YNU Research Center for Terahertz and Nano-Optical Sciences
SQIE/IMS: Photonics Lab. Department of Physics

Frontiers in Photonics: Terahertz and Fiber Technologies

Date and time: 5th March 2025, 10:00-12:10

Place: General Research Building W-202

Program

10:00-10:10 Preface, Ikufumi Katayama, YNU, Japan

10:10-10:50 Katsumasa Yoshioka, NTT-Basic Research Laboratories, Japan

On-chip Non-local Ultrafast Carrier Dynamics of 2D Materials Investigated Using Terahertz Electronics

10:50-11:30 Teun-Teun Kim, University of Ulsan, Korea

Metasurfaces for Terahertz Wave Modulation and Applications

11:30-12:10 Kun Wang, Federal Institute for Materials Research and Testing (BAM), Germany

Multimode Fiber Imaging: Overcoming Challenges with Machine Learning

Contact: Ikufumi Katayama
katayama-Ikufumi-bm@ynu.ac.jp / 045-339-3695

On-chip Non-local Ultrafast Carrier Dynamics of 2D Materials Investigated Using Terahertz Electronics

Dr. Katsumasa Yoshioka, NTT-Basic Research Laboratories, Japan

Advances in ultrafast laser spectroscopy now enable the observation and control of electronic states in solids on femtosecond timescales. However, high-frequency electronics remain constrained to slower nanosecond or gigahertz regimes. To bridge this gap, we developed terahertz (THz) electronics [1] capable of measuring sub-picosecond current responses on-chip using photoconductive switches. We demonstrated ultrafast optoelectronic conversion using a graphene photodetector with a 3dB bandwidth of 220 GHz, gaining insights into its mechanisms [2], and achieved electrical control of 1.2-picosecond plasmon wavepackets in graphene, revealing its ultrafast transport properties [3]. These methods are applicable to other 2D atomic-layer materials, enabling new explorations of charge transport dynamics. This work bridges ultrafast optical science and high-frequency electronics, paving the way for innovative device technologies.

[1] Appl. Phys. Lett. 117, 161103 (2020). [2] Nat. Photonics 16, 718 (2022). [3] Nat. Electronics 7, 537 (2024).

Metasurfaces for Terahertz Wave Modulation and Applications

Prof. Teun-Teun Kim, University of Ulsan, Korea

Metasurfaces have been extensively studied for novel optical functionalities. This talk highlights our lab's research on metasurface designs achieving gate-induced switching and linear modulation of terahertz (THz) waves using hybrid meta-atoms and atomically thin graphene. These metasurfaces enable high-performance optical devices surpassing traditional bulk elements. Additionally, we present recent findings on exceptional points (EPs) and phase singularities in non-Hermitian metasurfaces. By combining anisotropic meta-atoms with graphene, we controlled polarization eigenstates, revealing polarization phase singularities at EPs. Integrated with microfluidic channels, this system detects trace biochemical samples, providing a promising platform for polarization-based devices and sensitive sensors.

Multimode Fiber Imaging: Overcoming Challenges with Machine Learning

Dr. Kun Wang, Federal Institute for Materials Research and Testing (BAM), Germany

This presentation focuses on recent progress in multimode fiber (MMF) imaging, highlighting the use of machine learning to improve image reconstruction accuracy. Key challenges such as mode interference, signal degradation, and environmental changes, including temperature fluctuations, are addressed. Using neural network architectures, we demonstrate imaging methods that remain reliable and accurate under varying conditions. These results show the potential of neural network-based techniques to improve imaging stability and precision, supporting applications in biomedical imaging, remote sensing, industrial monitoring, and advanced endoscopic systems. The presentation will also include a brief introduction to the European project INFOTherm.

Contact: Ikufumi Katayama
katayama-Ikufumi-bm@ynu.ac.jp / 045-339-3695