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New insights into nanomagnetism by spin-polarized scanning tunneling microscopy and spectroscopy

Spin-polarized scanning tunneling microscopy (SP-STM) allows imaging and spectroscopic characterization of nanostructures with unsurpassed spatial resolution. Its working principle exploits the dependence of the tunnel current on the relative magnetization orientation of a sample and the magnetic STM tip. I will present results by SP-STM, where we investigate the correlation between structural, electronic, and magnetic properties of individual nm small Co islands with several hundred to thousands of atoms. We use external magnetic fields of up to 4 T to tune the magnetic state of both tip and sample, and we extract the corresponding change of the differential conductance of the tunnel junction.

A recent example is our measurement of magnetic hysteresis loops of individual nm small Co islands on Cu(111) at 8 K by SP-STM in external magnetic fields. We have found switching fields of up to 2.5 T for islands with roughly 8,000 atoms. The quantitative analysis of these results which provides novel insights into the magnetization reversal on the nanoscale, and deviations from the venerable Stoner-Wohlfarth model will be discussed.

We also exploit the high spatial resolution of SP-STM in magnetic fields to measure maps of the differential conductance within a single nm-small Co island. In connection with density functional theory calculations we demonstrate for the first time that the spin polarization is not homogeneous but spatially modulated within the Co island. We ascribe the spatial modulation of the spin polarization to spin-dependent electron confinement effect within the Co island.

Wednesday, August 31, 2011
3:30 pm - Room 151, Jorgensen Hall

Host:
Dr. Axel Enders
Department of
Physics & Astronomy

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