THE CHINESE UNIVERSITY OF HONG KONG
Department of Electronic Engineering
Seminar

Interface Engineering of Two-dimensional Tellurene for Ultrasensitive Infrared Photodetector

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Venue: **Room 222, 2/F, Ho Sin Hang Engineering Building, CUHK**

Abstract

The mid-infrared(IR) spectral band is of significant technological importance for security surveillance, remote sensing, infrared countermeasures, and free-space communications. This report aims to enable the design, fabrication, and integration of mid-IR photodetector based on a new emergent optical nanomaterial, namely two-dimensional tellurene. The research is to capitalize on the tunable band gap properties of tellurene, the high mobility of its carriers and its stability to enable fast response time detectors, and at the same time, the atomically sharp interfaces between two-dimensional van der Waals heterostructures should yield ultra-sensitive detectors by reducing dark currents. Technologically, the objectives are: (i) Investigate the intrinsic optoelectronic properties of tellurene at room-temperature and explore the unique advantage and capability of tellurene for mid-IR optoelectronics. (ii) Develop the interfacial band alignment engineering of 2D van der Waals heterostructures by tailoring the lattice mismatch and distance. (iii) Innovate a process scheme that fabricate waveguide structure on tellurene and related heterostructure using compositionally-engineered chalcogenide glass as the light guide as well as an infrared-transparent gate dielectric with lithographic accuracy. Scientifically, exploration of anisotropic excitons and their tunability of tellurene by electric field will advance our basic understanding of many body physics in this unique one-dimensional van der Waals 2D material with low crystalline symmetry. Besides, the element tellurium hosts a crystal structure made up of spiral chains in a hexagonal array and its symmetry leads to the existence of two opposite handedness chirality. The exploring of the light matter interaction in this chiroptical materials allow us to have a new degree of freedom to design novel non-linear optical device concepts. The research holds great promise as an important platform for materials science and opto-electronic engineering, enabling an emerging interdisciplinary research field spanning from nanoelectronics to information technology.

Biography

Yixiu Wang is currently employed as a researcher at Zhejiang Lab. He obtained his Bachelor of Science degree in inorganic non-metallic materials from Hefei University of Technology in 2010. Following this, he conducted three years of research for his master's thesis at the University of Science and Technology of China, during which he gained expertise in wet-chemistry synthesis of nanocrystals. In 2020, he earned his Ph.D. in Industrial Engineering from Purdue University, with his doctoral research primarily centered on the discovery of tellurene and its related electrical properties, sparking a new surge of research interest. Since joining Zhejiang Lab as a principal investigator, Wang has been leading research efforts on high-performance integrated sensors for mechanical and optical detection. Overall, his main research endeavors concentrate on the synthesis of low-dimensional materials and novel 2D atomic crystals for applications in nanoelectronics and energy conversion devices, along with exploring fundamental phenomena in nanoscale systems.

***** ALL ARE WELCOME *****

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