School of Physics & Astronomy
Stoner Colloquium

UNIVERSITY OF LEEDS

Dr Matthias Bode,
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Seminar Wednesday 26th November 2008 1.30-2.30pm
Roger Stevens LT 14

"Imaging of Magnetic Nanostructures with Atomic Spin Resolution"

The experimental progress in spin-polarized scanning tunneling microscopy (SP-STM)—a magnetically sensitive imaging technique with ultra-high resolution—allows the investigation of surfaces, thin films, and epitaxial nanostructures with unforeseen precision. Together with its high surface sensitivity, the atomic resolution capability of SP-STM makes it particularly suited for the investigation of antiferromagnetic and superparamagnetic surfaces which could only be studied in some rare cases with moderate spatial resolution in the past because of the lack of macroscopic magnetization. By choosing appropriate substrates and growth conditions Fe nanostructures with a wide range of magnetic properties, including of ferro-, antiferro-, and superparamagnets, can be prepared. For example, we have recently shown by spin-polarized scanning tunneling microscopy that the Fe monolayer on W(001) is c(2×2) antiferromagnetic, i.e., it exhibits a checkerboard pattern of antiparallel magnetic moments. Measurements performed in an external magnetic field reveal an out-of-plane easy magnetization axis. On this antiferromagnetic Fe layer phase domain walls are occasionally observed which are typically very short and clamped between defects like adsorbates or islands. These results demonstrate that atomic resolution SP-STM can also be applied to non-periodic and non-collinear spin structures. The domain wall width amounts to 6-8 atomic rows only and the walls are centered between two atomic rows. The results are compared to Monte-Carlo simulations. While walls oriented along (100) directions are found to be fully compensated, the detailed analysis of (110) walls reveals an uncompensated perpendicular magnetic moment. This may be of technological importance as uncompensated moments are responsible for the exchange-bias effect which is widely used in state-of-the-art magnetic storage devices

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