世纪物理情·系列讲座

Approaching a topological qubit with selective-area-epitaxied Majorana nanowires

【报告人】
何柯
清华大学

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【摘要】

Semiconductor-superconductor hybrid nanowire is one of the major platforms for realizing Majorana zero modes and topological quantum computing. Despite enormous efforts for over one decade on InAs and InSb-based nanowires, a working topological qubit remains elusive. A too high disorder level in the III-V-based hybrid nanowires is considered the central problem hindering the research progress and leading to controversial experimental results in this field. In this talk, I will introduce our approach of building high-quality Majorana nanowires for topological qubits with selective-area-epitaxied PbTe-based hybrid nanowires. The large dielectric constant of PbTe at low temperature and the available lattice-matched substrate CdTe grant it great potential in overcoming the disorder problem. Selective-area molecular beam epitaxy technique enables fabrication of planar PbTe-superconductor hybrid devices with atomically clean, flat, sharp, and tunable interfaces. With these improvements, we obtained PbTe-based nanowires with higher quality than III-V-based nanowires, characterized by ballistic transport properties sustaining over 1.5 micron and quantized Andreev conductance. Robust zero-base peak was observed in planar PbTe-Pb nanowires in the ballistic transport regime. The advantages and problems, as well as the prospective of realizing a topological qubit, of the new candidate Majorana nanowire system will be discussed.

【报告人简介】

Prof. Ke He graduated from Shandong University in 2000, and received his PhD in 2006 in Institute of Physics, Chinese Academy of Sciences (IOP, CAS). After a three-year-long postdoc research in the University of Tokyo, he came back to IOP, CAS as an associate professor. In 2013, he joined Department of Physics, Tsinghua University and became a full professor since 2016. His researches focused on molecular beam epitaxy growth of low-dimensional topological materials and experimental exploration in various topological quantum effects in them. Prof. He made outstanding contributions in the first experimental realization of the quantum anomalous Hall effect. Prof. Ke He won the first-class National Natural Science Award of China in 2018, Yeh Chi-Sun Prize in Physics in 2017, Nishina Asia Award of Japan in 2015.

主办单位:清华大学高等研究院