O 7 Symposium Recent Progress in Scanning Probe Methods

Zeit: Freitag 11:00–13:00 Raum: TU H3005

Fachvortrag O 7.1 Fr 11:00 TU H3005

From Spins to Phonons: Mapping Local Excitations with Atomic Resolution — •Klaus Kern — Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, 70569 Stuttgart

Recent experimental advances have provided the unique ability to investigate matter with sub-Ångstrom precision. Scanned probes not only allow us to image and manipulate individual atoms and molecules adsorbed at surfaces with unprecedented resolution but also to probe their electronic and vibrational states by tunneling spectroscopy. In this talk we demonstrate the power of elastic and inealastic tunneling spectroscopy for detecting and mapping local excitations with atomic resolution. As examples we will discuss the phonon spectromicroscopy of single walled carbon nanotubes and the spin detection and manipulation of adatoms and molecules on metallic surfaces.

Fachvortrag O 7.2 Fr 11:30 TU H3005

Spin Mapping on the Atomic Scale: From 2D Antiferromagnets to Single Impurities — •Roland Wiesendanger — University of Hamburg, Institute of Applied Physics, Jungiusstr. 11, 20355 Hamburg

Spin-polarized Scanning Tunneling Microscopy (SP-STM)[1] and Spectroscopy (SP-STS)[2] have allowed the visualization of atomic-scale spin structures [3,4] and the investigation of the spin-dependent local density of states spatially resolved [5]. In a recent SP-STM experiment we could prove that a single monolayer of Fe on a W(001) substrate exhibits a c(2x2) antiferromagnetic ground state with perpendicular anisotropy in contrast to a single Fe monolayer on W(110) which is ferromagnetic with in-plane anisotropy [6]. Spin-dependent scattering at single oxygen impurities on Fe/W(110) was visualized in real-space reflecting the orbital nature of the electronic states involved as well as their spin character [7]. Finally, applications of SP-STM and SP-STS for studying spin states of single magnetic impurities will be discussed. [1]R. Wiesendanger et al., Phys. Rev. Lett. 65, 247 (1990). [2]M. Bode, M. Getzlaff, R. Wiesendanger, Phys. Rev. Lett. 81, 4256 (1998). [3]R. Wiesendanger et al., Science 255, 583 (1992). [4]S. Heinze et al., Science 288, 1805 (2000). [5]O. Pietzsch et al., Phys. Rev. Lett. 92, 057202 (2004). [6]O. Pietzsch et al., Phys. Rev. Lett. 84, 5212 (2000). [7]K. von Bergmann et al., Phys. Rev. Lett. 92, 046801 (2004).

Fachvortrag O 7.3 Fr 12:00 TU H3005

Force microscopy experiments of single molecules on insulators — •Ernst Meyer, Laurent Nony, Enrico Gnecco, Anisoara Socoliuc, Lars Zimmerli, Sabine Maier, and Oliver Pfeiffer — Institute of Physics, Klingelbergstr. 82, CH-4056 Basel, Switzerland

So far, most of the high resolution SPM studies of molecules were restricted to metallic substrates. However, insulating surfaces are necessary to avoid coupling between the molecule electrons and the substrate. Apart from the advantage to be independent of the conductance of the substrate, AFM offers the possibility to perform local force vs. distance curves [1]. The application of force microscopy on single molecules of Cu-tetra (3,5 di-t-butylphenyl) porphyrines revealed that different molecular conformations can be detected. In addition, the energetics of these simple molecular switches can be studied in a quantitative manner. Here, we present force microscopy investigations of molecules deposited on insulators. The surface of KBr(001) is structurized by electron beam irradiation. Small pits of some nanometers in diameters are formed. The decoration with perylene and sub-phtalocyanine molecules shows that the pits act as molecular traps [2].

[1]Ch. Loppacher, M. Guggisberg, O. Pfeiffer, E. Meyer, M. Bammerlin, R. Luethi, R. Schlittler, J. K. Gimzewski, H. Tang and C. Joachim, Phys. Rev. Lett. 066107 (2003).

[2] L. Nony et al., to appear in Nanoletters (2004).

Fachvortrag O 7.4 Fr 12:30 TU H3005

Recent Progress in Friction Force Microscopy — •Roland Bennewitz — Physics Department, McGill University, Montreal, Canada

The development of Scanning Force Microscopy has provided us with tools to study friction and wear on the nanometer scale. The atomic granularity of matter shows up in the lateral force which is necessary to slide a small contact over a flat surface. Also, mechanical damage of a sample surface can be monitored with monolayer resolution. I will discuss the laws which determine the dependence of atomic friction on normal load or velocity, and in what respect they differ from the ones we have learned to describe macroscopic friction. For small scales, a regime of ultra-low friction has long been suggested which recently has been experimentally realized.