MA 32 Mikro- und nanostrukturierte magn. Materialien II

Zeit: Mittwoch 11:00–13:15 Raum: TU H1028

MA 32.1 Mi 11:00 TU H1028

Anisotropy and Magnetic Microstructure of Monodisperse FePt Nanoparticles. — •Keir Foster[1], Jörg Weissmüller[1,2], Balaji Gopalan[1], Harald Rösner[1], and Joachim Kohlbrecher[3] — [1]Intitiute for Nanotechnology, Forchungszentrum Karlsruhe, Postfach 3640, D 76021 Karlsruhe, Germany — [2]Universität des Saarlandes, Im Stadtwald, PO Box 15 11 50, D 66041 Saarbruecken, Germany — [3]Laboratory for Neutron Scattering, PSI, CH 5232, Villigen, Switzerland

The magnetic anisotropy and magnetic microstructure of 4nm fcc alloy FePt nanoparticles coated with an organic shell were investigated using small−angle neutron scattering (SANS). Measurements were performed in conjunction with more standard magnetic characterization techniques, including vibrating sample magnetometry and AC susceptibility. The average particle size and size distribution were determined from transmission electron microscopy and small−angle X−ray scattering. For a ferromagnetic material it is expected that the SANS scattering intensity varies as a function of the angle α between the magnetization vector M and the scattering vector q as $\sin^2\alpha$. To enhance this magnetic component of the scattering, measurements were made with polarized neutrons. From the field dependence of the SANS cross−sections, above and below the superparamagnetic blocking temperature (T_B), quantitative information about the magnitude and spatial variation of the magnetic anisotropy field perturbing the system and of the anisotropy of the individual particles themselves respectively is derived.

MA 32.2 Mi 11:15 TU H1028

Synthese Magnetischer Hohlkugeln mit μm-Durchmesser — •Arnold Schlachter, Marina Spasova und Michael Farle — Fachbereich Physik, Experimentalphysik-AG Farle, Universität Duisburg-Essen

Mit der Layer-by-Layer Methode wurden Kern-Hülle Partikel mit einem Gesamtdurchmesser im Submikrometerbereich hergestellt [1]. Diese besitzen einen Polystyrol-Kern von 590 bzw. 640 nm und eine Schale bestehend aus superparamagnetischen Magnetit- bzw. Manganferrit-Nanopartikeln mit einem Durchmesser von 12 nm. Es konnten geschlossene Schalen mit einer Dicke von 30 bis 180 nm hergestellt werden. Mit Hilfe eines induktiv gekoppelten Plasmas wurde der Polystyrolkern komplett entfernt, wodurch stabile magnetische Hohlkugeln auf unterschiedlichen Substraten hergestellt wurden. Die Hohlkugeln konnten anschließend in Wasser suspendiert werden. Die Struktur und Zusammensetzung der Hohlkugeln wurde mit Elektronenmikroskopie (SEM, TEM) und EDX-Linescans analysiert. Unterstützt durch die DFG, SFB 445.

[1] F.Caruso, M.Spasova, A.Susha, M.Giersig, R.A.Caruso, Chem. Mater.13, (2001),109

MA 32.3 Mi 11:30 TU H1028

Magnetic Properties of Cobalt/Polymer Composite Nanotubes — •Kornelius Nielsch[1], Fernando J. Castaño[2], Sven Matthias[1], Woo Lee[1], Ramkumar Krishnan[2], and Caroline A. Ross[2] — [1]Max Planck Institute of Microstructure Physics, Halle, Germany — [2]Massachusetts Institute of Technology, Cambridge, MA, USA

In the present work we report on a novel approach for the fabrication of ferromagnetic nanotubes and present results concerning the magnetic properties of Co nanotubes. The pores surfaces in porous alumina membranes patterned by imprint lithography and macroporous silicon membranes are wetted with a polystyrene layer containing a metallo-organic precursor with a thickness of 40 to 70 nm. During an annealing process at 180 C for 24 h, a cobalt thin-film forms at the oxide pore-wall/polymer interface. The decomposition of the precursor leads to the formation of thin-walled magnetic tubes with diameters of 160 to 520 nm and wall thicknesses of 1 to 5 nm. Magnetic measurements at room temperature and 5 K show that the tubes have a lower saturation field parallel to their axes, while the in-plane direction is a harder axis. The magnetic properties on varying the wall thickness and diameter of the nanotubes will be discussed. This synthesis method is not limited to Co. We have also precipitated metallic Fe and Ni nanotubes based on polymer wetting of porous templates.

MA 32.4 Mi 11:45 TU H1028

Magnetic frustration in coupled ferromagnetic ring structures — •Volker Rose[1], Harald Ibach[1], Vitali Metlushko[2], Seok-Hwan Chung[3], Axel Hoffmann[3], and Sam D. Bader[3] — [1]Forschungszentrum Jülich (ISG3), Germany — [2]University of Illinois, Chicago, USA — [3]Argonne National Laboratory (MSD), USA

It is well known that patterned soft magnetic ring structures can exhibit a magnetic vortex state. When two rings interact, i.e., through direct contact, then it is expected that the vortex states have opposite chiralities. Thus, if three rings are interacting there is an obvious frustration between the magnetic states. We have fabricated isolated and contiguous arrays of rings using e-beam lithography and lift-off, with diameters of 1-4 μm and ring widths of 0.2-1.8 μm made of permalloy thin films with a thickness of 15 nm. Their field dependent magnetization was investigated with magnetic force microscopy (MFM) and magneto-optical Kerr effect (MOKE) accompanied by micromagnetic simulations. Generally, in the case of isolated rings the magnetization predominately follows the circumference resulting in a flux-close vortex state. In case of a three ring structure two transitions are observed. One from a high-magnetic-moment state obtained after relaxing the field from saturation to the low-magnetic-moment state, indicating the magnetic frustration of one ring in presence of two rings in vortex state. The second transition belongs to the reverse high-magnetic-moment state. Work at ANL was supported by US DOE-BUS

MA 32.5 Mi 12:00 TU H1028

Dreidimensionale Magnetisierungsstrukturen in Fe/Mo(110)-Inseln — •R. Hertel[1,2], O. Fruchart[3], S. Cherifi[3], P.-O. Jubert[3,4], A. Locatelli[5] und S. Heun[5] — [1]Institut für Festkörperforschung, Forschungszentrum Jülich, D-52425 Jülich — [2]Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle — [3]Laboratoire Louis Néel, CNRS, BP166, F-38042 Grenoble Cedex 9, Frankreich — [4]IBM Research, Zürich Research Laboratory, CH-8803 Rüschlikon, Schweiz — [5]Sincrotrone ELETTRA, I-34012 Basovizza, Trieste, Italien

Mittels zirkularem magnetischen Röntgendichroismus in Verbindung mit Photoelektronen-Emissionsmikroskopie (XMCD-PEEM) wurde die Magnetisierungsverteilung in einer großen Anzahl mesoskopischer Fe Inseln untersucht. Die Fe Inseln wurden auf einem Mo(110)-Substrat durch selbstorganisiertes Wachstum hergestellt. Sie sind bis zu ca. 2,5 μm groß, bis zu ca. 250 nm dick und haben eine charakteristische hexagonale Form mit geneigten Randflächen und atomar glatten Oberflächen. Die XMCD-PEEM Untersuchungen zeigen unerwartete, stark asymmetrische Magnetisierungsverteilungen an der Probenoberfläche. Erst die Verwendung präziser mikromagnetischer finite-Elemente Simulationen ermöglicht ein Verständnis der zu Grunde liegenden komplexen Magnetisierungsverteilung. Die Simulationen zeigen, dass die beobachteten Strukturen signifikant von der Schichtdicke, jedoch nur in geringem Maße von der Probenform beeinflusst werden. Die in Dünnschichtelementen wohlbekannte Landaustruktur weist bei dieser Schichtdicke interessante Besonderheiten auf.

MA 32.6 Mi 12:15 TU H1028

Bragg-MOKE, Vector MOKE, ROTMOKE: The magnetic reversal of microstructured patterns — •Andreas Westphalen, Katharina Theis-Bröhl, and Hartmut Zabel — Institut für Experimentalphysik/Festkörperphysik, Ruhr-Universität Bochum, 44780 Bochum, Germany

The Bragg MOKE technique extends the information of standard MOKE measurements by making use of diffraction from regular arrays of magnetic microstructures. The nth order diffraction spot is particularly sensitive to the nth order Fourier component of the magnetisation distribution. The orientation of the magnetisation vector during the reversal process is studied with Vector MOKE. The orientation is obtained through the determination of two orthogonal magnetisation components as a function of the external field. The ROTMOKE method, where the Kerr-angle is measured as a function of a rotating field, enables the quantitative determination of the Voigt effect contribution to the longitudinal Kerr effect. Here we have explored the properties of all three techniques for the investigation of regular arrays of magnetic microstructures. The samples under investigation are microstructured patterns of Fe and Co,