MA 8: Magnetic Imaging

Time: Monday 15:15–16:45 Location: H 1012

MA 8.1 Mon 15:15 H 1012

Bubble domains in [Co/Pt]/Ru multilayers — •Cristina Bran[1,2], Ulrike Wolff[1], Olav Hellwig[3], Ludwig Schultz[1], and Volker Neu[1] — [1]IFW Dresden, Institute for Metallic Materials, P.O. Box 270116, D-01171 Dresden, Germany — [2]IMPRS "Dynamical Processes in Atoms, Molecules and Solids", Nöthnitzer Str. 38 — [3]San Jose Research Center, Hitachi Global Storage Technologies, 650 Harry Road, San Jose, CA 95120, USA

[Co/Pt]/Ru multilayers present a large variety of different magnetic domain configurations due to the competition between ferromagnetic dipolar coupling and antiferromagnetic coupling through the Ru spacer layer. In this study we focused on $[(Co(4Å)/Pt(7Å))_8Co(4Å)/Ru(9Å)]_{18}$ multilayers which present a predominant dipolar coupling at room temperature. We used a Digital Instruments Dimension 3100 to image the domain structure as a function of an external perpendicular field. In a zero field state, due to the perpendicular anisotropy, band domains with average domain width of 180 nm are observed. By increasing the external magnetic field the domains which are aligned parallel to the field grow, while the oppositely aligned domains shrink. This process is gradually, until the domains transform into worms and, in the end, into a bubble domain structure at 0.34 T. Theoretical calculations, previously developed for single layer film with perpendicular anisotropy [1], are in good agreement with our experimental results, revealing little influence of the antiferromagnetic coupling.

[1] A.A. Thiele, J. Appl. Phys, 41, 1139 (1970).

MA 8.2 Mon 15:30 H 1012

spin-polarized scanning tunneling spectroscopy on individual magnetic adatoms — •lihui zhou, focko meier, jens wiebe, and roland wiesendanger — Institue of Applied Physics, Hamburg University, Jungiusstrasse 11, D-20355 Hamburg, Germany

Using spin-polarized scanning tunneling spectroscopy the spin-resolved electronic states of single Co adatoms on Pt(111) are studied as a function of an external magnetic field, which allows to access the magnetization curves of individual adatoms directly. Surprisingly, we find that the adatoms show paramagnetic behaviour at very low temperature despite of their large magnetic anisotropy [1]. Although the adatoms have identical electronic configurations the magnetic field necessary for saturation shows a strong variation from atom to atom. We ascribe this effect to their mutual RKKY interaction. Indeed, we find experimental evidence for the magnetic interaction between the adatoms and a Co monolayer stripe, which oscillates back and forth between ferromagnetic and antiferromagnetic coupling over a distance of several nanometers.

[1] P. Gambardella et al., Science 300, 1130 (2003)

MA 8.3 Mon 15:45 H 1012

Real space imaging of 2-dimensional 120° Néel structure: one monolayer Mn on Ag(111) — •Chunlei Gao[1], Wulf Wulfhekel[1,2], and Jürgen Kirschner[1] — [1]Max Planck Institute of Microstructure Physics, Halle, Germany — [2]Physikalisches Institut, Universität Karlsruhe (TH), Wolfgang-Gaede Strasse 1, Karlsruhe, Germany

In magnetic materials, the competing exchange interaction between neighboring atoms very often leads to frustrated spin structures. Magnetic frustration may have chemical or topological origin. A classical example of a topological frustration is a 2-dimensional triangular lattice of antiferromagnetic atoms in which a noncollinear 120° Néel structure stabilizes. In this report, we demonstrate the 120° Néel structure of Mn monolayer on Ag(111) with spin-polarized scanning tunneling microscopy (Sp-STM) operating in the constant current mode [1]. Mn grows as monolayer triangular islands either on fcc or hcp atomic sites. The existence of structurally equivalent, but magnetically distinguished Mn islands of the same atomic site is observed. The fcc and hcp islands are found to have the same 120° Néel structure but with different orientation of the moments which means the fcc and hcp islands have different magnetic anisotropy.

[1]D. Wortmann, S. Heinze, Ph. Kurz, G. Bihlmayer, and S. Blügel, Phys. Rev. Lett. 86, 4132 (2001)

MA 8.4 Mon 16:00 H 1012

Slow magnetic dynamics observed by photon correlation spectroscopy — Stan Konings[1], •Christian Schüssler-Langeheine[2], Holger Ott[2], Eugen Weschke[3], Enrico Schierle[3], and Jeroen B. Goedkoop[1] — [1]Van der Waals Zeeman Institute, University of Amsterdam — [2]II. Physikalisches Intitut, Universität zu Köln — [3]Institut für Experimentalphysik, Freie Universität Berlin

Slow dynamics on nm length scales and time scales longer than 1 μs is best observed by x-ray photon-correlation spectroscopy (XPCS). The method uses the static interference pattern caused by the scattering of coherent x-rays from a sample containing disorder (speckle). When the system fluctuates the speckle pattern changes on the time scale of the fluctuations in the sample itself. From the dynamics of the speckle pattern the dynamics in the sample can hence be determined. We present the first application of this approach to slow magnetic domain fluctuations in an antiferromagnetic system using PCS in soft x-ray resonant magnetic diffraction. Ultrathin Ho metal films show a decay of long-range magnetic order over an unusually broad temperature range. Using PCS we can identify domain wall pinning as the dominant mechanism causing this broadened phase transition [1].

[1] S. Konings et al., cond-mat/0707.2765

MA 8.5 Mon 16:15 H 1012

Standard samples to determine the influence of external in-plane magnetic fields on magnetic force microscopy probes — •Tanja Weis[1], Dieter Engel[1], Arno Ehresmann[1], Volker Höink[2], Jan Schmalhorst[2], and Günter Reiss[2] — [1]Department of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel — [2]University of Bielefeld, Department of Physics, Nano Device Group, P.O. Box 100131, D-33501 Bielefeld

Analyzing magnetic force microscopy images measured in external in-plane magnetic fields is always hampered by the tilt of the magnetic moment of the MFM tip due to the external magnetic fields. To determine this tilt we use magnetically patterned samples whose magnetic state is independent on the magnetic field in a certain field range. For the fabrication of such topographically planar patterns we used standard lithography methods and keV He ion bombardment of exchange biased bilayers. We will present the production of standard samples and a procedure to determine the influence of external in-plane magnetic fields on the magnetic dipole moment of MFM tips.

MA 8.6 Mon 16:30 H 1012

Tip Effects in Magnetic Exchange Force Microscopy — •Uwe Kaiser, Alexander Schwarz, and Roland Wiesendanger — Institut für Angewandte Physik, Jungiusstr. 11, 20355 Hamburg

Magnetic Exchange Force Microscopy (MExFM) is a novel technique that was invented in order to perform magnetic imaging of insulating or conducting surfaces with atomic resolution [1]. It is based on conventional atomic force microscopy but uses a magnetic tip, which is approached very closely to a magnetic sample to detect the magnetic exchange interaction between tip and sample.

In our study we analyze the (001) surface of NiO by means of MExFM. The measurements have been carried out in a home-built microscope, operated in UHV at a temperature of 8 K. As magnetic probes we used supersharp silicon cantilevers that were coated with 22 nm of iron as a ferromagnetic layer. To get a favourable alignment between the spins of tip and sample we applied a magnetic field of 5 T perpendicular to the sample surface. Using this set-up we obtained magnetic resolution of the antiferromagnetically arranged nickel atoms on the atomic scale. However, some of our experimental results show sudden changes or even a contrast reversal of the magnetic contrast. These experimental findings are discussed with respect to the influence of the orientation of the spin at the tip apex and the applied magnetic field.

[1] U. Kaiser, A. Schwarz, and R. Wiesendanger, Nature **446**, 522 (2007).