



Seminar

Mid-infrared Detection and Spectroscopy with 2D Materials

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地点: 北京大学物理楼, 西563会议室

Abstract

Mid-infrared (MIR) detection is widely used in life sciences, remote sensing, security, industrial imaging, and environmental monitoring. Despite significant attempts, development of simple, low-cost, low-noise systems for MIR detection and imaging at room temperature remains a challenge. Two-dimensional (2D) materials have attracted tremendous research interests due to their unique and intriguing electrical and optical properties. In this talk, I will present our early research in applying 2D materials for applications in the MIR regime, in particular, broadband PtSex-based photodetector [1] and a high responsivity hybrid MIR photodetector based on graphene integrated with broadband oxide-based nanoparticles [2]. Furthermore, converting MIR radiation to visible and near-infrared regions is an interesting approach, which can be easily detected and imaged with silicon photodetectors due to their high sensitivity, low cost, and CMOS compatible. We report a transducer using lanthanide nanocrystals that realize broadband MIR detection under ambient conditions [3]. The broadband wavelength response ensures its application for MIR spectroscopy and imaging. I will also present our research on-chip photothermoelectric detectors for full-Stokes detection [4], on-chip photodetection of angular momentums of vortex structured light [5], and on-chip mid-IR multi-dimensional detection [6].

Acknowledgement

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References

- [1] X. Yu, Peng Yu, Di Wu, Bahadur Singh, Qingsheng Zeng, Hsin Lin, Wu Zhou, Zheng Liu and Qi Jie Wang, "Atomically-thin Noble Metal Dichalcogenide: A Broadband Mid-infrared Semiconductor", Nat Commun., 9:1545, 2018.
- [2] X. Yu, Yangyang Li, Xiaonan Hu, Daliang Zhang, Ye Tao, Md. Azimul Haque, Tom Wu, and Qi Jie Wang, "Room-Temperature Broadband Mid-infrared Photodetection Realized via Coupling Graphene with a Narrow-Bandgap Semiconductor", Nat. Commun., 9:4299, 2018.
- [3] L. Liang, C. Wang, J. Chen, Q. J. Wang, X. Liu, "Incoherent broadband mid-infrared detection with lanthanide nanotransducers", Nat. Photon. 16, 712, 2022.
- [4] Mingjin Dai, Chongwu Wang, Bo Qiang, Fakun Wang, Ming Ye, Song Han, Yu Luo, and Qi Jie Wang, On-chip mid-infrared photothermoelectric detectors for full-Stokes detection, Nat Commun., 13, 4560, 2022.
- [5] Mingjin Dai, Chongwu Wang, Fangyuan Sun, and Qi Jie Wang*, On-chip photodetection of angular momentums of vortex structured light, Nature Communications, 15:5396, 2024.
- [6] Fakun Wang, et al, "Multidimensional detection enabled by twisted black arsenic-phosphorus homojunctions", Nat Nano, 19, 455–462, 2024.

About the speaker

Prof. WANG Qijie is a full professor at the School of Electrical and Electronic Engineering (EEE) and the School of Physical and Mathematical Sciences (SPMS) NTU. He is an OPITCA Fellow. He is a co-recipient of the Institution of Engineers Singapore, Prestigious Engineering Achievement Team Award of Singapore Twice in 2005 and 2017, respectively, the prestigious Singapore Young Scientist Award 2014, Nanyang Research Award 2015 (Young Investigator), ARC Sciences Nanotechnology Medal and Prize, 2021, and NTU College of Engineering Research Excellence Award, 2022.