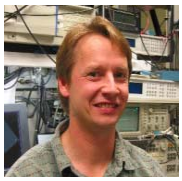
量子材料科学中心
International Center for Quantum Materials

Seminar

High-resolution scanning probe microscopy as a tool for solid-state research



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- **Time: 10:00am, Oct. 22, 2010 (Friday)**
- **Venue: Conference Room A (607), No. 5 Science Building**

Abstract

In this talk I will highlight how scanning tunneling microscopy can be used to gain unprecedented insight into the world of atoms and molecules on surfaces.

As a first example we will discuss an application of precise atom manipulation with STM. When molecules are properly positioned on a surface, the physical motion of one molecule from one binding site to an adjacent one can trigger the motion of the adjacent molecules, leading to a cascade of motion which we termed a "molecule cascade" [1]. Interestingly, at low temperatures the propagation of entire CO molecules is dominated by quantum tunneling. A molecule cascade can transmit digital information along a surface and at the intersection of such cascades binary logic operations can be performed - at the atomic length scale.

As a second example, I will discuss the magnetism of atoms on surfaces. Understanding and controlling of magnetic properties of nanoscale systems is crucial for the implementation of future data storage and computation paradigms. When placing magnetic atoms on top of thin insulating films, one can gain access to their quantum spin properties with tunneling electrons. Here we employ elastic and inelastic tunneling spectroscopy with STM to measure magneto-crystalline anisotropy parameters [2], spin-spin interactions [3]. The magnetic atoms on the thin insulators can be well modeled with simple spin Hamiltonians.

I will then outline my vision for the future of high-resolution scanning probe microscopy entailing high energy resolution, high spatial resolution, and high time resolution [4].

[1] "Molecule Cascades", A.J. Heinrich, J.A. Gupta, C.P. Lutz, and D.M. Eigler, *Science* **298**, 1381 (2002).

[2] "Large Magnetic Anisotropy of a Single Atomic Spin Embedded in a Surface Molecular Network", C.F. Hirjibehedin, C.-Y. Lin, A.F. Otte, M. Ternes, C.P. Lutz, B.A. Jones, A.J. Heinrich, *Science* **317**, 1199 (2007).

[3] "Spin-coupling in engineered atomic structures", C.F. Hirjibehedin, C.P. Lutz, A.J. Heinrich, *Science* **312**, 1021 (2006).

[4] "Measurement of Fast Electron Spin Relaxation Times with Atomic Resolution", S. Loth, M. Etzkorn, C.P. Lutz, D.M. Eigler, A.J. Heinrich, *Science* **329**, 1628 (2010).