THE CHINESE UNIVERSITY OF HONG KONG
Department of Physics
SEMINAR

Chiral Induced Spin Selectivity Effect and Unconventional Superconductivity in Chiral Molecule Intercalation Superlattices

by

Professor Qi QIAN (錢琦教授)
The School of Science and Engineering
The Chinese University of Hong Kong Shenzhen, China

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ALL INTERESTED ARE WELCOME
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Abstract

The discovery of chiral induced spin selectivity (CISS) opens up possibilities to magnetic-field-free spin manipulation, which offers transformative applications in spintronics While numerous methods have been explored to introduce CISS into solid-state materials and devices, previous systems have often suffered from issues such as high inhomogeneity, low spin selectivity, limited stability, and challenges in creating robust spintronic devices. In this talk, I will introduce a novel chiral molecule intercalation superlattice (CMIS) as a reliable platform to study CISS in solid-state materials. Using these CMIS structures as spin filtering layers, we have achieved a spin polarization ratio exceeding 60% in spin tunnel junctions. Moreover, superconducting ring devices based on CMIS exhibit peculiar π phase shifts and a robust field-free superconducting diode effect, indicating intriguing coupling between molecular chirality and solid-state superconductivity, as well as time-reversal symmetry breaking in the hybrid system. This suggests that CMIS could serve as a novel material platform for fault-tolerant topological quantum computing. Inspired by these findings and together with other transport studies in van der Waals (vdW) systems, I will also discuss the exciting opportunities of vdW integration for creating new artificial quantum solids with designable chemical compositions, dimensionality, interlayer distances, structure motifs and potential landscape, which would provide brand new platforms for both the fundamental studies and quantum technologies.