases of molecule cloud size are due to the elastic collision with “hot” atoms and the temperature is proportional to the cloud size. The thermalization rates are extracted from the temperature time evolution. With further analysis, the elastic cross sections can be obtained from the thermalization rate. The elastic scattering cross sections vary by more than two orders of magnitude close to the resonance, and can be well described by an asymmetric Fano profile. The parameters that characterize the magnetically tunable s-wave scattering length are determined from the elastic scattering cross sections. Furthermore, we measure the loss rate coefficients and estimate the good-to-bad collision ratio which is about 10-30.

The direct observation of the tunable elastic scattering cross sections or the scattering length opens up the possibility of studying a new type of impurity problem, such as angulon and can be used to determine the universal binding energy of triatomic molecule weakly bound state..

Biography

Zhen Su has been a graduate student in Professor Jianwei Pan’s group at University of Science and Technology of China since 2017. Main purpose of her project is to create and study ultracold polar molecules. She focused on the study of Feshbach resonance between atom and molecule, which would be a useful technique in the study of quantum simulation and quantum computation.
POSTER ID: ICOEO-02

Title: The Temperature Difference Method for Screening Patients with COVID-19 Fever Symptoms

Dr. Yantang Huang1,2*, Zhiwei Zeng, Guangdong Mei and Tingdi Liao3
1College of Physics and Information Engineering, Fuzhou University, China
2Photonic Technology Research Centre, Quanzhou Normal University, China

Abstract

Coronavirus disease (COVID-19), caused by the SARS-CoV-2 virus, is a potentially fatal disease of global public health concern. Fever has been reported to be a common clinical finding in COVID-19 and current CDC recommendations for mitigation of community COVID-19 transmission include temperature screening, so prompting widespread temperature screening across multiple sectors, including hospitals, office buildings and airports. The need to measure body temperature contactless and quickly during the COVID-19 pandemic emergency has led to the widespread use of infrared thermometers, thermal imaging cameras and thermal scanners as an alternative to the traditional contact clinical thermometers.

However, the body temperature measurement is also disturbed by the environment factors including temperature, humidity, wind speed and background light, and the temperature measurement accuracy is low. When the ambient temperature is low, the temperature of the patient will also be low. It was difficult to screen the fever patients by using the absolute temperature criteria, and it often result in missing detection. In order to solve this problem, this paper proposed a method of screening COVID-19 symptom fever patients by the body temperature difference detection.

The temperature difference detection method combined the temperature measurement of the infrared imaging camera and the visible camera face recognition is as follows: (i) The visible RGB camera captured the image and judged whether there was a face in the image through the face recognition module; (ii) If there was a face, the infrared imaging camera test the temperature, $T_1$; (iii) The average temperature of a several tens of number (such as 30) $T_1$ was set to $T_0$; (iv) The temperature difference $\Delta T = T_1 - T_0$, $\Delta T > 0.5^\circ C$, there would be a suspected fever. This method will eliminate environmental interference and equipment errors, to reduce the probability of the fever missed detection.

Keywords: COVID-19 pandemic; fever; infrared thermometer temperature measurement, the temperature difference detection method

Biography

Dr. Huang completed his doctorate in photonics in the field of light-matter interaction at Xiamen University in 2004. He joined the College of Physics and Information Engineering of Fuzhou University in 2005. He devoted himself to the optical engineering, including the principle and application of microcavity, the optical fiber temperature sensor, the flammable gas detection, infrared imaging temperature measurement. In January 2000 COVID-19 epidemic, he engaged in the research of infrared thermal imaging human body temperature measurement technology.
POSTER ID: ICOEO-03

Title: Evidence for the Association of Triatomic Molecules in Ultracold $^{23}$Na$^{40}$K + $^{40}$K Mixtures

Dr. Jin Cao
School of Physical Science, University of Science and Technology of China, China

Abstract

Ultracold triatomic molecules is an ideal platform to investigate quantum-mechanical three-body problem. Moreover, ultracold triatomic molecules have more degrees of freedom and symmetric properties that offer new opportunities in quantum simulation and precision measurement. This poster demonstrates the process of observing the evidence for the association triatomic molecules in $^{23}$Na$^{40}$K and $^{40}$K mixture. We prepare an ultracold atom-molecule mixture in a large volume three-beam optical dipole trap. Similar to diatomic Feshbach molecules association RF loss spectrum, a radio frequency pulse used to couple the scattering state and triatomic molecule bound state is applied to the atom-molecule mixture in the vicinity of a certain magnetic Feshbach resonance. The coupling strength is enhanced and additional molecules loss features emerge on the left side of atom transfer loss (at about 57.6G). As the magnetic field magnitude changes from 57.603G to 55.691G, the association loss feature moves away from the central position, which provides strong evidence for the formation of triatomic molecules and directly give the universal binding energies of triatomic molecules. However, the triatomic molecules are in an unstable excited vibrational state and will decay quickly and suppress the RF association due to quantum Zeno effect. One decay mechanism is the excitation by trap laser. In order to improves the resolution of the association signal, we modulate the trap laser intensity with 25% duty cycle and leave the RF association without being affected during the dark time. In future we will concentrate on studying the triatomic molecules decay mechanism and find the approach to prepare ultracold triatomic molecules gases.

Biography

Jin Cao is a PhD student of Department of Modern Physics, School of Physical Science, University of Science and Technology of China. He majors in atomic and molecular physics and is supervised by Professor Bo Zhao. His research subject focuses on scattering properties between $^{23}$Na$^{40}$K molecules and $^{40}$K atoms in ultracold regime.
POSTER ID: ICOEO-04

Title: Mode-locked Fiber Lasers Based on a Mach-zehnder Interferometer Filter

Fan Yang, Liqiang Zhang, Minghong Wang*, Nan-Kuang Chen, Yuanchuan Huang, Xiuying Tian, and Chenglin Bai

School of Physics Science and Information Engineering, Liaocheng University, China

Abstract

The filter is one of the most important elements in normal-dispersion mode-locked fiber lasers, which narrows the pulse in spectral domain by cutting edges of the spectrum. Quartz plate, diffraction grating and fiber Bragg grating have all been used in fiber lasers to realize spectrum filtering. However, discrete elements such as Quartz plate or diffraction grating complicate the laser structure. Fiber Bragg grating is not very suitable for dissipative solitons, as the bandwidth of a fiber Bragg grating is usually very narrow. Another kind of widely used filters is the comb filter, based on interferometers. In addition to fiber sensors to accurately measure physical, biological or chemical parameters, fiber interferometers can also be used as filters in fiber lasers. Among them, filters based on Mach-Zehnder interferometer (MZI) have the advantages of low cost and simple structure.

We fabricate a MZI filter by splicing segments of single-mode fibers (SMFs), multi-mode fibers (MMFs) and seven-core fiber (SCF) sequentially. The light propagating in SMF is coupled into different cores and cladding of the SCF through the first segment of MMF, and is coupled back to the SMF by the second segment of MMF. Interference occurs due to the optical path difference among the light propagating in different cores and cladding of SCF. The free space range (FSR) of the interference curve relates to the length of SCF. When a segment of 4mm SCF is selected, the FSR of the interference curve is 15.44nm. Inserting the interference filter into an Yb-doped fiber laser mode-locked by nonlinear polarization rotation, stable dissipative solitons have been obtained. The central wavelength locates at 1043.88 nm, with a 3 dB bandwidth of 12.32nm.

Biography

Fan Yang is currently working toward the master’s degree in the major of the information and communication engineering from Liaocheng University.
POSTER ID: ICOEO-05

Title: A Rapid Theoretical Method for Inverse Design on Tip-enhanced Raman Spectroscopy (TERS) Probe

Zhao-dong Men, Jun Yi and Zhong-qun Tian
State Key Laboratory of Physical Chemistry of Solid Surfaces, College of Chemistry and Chemical Engineering, College of Materials, Xiamen University, China

Abstract

Tip-enhanced Raman spectroscopy (TERS) is an important spectral analytical method, providing correlated topographic and chemical information in nanoscale. Generally, the enhancement of Raman signal by TERS probe is dominated by lightning-rod effect and gap mode plasmon resonance, while these effects are highly determined by structure of the metallic tip. Therefore, rational designing TERS probe structure is critical for improving the sensitivity and spatial resolution of TERS technique. In previous work, researchers sweep scanning one or two parameters to optimize TERS probe design in three-dimensional (3D) numerical simulation. However, 3D numerical simulation consumes huge computation resources and the computation cost of this method grows exponentially as the number of parameters increases.

In this work, we propose a rapid theoretical method features with a reduction of computational loading by rotational symmetry and smartly optimizes the TERS probe by inverse design. As a demonstration, we apply our new method for TERS probe designing with 4 free structural parameters. The result shows the enhancement factor of optimized TERS probe is improved by 1 order compared to unoptimized one, and more importantly, the optimization time reduces to ~60 hours by our method, in contrast to ~7000 hours by previous parameter sweeping in 3D simulation methods. The method would be a useful tool for designing not only TERS probes but also other near-field optical probes and optical antennas.

Biography

Zhao-dong Meng completed his bachelor degree in mechanical engineering at Xiamen University in 2016. After his undergraduate study on electronics and mechanics, he joined College of Chemistry and Chemical Engineering, Xiamen University in 2020. His research interest is scanning near-field optical microscopy (SNOM) and nanoscale complementary vibrational spectroscopy (nano-CVS).
Resonant control of elastic collisions between $^{23}{\text{Na}}^{40}{\text{K}}$ molecules and $^{40}{\text{K}}$ atoms

Zhen Su,1,2,3 Huan Yang,1,2,3 Jin Cao,1,2,3 Xin-Yao Wang,1,2,3 Jun Rui,1,2,3 Bo Zhao,1,2,3 and Jian-Wei Pan1,2,3

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2Shanghai Branch, CAS Center for Excellence and Synergetic Innovation Center in Quantum Information and Quantum Physics, University of Science and Technology of China, Shanghai 200030, China
3Shanghai Research Center for Quantum Sciences, Shanghai 200030, China

Motivation
- Understand the complex atom-molecule Feshbach resonances
- Study strongly interacting atom-molecule mixtures

Experimental protocol
- Form $^{23}{\text{Na}}^{40}{\text{K}}$ Feshbach molecules
- Transfer Feshbach molecules to ground state
- Heat $^{40}{\text{K}}$ atom using resonant light pulse
- Prepare atom-molecule mixture: $^{23}{\text{Na}}^{40}{\text{K}} |v=0,N=0,m_{v}=3/2,m_{F}=4\rangle \rightarrow 2 \times 10^{4}$ 300K $^{40}{\text{K}} |F=9/2,m_{F}=9/2\rangle \rightarrow 1 \times 10^{5}$ 500K
- Monitor the thermalization of the molecule at target magnetic field
  - Feshbach resonance: $B_{0} \sim 48.4G$

Experimental result
1. Elastic scattering cross section
- Asymmetric Fano profile
  - $a = a - i\beta$
  - $\sigma_{el} = 4\pi (\alpha^{2} + \beta^{2}) \propto \Gamma_{th}$
- The $\sigma_{el}$ can be tuned by more than two orders of magnitude!

2. Scattering length
- $a(B) = a_{bg} \left(1 - \frac{\Delta}{B-B_{bg} - i\gamma/2}\right)$
  - $a = a - i\beta$
  - Background scattering length: $a_{bg} = -692(36)a_{0}$
  - Resonance width: $\Delta = 4.3(4)G$
  - Resonance position: $B_{bg} = 47.5(3)G$
  - Decay term: $\gamma = 2.4(4)G$

3. Loss rate coefficient
- $B_{bg}^{th} = 48.8(3)G$
  - FWHM width $\gamma^{th} = 2.8(5)G$
- These values are very close to those determined from $\sigma_{el}$ measurements
- Good-to-bad collision ratio is 10-30

Outlook
- Angulon, a new type of impurity problem
- Determine the universal binding energy of triatomic molecule

Reference:
Zhen Su, Huan Yang, Jin Cao, Xin-Yao Wang, Jun Rui, Bo Zhao, and Jian-Wei Pan. Resonant control of elastic collisions between $^{23}{\text{Na}}^{40}{\text{K}}$ molecules and $^{40}{\text{K}}$ atoms. 10.1103/PhysRevLett.129.033401
Evidence for the association of triatomic molecules in ultracold $^{23}\text{Na}^{40}\text{K} + ^{40}\text{K}$ mixtures

Jin Cao$^{1,2,3}$, Huan Yang$^{1,2,3}$, Xin-Yao Wang$^{1,2,3,4}$, Zhen Su$^{2,3}$, De-Chao Zhang$^{1,2,3}$, Jun Rui$^{1,2,3}$, Bo Zhao$^{1,2,3}$, Chun-Li Bai$^{4,5}$ & Jian-Wei Pan$^{1,2,3}$

1. Hefei National Laboratory for Physical Sciences at the Microscale and Department of Modern Physics, University of Science and Technology of China, Hefei, Anhui, China.
2. Shanghai Branch, CAS Center for Excellence and Synergetic Innovation Center in Quantum Information and Quantum Physics, University of Science and Technology of China, Shanghai, China.
3. Shanghai Research Center for Quantum Sciences, Shanghai, China.
4. Beijing National Laboratory for Molecular Sciences, Key Laboratory of Molecular Nanoscale and Nanotechnology, CAS Research Education Center for Excellence in Molecular Sciences, Institute of Chemistry, Chinese Academy of Sciences, Beijing, China.
5. University of Chinese Academy of Sciences, Beijing, China.

Motivation

- Three-body problem
  - Provide an ideal platform to investigate the quantum-mechanical three-body problem.

- Precision Measurement & Quantum Simulation
  - More symmetric properties and degrees of freedom.
  - Offer new opportunities in tests of fundamental physics and quantum simulation of exotic Hamiltonians.

Experimental Schemes

- Initial condition
  - Large volume three-beam optical dipole trap $2.3 \times 10^5$ $^{40}\text{K}$ atom and $2 \times 10^4$ $^{23}\text{Na}^{40}\text{K}$

- rf association of triatomic molecules
  - Atom-molecule Feshbach resonance$^2$: $B_g=57.6\text{G}$, FWHM $\delta = 5.3\text{G}$ for $^{23}\text{Na}^{40}\text{K}$ for $|\ell=0,m=0,m_{3}=3/2, m_{5}=3\rangle$ and $^{40}\text{K} |\ell=9/2, m_{3}=-7/2\rangle$
  - rf $\Omega_{\text{rad}} = 2 \pi \times 20 \sim 30 \text{kHz}$
  - Pulse duration $T = 30 \text{ ms}$
  - Clear association signal
  - Obtain the binding energy directly

- Improve signal resolution
  - Modulate optical dipole trap intensity by square wave: $f_{\text{mod}} = 2.5\text{kHz}$, duty cycle 25%.
  - Suppress triatomic molecule loss
  - Better resolution of the $^{23}\text{Na}^{40}\text{K}_2$ association loss feature

Experimental Results

- rf spectra at different magnetic fields
  - $B_0 = 57.6\text{G}$
  - Loss feature due to the atomic transfer
  - $55.69\text{G} \leq B_0 \leq 56.13\text{G}$
  - Additional loss feature changes with $B_0$
  - $B_0$ uncertainty $< 20\text{mG}$ (a few kHz)
  - Mean field shift is negligible

- Evidence of the association of triatomic molecules $^{23}\text{Na}^{40}\text{K} + ^{40}\text{K}$

- Binding energies of the triatomic molecules
  - $B_0'$ is consistent with $B_0$ and $B_0'$ is lower than $B_0$ by $1\text{G}$
  - The strong coupling between the scattering state and the bound state causes the binding of the molecular state!

- Molecule loss spectrum resonant position$^2$
  - Universal relation $E_b \propto (B - B_0)^2$
  - $B_0' = 57.58(16)\text{G}$
  - Linear fit $B_0' = 56.74(7)\text{G}$

Outlook

- Understand and suppress the decay of triatomic molecules
- Prepare ultracold triatomic molecule gases

Reference:


Introduction

Metal-organic frameworks (MOFs) are frequently applied as the skeleton materials for supramolecular probes due to their high porosity, regular channels and multiple interactions. University Institute of Oslo-66 (UIO-66) and Materials of Institute Lavosier-125 (MIL-125) are two MOFs that stand out owing to their strong chemical and thermal stabilities.

Many studies have been conducted on the interaction of MOFs with probes, and the two most popular methods are adsorption and covalent linkage. However, the stability of the adsorption is not high, and the fluorophore is easily dislodged. In addition, there are certain limitations on the size of the molecule and the channel of MOFs.

Our synthetic strategy has two main advantages. One is that the material may have excellent FA sensing properties because of the numerous hydrazine groups on its surface that can be directly contacted with FA. Another is that the fluorescent groups of the material are bounded by covalent bonds, which can restrict n→π stacking and cause it to exhibit AIE characteristics.

Methods & Structure Simulation

Fig 1. Methods for preparation

Fig 2. Crystal simulation structure of UD-46-NH2 and MIL-125-NH2

Morphological Characterization

Fig 3. SEM images of the UD-46-NH2; a) UD-46-NH2, b) UD-46-NH2 and c) UD-46-NH2 particles

Fig 4. SEM images of the MIL-125-NH2; a) MIL-125-NH2, b) MIL-125-NH2 and c) MIL-125-NH2 particles

The AIE Properties of Materials

The unique 3D structure of MOF can provide a rigid environment to avoid the planarization aggregation of NIs, thereby reducing non-radiative transitions and becoming AIE-active molecules.

Fig 5. a) FL spectra of UD-46-NH2. b) The solid-state fluorescence emission spectra of UD-46-NH2. Inset: CIE chromaticity coordinates of UD-46-NH2.

Efficient Detection of Formaldehyde

The recognition sites are more concentrated on the surface, which can identify the target more quickly and thus reduce the response time with the target.

Fig 6. a) Time-dependent fluorescence intensity at 25 nm for UD-46-NH2. b) Time-dependent FL spectra of UD-46-NH2

Conclusion

Two novel "Turn-Off" probes

Ultrafast response time and low detection limit for FA detection

The covalent linkage of N to MOF and give the probe AIE properties

We hope that our synthesis strategy and choice of skeleton materials will provide you with some new ideas for developing optical materials with greater application potential in the future.
Analogue memristor made of Silk Fibroin Polymer

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Abstract

A novel protein-based polymer memristor is synthesized by a polymerization reaction using silk fibroin protein (SFP) and 2-isocyanatoethyl methacrylate. The analogue-type protein-based memristor demonstrates that more than 32 conductance levels are impressively obtained and outstandingly maintained for 4 months. This work provides a new horizon for high performance analogue computing systems.

keywords: protein-based polymer, silk fibroin, analogue memristor

Artificial synapses and research implications

Synthesis of silk fibroin protein polymer

The preparation process

Mechanism of the analog RS behavior

Resistive switching memory behavior

Mode-locked fiber lasers based on a Mach-Zehnder interferometer filter

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Introduction

The filter is one of the most important elements in normal-dispersion mode-locked fiber lasers, which narrows the pulse in spectral domain by cutting edges of the spectrum. Quartz plate, diffraction grating and fiber Bragg grating have all been used in fiber lasers to realize spectrum filtering. However, discrete elements such as Quartz plate or diffraction grating complicate the laser structure. Fiber Bragg grating is not very suitable for dissipative solitons, as the bandwidth of a fiber Bragg grating is usually very narrow. Another kind of widely used filters is the comb filter, based on interferometers. In addition to fiber sensors to accurately measure physical, biological or chemical parameters, fiber interferometers can also be used as filters in fiber lasers. Among them, filters based on Mach-Zehnder interferometer (MZI) have the advantages of low cost and simple structure. We make a MZI filter with multi-mode fiber and seven-core fiber and insert it in an Yb-doped mode-locked fiber laser, stable mode-locked pulses have been obtained.

Experimental Setup

The MZI filter is fabricated by splicing segments of single-mode fibers (SMFs), multimode fibers (MMFs) and seven-core fiber (SCF) sequentially. The light propagating in SMF is coupled into different cores and cabling of the SCF through the first segment of MMF, and is coupled back to the SMF by the second segment of MMF. Interference occurs due to the optical path difference among the light propagating in different cores and cabling of the SCF. The free space range (FSR) of the interference curve relates to the length of the SCF. When a segment of 0.4 cm SCF is selected, the FSR of the interference curve is 15.44 nm. Inserting the interference filter into an Yb-doped fiber laser mode-locked by nonlinear polarization rotation, stable dissipative solitons have been obtained. The central wavelength locates at 1043.88 nm, with a 3 dB bandwidth of 12.32 nm.

Results and Discussion

The output characteristics of the mode-locked pulses when the pump power is set to be 3.3 W are shown in Figure 3. The spectrum shows the typical characteristic of dissipative solitons, as shown in Figure 3(a). The central wavelength is located at 1043.88 nm, with a 3 dB bandwidth of 12.32 nm.

The pulse sequence recorded by the oscilloscope is shown in Figure 3(b). The interval between two pulse is about 41 ns, with a repetition rate of 24.39 MHz.

Figure 3(c) reveals the autocorrelation trace. Assuming a Gaussian shape, the pulse duration is 5.94 ps.

To monitor the stability of the laser, the RF (Radio Frequency) spectrum was measured. As shown in Figure 3(d), the results for a resolution of 100 Hz in the spectrum range from 0 to 300 MHz, and the inset displays the RF signal with a resolution of 10 Hz in the spectrum range from 14.39 MHz to 54.39 MHz. The SNR(signal-to-noise) ratio is as high as 76.99 dB. It indicated that the laser maintains a stable mode-locked state.

Conclusion

We fabricate a Mach Zehnder interferometer filter by inserting two segments of MMFs and one segment of SCF between SMFs.

Insert the interference filter into an Yb-doped fiber laser mode-locked by nonlinear polarization rotation, stable dissipative solitons have been obtained.

Acknowledgment

This research was supported in part by the National Natural Science Foundation of China (No. 61875247), and the Natural Science Foundation of Shandong Province (ZR2020MF068, ZR2022MF253). It was also supported by Liaocheng University under Grants (118052199, 118012023, 118051412, 31005180101, 319130301, and 318051411).

Reference

Tailoring the Crystallographic Orientation of a Sb$_2$S$_3$ Thin Film for Efficient Photoelectrochemical Water Reduction

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Introduction

Antimony sulfide (Sb$_2$S$_3$) is an emerging earth-abundant semiconductor for photoelectrochemical (PEC) water reduction. The anisotropic nature of Sb$_2$S$_3$ is responsible for its direction-dependent carrier transport efficiency. In general, photogenerated carriers transfer more efficiently along the [hk1] orientation than along the [hk0] orientation. However, the synthesis of a Sb$_2$S$_3$ film with precisely controlled [hk1] orientation is still very challenging. Herein, a completely [hk1]-oriented Sb$_2$S$_3$ film is prepared by sulfidizing an Ag/Al film deposited using dual-source electron beam evaporation. A silver-induced crystal growth model is proposed to elucidate the formation mechanism of the [hk1]-oriented Sb$_2$S$_3$ films. Mechanical studies reveal that the [hk1]-oriented Sb$_2$S$_3$ film has a higher defect density and better carrier transport efficiency in comparison to those of randomly oriented Sb$_2$S$_3$ films. As a result, a photocathode based on the [hk1]-oriented Sb$_2$S$_3$ film delivers a high photocurrent density of 9.4 mA cm$^{-2}$ at 0.5 V versus RHE and a high applied bias photo-to-current efficiency of 1.2%. It is a new approach to the development of new material.

Results

The Ag/Al bimetallic precursor films were deposited on MgO-coated soda-lime glass substrates by dual-source electron-beam (EB) using Ag pellet and Sb pellet as starting materials. The Ag and Sb bimetallic precursor films were deposited at room temperature under a working pressure of about 8 x 10$^{-4}$ Torr. The deposition rates of Ag and Sb were monitored by quartz crystal microbalances to control the thickness and composition of the deposited films. To prepare Ag/Al$_x$S$_y$ films with different Ag concentrations, the deposition rate of Sb was fixed at 50 A s$^{-1}$, while the deposition rate of Ag (0.10 - 0.25 A s$^{-1}$) was varied to produce Ag/Al$_x$S$_y$ bimetallic precursor films, followed by the same sulfidization process. For the sulfidization process, the deposited Ag/Al$_x$S$_y$ bimetallic precursor films and elemental sulfur powder (0.5 g) were put at two separate positions in the quartz tube furnace with the sulfur powder at the upstream side of the furnace. Subsequently, the deposited Ag/Al$_x$S$_y$ bimetallic precursor films were heated at 900 °C for 60 min under an Ar flow of 100 sccm. The temperature at the position of sulfur powder is measured to be ~250 °C. After sulfidization process, 2 mL 0.5 mmol L$^{-1}$ (NH$_4$)$_2$SO$_4$ solution was spin-coated onto the surface of Ag/Al$_x$S$_y$ films in order to remove the residual element S.

Conclusion

In summary, Ag/Al$_x$S$_y$ film photocathode are prepared by sulfidizing Ag/Al bimetallic precursor film deposited using dual-source EB evaporation. During the sulfidization, some Ag$_3$S$_2$S$_3$ crystal units were formed in the Ag/Al$_x$S$_y$ bimetallic films, which facilitate the growth of the (Sb$_2$S$_3$) in ribbons along the [hk1] orientation and prevent the stack of (Sb$_2$S$_3$) in ribbons along the [hk0] orientation. As a result, a completely [hk1]-oriented Sb$_2$S$_3$ film was obtained with Ag doping. The Ag$_3$S$_2$S$_3$ film with completely [hk1] oriented crystal structure has lower defect density, higher conductivity and faster carrier mobility than that of randomly oriented Sb$_2$S$_3$ film, thereby contributing to higher separation and injection efficiency of photogenerated carriers. The significantly improved efficiency of the fabricated photocathode based on [hk1]-oriented Sb$_2$S$_3$ film demonstrate the effectiveness of our crystallographic orientation engineering strategy.
Vortex symmetric Airy beam as optical communication link through turbulence channel
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Abstract
The orbital angular momentum of the vortex beam can be used for information coding and help to improve the communication rate. The self-focusing phenomena of the symmetric Airy beam (SAB) can help improve the light intensity in the receiving aperture. The vortex symmetric Airy beam (VSAB) which couples the self-focusing SAB and topological charge can provide new possibilities for the optical carrier of free space optical communication (FSOC). In this paper, the performance analysis of VSAB as the optical carrier propagation in the turbulence is studied. The evaluation parameters mean signal-to-noise ratio (SNR) and mean bit error rate (BER) for the VSAB propagating in turbulent atmosphere are calculated, using numerical calculations. The influences law of the parameters of the VSAB on evaluation parameters have been obtained.

Introduction
Free space optical communication (FSOC) uses laser beam to transmit information in the free space. It has faster transmission rate, lower communication capacity, stronger anti-electromagnetic interference performance and higher confidentiality than the traditional microwave communication. However, the atmospheric turbulence on the link will cause beam spreading and scattering in the optical carrier, which will reduce signal power and increase link noise. So it is necessary to find the optical beams that exhibit stable transmission in the turbulence in developing FSOC systems.

VSAB propagation in atmospheric turbulence
The VSAB leaves from the source plane, propagates a certain distance L in the atmospheric turbulence link, then arrives at the receiver plane. The modeling schematic diagram of VSAB propagation in turbulence is shown in Fig. 1. The whole propagation distance is divided into m segments. \( U_i \) and \( U_{i+1} \) respectively represent the optical field on the i-th and (i+1)-th receiver plane. The relationship between the optical field on the adjacent receiver plane is

\[
U_{i+1}(x, y, z) = F \left[ F \left[ U_i(x, y, z) \right] \exp \left[ j \phi(x, y) \right] \right] H(p)
\]

where \( U_i \) and \( U_{i+1} \) respectively represent the optical field and position vector of the (i-th) plane and \( F \) represents the position vector of the (i+1)-th plane, and the \( p \) is the phase frequency of the i-th plane. The \( H(p) \) stands for the phase induced by atmospheric turbulence.

Fig. 1. Schematic diagram of modeling VSAB propagation in turbulence.

To study the performance of VSAB as communication link operating in free space, here we adopt mean signal-to-noise ratio (SNR) and mean bit-error-rate (BER) as the evaluation parameters.

The optical beam on-off keying modulation. Under the atmospheric turbulence circumstance, the mean BER is a conditional probability and it is expressed as

\[
<BER> = -\frac{1}{2} \int_{-\infty}^{\infty} p(x) \Phi \left( \frac{SNR > x}{\sqrt{2}} \right) dx
\]

where \( p(x) \) is the log-normal distribution, \( \Phi \) represents the complementary error function, and \( <SNR> = \text{mean signal-to-noise ratio} \) and its expression is

\[
<SNR> = \frac{SNR}{P_{in} \cdot P_{out} + \sigma^2 \cdot SNR^2}
\]

where \( SNR \) represents the output SNR in vacuum and \( P_{in} \) is signal power in vacuum. \( P_{in} \) is the mean value of the signal power on the receiving plane in turbulence. \( \sigma^2 \) is the aperture averaged standard deviation and its expression is

\[
\sigma^2 = \frac{1}{\pi} \int_0^{2\pi} \int_0^{\infty} (r^2 / x) \exp \left( -\frac{r^2}{x} \right) \sin \theta d\theta d\phi
\]

Results and discussion
In this section, the performance analysis of VSAB as the optical carrier propagating through the turbulence is investigated in terms of mean SNR and mean BER. The wavelength selected for this study is 1550 nm. The inner scale and outer scale of the turbulence are respectively 0 and \( \lambda \). The distance of the VSAB propagation in the atmospheric turbulence is 3 km and is divided into 50 segments. The realization of turbulence phase screen are 500. The coordinate of the vortex phase displacement is set to (0,0).

The effect of decaying factor on mean SNR and mean BER of VSABs are studied. The influence law of decaying factor on mean SNR and mean BER are respectively shown in Fig. 2 and Fig. 3. The VSABs with the smaller decaying factor have higher values of mean SNR and smaller values of mean BER than that of the VSABs with the greater decaying factor under the same conditions.

Fig. 2. SNR of the VSABs with different decaying factors
Fig. 3. BER of the VSABs with different decaying factors

The influence of the transverse length scales \( x_0, y_0 \) on mean SNR and mean BER of VSABs are explored. The influence of transverse length scales on mean SNR and mean BER are respectively shown in Fig. 4 and Fig. 5. The smaller transverse length scales can make VSABs have better mean SNR and lower mean BER.

Fig. 4. SNR of the VSABs with different transverse length scales
Fig. 5. BER of the VSABs with different transverse length scales

The effect of topological changes on mean SNR and mean BER of VSABs are studied and the influence law of transverse length scales on mean SNR and mean BER are respectively shown in Fig. 6 and Fig. 7. The results in Fig. 6 and Fig. 7 show that the less topological changes can make VSABs have higher mean SNR and lower BER.

Fig. 6. SNR of the VSABs with different topological charges
Fig. 7. BER of the VSABs with different topological charges

Summary
This paper investigates the performance of the VSABs as optical carrier propagating in atmospheric turbulence. The influence law of the decaying factor, transverse length scales, and topological change on the mean SNR and mean BER are obtained.

The VSABs with smaller decaying factor, smaller transverse length scales, and less topological change have stronger capability in resisting the atmospheric turbulence. It can help the optical carrier obtain better mean SNR and smaller mean BER to improve the performance of FSOC. In short, the VSAB with smaller decaying factor, small transverse length scales and less topological change is a great potential optical carrier. For space optical communication. Also, clarifying the mechanism of this phenomena needs further investigations.
Abstract

NPC effect is impressively detected in the high resistance state branch of the Ag/Graphene quantum dots (GQDs)/TiOx/F-doped SnO₂ memristor, for that, the power consumption is downscaled. Memory logic display and multilevel data storage are developed under visible light illumination. Our results provide an interfacial engineering design for the NPC effect in memristor as well as give a horizon on multi-functionality.

Key Words: Memristor; Negative Photoconductance Effect; GQDs; TiOₓ film

Highlights

- **Uniform GQDs Preparation:** Graphene was processed in 98% H₂SO₄ and NaOH, ultrasonic dialysis in water.
- **Memristor Structure:** Ag/GQDs/TiOₓ/FTO
- **Coexistence of the NPC and RS:** Interfacial Engineering to construct the NPDs in HRS of the memristor, extension its function

Methods and Technique

Characterization and calculation of the GQDs of the electron distribution

Physical Mechanism

Coexistence of the NPC effect and RS memory behavior in HRS branch

Coexistence of NPC and RS

CS-AFM evidence for the NPC effect in the GQDs/TiOₓ interface
A rapid theoretical method for inverse design on Tip-enhanced Raman spectroscopy (TERS) probes

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Introduction

Tip-enhanced Raman Spectroscopy (TERS) has developed to be a popular technique for scientists, for its great power in correlating chemical information to topography. Rational designing TERS probes is widely emphasized by researchers since TERS performance is determined by metallic structure, which is highly dependent on the lightning-rod effect and localized surface plasmon resonance of probes. However, conventional 3D numerical simulation consumes huge computation resources and the computation cost of this method grows exponentially as the number of parameters increases.

Motivation

- Develop a method of rapid optimizing TERS probes design in high dimensional parameter space.
- Reduce the computation loading and cost for TERS probes design.

Methods

![Fig. 1 Method of optimizing the TERS probe by inverse design.](image1)

Results

![Fig. 3 EM field of optimal result and initial one](image2)

![Fig. 4 FWHM and optical resonance of optimal result and initial one](image3)

Conclusion

- Improve the performance of TERS probes by -1 order.
- Reduce optimization time to ~1% of that in conventional 3D simulation method.
- Suitable for other optical antenna design.

Funds

National Key R&D Program (2021YFA1201502), National Natural Science Foundation of China (22272140, 21727807)
Features of a THz Pulse Genera in a Nonlinear Crystal Partially Filling the Waveguide Cross Section

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Moscow Institute of Electronics and Mathematics. A.N. Tikhonova, Taldinskaya st., 34, Moscow, Russia

Abstract: The experimental and numerical study of the generation and transmission terahertz (THz) pulse by the structure “waveguide partially loaded by nonlinear crystal” is performed. The femtosecond laser (Ti:Sapphire) with a pulse width of 100 fs, a central wavelength of 800 nm and an average power of ~800 mW was used as a laser source for pumping and detecting broadband terahertz pulses. A terahertz pulse is generated in a nonlinear crystal by optical rectification of a femtosecond optical pulse.

Results:

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