北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Electrical Properties of Silicon and Germanium Molecular Wires

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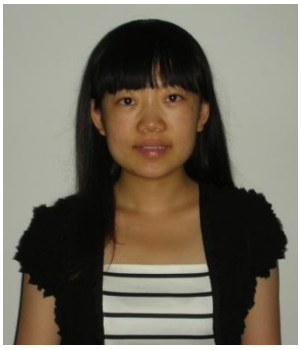

Time: 4:00pm, May 17, 2016 (Tuesday)

时间：2016年5月17日 （周二）下午4:00

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

The progress in modern information technology is enabled by miniaturization of transistors which have feature sizes that are fast approaching ~10 nm scale. However, the mechanism of electron transport, which is well known for the macroscopic transistors, hasn't been studied and understood very well in nano-scale systems where quantum mechanical effects come into play. To address this, we study the electrical properties of one-dimensional silicon and germanium chains with chain-length 0.3-2 nm, about one order of magnitude smaller than current device sizes. We create single-molecule circuits by using the scanning tunneling microscope-based break junction technique and study the conductance (current/voltage) behaviors of different molecular components. We can form stable molecular circuits with carbon, silicon and germanium (group VI elements) molecular wires terminated with methylsulfide gold-binding groups and find that they have well-defined conductance signatures. Furthermore, we realize a single molecule conductance switch activated by compressing and stretching the junction in both silicon and germanium series. With theoretical support, we demonstrate that the strong conjugation in Si—Si and Ge—Ge σ-bonds enables us to observe and exploit stereoelectronic properties of the sulfur–methylene σ bond in single-molecule junctions. We also apply a high voltage on these molecular junctions and study the bond rupture behaviors across a range of chemical bonds. We envision that an understanding of electron transport in atomically precise single molecule devices will inform the design of next-generation electronic circuits.

About the speaker

Haixing Li is a Ph.D. student in the department of Applied Physics at Columbia University working on experimental measurements of transport in single molecule circuits with Prof. Latha Venkataraman. Currently she uses the scanning tunneling microscope-based and mechanically controlled break junction techniques to study electron transport in single molecule junctions. She hopes to understand the fundamental physics behind the rich phenomena emerging at the single molecule level, as well as to develop technologies at the forefront of miniaturization of electronic devices. Before this, she did superconductor research with Prof. Xianhui Chen at University of Science and Technology of China and quantum optics research with Prof. Brian Smith at University of Oxford.