MA 36: Micro- and Nanostructured Magnetic Materials III

Time: Wednesday 14:45–16:45 Location: HSZ 103

MA 36.1 Wed 14:45 HSZ 103

Magnetic correlations in laterally patterned antiferromagnetically coupled Fe/Cr multilayers — •Markus Schmitz, Alexander Weber, Elisabeth Josten, Ulrich Rücker, and Thomas Brückel — IFF-Streumethoden, Forschungszentrum Jülich, 52425 Jülich

Patterned magnetic structures are the basic elements of spintronic devices. The ongoing miniaturization makes the influence of neighboring structures more and more important. Fe/Cr multilayers have been grown epitaxially on GaAs (100) single crystals by Molecular Beam Epitaxy. The Cr interlayers induce an antiferromagnetic coupling between adjacent Fe layers. Thus, the magnetic dipole moment is reduced and a magnetic superstructure is created, which is, due to the contrast of Cr to Fe, easily observable by polarized neutron reflectometry. The lateral structuring was performed by UV-nanoimprint lithography and Reactive Ion Etching. The structural characterization was carried out by Scanning Electron Microscopy, Atomic Force Microscopy and X-ray scattering under grazing incidence. The macroscopic magnetic properties were determined by MOKE and SQUID magnetometry. Polarized neutron reflectometry and off-specular scattering was used to determine the magnetic domain formation within the individual layers. The work presented gives insight into the interplay of shape and crystal anisotropy within the individual layers and patterns.

MA 36.2 Wed 15:00 HSZ 103

Reversible tuning of the magnetic moment of nanocrystalline maghemite/platinum composites by electrochemical charging — •Thomas Traussnig[1], Stefan Topolovec[1], Kashif Nadeem[2], Dorothée Vinga Szabo[3], Heinz Krenn[2], and Roland Würschum[1] — [1]Inst. f. Materialphys., TU Graz, Petersgasse 16, 8010 Graz, Austria — [2]Inst. f. Physik, Univ. Graz, Graz, Austria — [3]Inst. f. Materialforschung III, KIT, Karlsruhe, Germany

Recent studies on nanocrystalline metals demonstrated that their physical properties, such as magnetic moment or conductivity, can be reversibly tuned by electrochemical charging owing to the high interfacial charge carrier densities and the high surface-to-volume ratio. In the present work this concept of charge-induced property tuning is extended to nanocrystalline metal oxides. Reversible variations of the magnetic moment of up to 10.4% could be achieved by making use of a γ-Fe_2O_3/Pt nanocomposite. The maghemite nanocrystallites with a small crystallite size and a narrow size distribution were prepared by microwave plasma synthesis. Intermixing the ferrimagnetic maghemite nanocrystallites with paramagnetic Pt nanocrystallites results in a conductive porous network which can be charged electrochemically upon immersing in 1-M KOH electrolyte. Magnetic measurements were performed in-situ by SQUID magnetometry. The reversible variations of the magnetic moment in the 10%-regime are considered to arise from surface modifications of the maghemite nanoparticles due to reversible oxygen adsorption/desorption processes. Financial support by the FWF Austrian Science Fund is appreciated (project S10405-N16).

MA 36.3 Wed 15:15 HSZ 103

Self assembled Iron Oxide Nanoparticles - Variation of the growth process analysed by GISAXS — •Elisabeth Josten[1], Ulrich Rücker[1], Denis Korolkov[3], Erik Wetterskog[2], Artur Glavic[1], Sabrina Disch[1], Raphael Hermann[1], Florian Menau[4], Lennard Bergström[2], and Thomas Brückel[1,3] — [1]IFF-4, Forschungszentrum Jülich, 52425 Jülich — [2]Stockholm Universitet, Department of Materials and Environmental Chemistry, Stockholm, Sweden — [3]JCNS, Forschungszentrum Jülich, Garching, Germany — [4]Synchrotron Soleil, L'Orme des Merisiers, Saint-Aubin, BP 48, 91192 Gif-sur-Yvette, France

Fundamental research on magnetic nanostructures is an important part of todays science in the field of information technology. Highly ordered 3 dimensional structures of nanoparticles are model systems to study the magnetic inter-particle interactions. In this investigation we studied the influence of growth parameters on the ordering of the superstructures. Monodisperse Fe_2O_3 nanoparticles have been deposited on a substrate to form highly ordered superstructures (mesocrystals) using drop casting. The type of order in these superstructures has shown dependency on the nanoparticle shape and deposition conditions. Structural surface characterization was carried out by SEM and AFM. The 3D order has been investigated by GISAXS. We found that mesocrystalline order of the nanoparticles in the μm-range appears under appropiate conditions.Additionally a simulation of the GISAXS pattern was developed, which describes well the observed intensity.

MA 36.4 Wed 15:30 HSZ 103

Influence of crystallite size and temperature on the antiferromagnetic helices of terbium and holmium metal — •Jens-Peter Bick[1,2], Andreas Michels[1,2], Adrian Ferdinand[1], Rainer Birringer[1], Jörg Baller[2], Roland Sanctuary[2], Stefan Philippi[3], Dieter Lott[4], Sandor Balog[5], Eli Rotenberg[6], Günter Kaindl[7], and Kristian M. Döbrich[7,8] — [1]Universität des Saarlandes, D-66041 Saarbrücken — [2]University of Luxembourg, L-1511 Luxembourg — [3]Leibniz Institute for Solid State and Materials Research, D-01069 Dresden — [4]GKSS Research Center, D-21502 Geesthacht — [5]Paul Scherrer Institute, CH-5232 Villigen — [6]Lawrence Berkeley National Laboratory, California 94720, USA — [7]Freie Universität Berlin, D-14195 Berlin-Dahlem — [8]Max-Born-Institut, D-12489 Berlin

We report on the results of grain-size and temperature-dependent magnetization, specific-heat, neutron-scattering, and angle-resolved photoelectron spectroscopy (ARPES) experiments on the heavy rare-earth metals terbium and holmium, with particular emphasis on the temperature regions where the helical antiferromagnetic phases exist. In contrast to Ho, we find that the helical structure in Tb is relative strongly affected by microstructural disorder, specifically, it can no longer be detected for the smallest studied grain size of $D = 18$ nm. Moreover, in coarse-grained Tb a helical structure persists even in the ferromagnetic regime, down to about $T = 215$ K, in agreement with the ARPES data, which reveal a nesting feature of the Fermi surface at the L point of the Brillouin zone at $T = 210$ K.

MA 36.5 Wed 15:45 HSZ 103

Influence of MnAs nanoclusters on the angle-dependent transport behaviour in GaAs:Mn/MnAs hybrid structures — •Matthias T. Elm[1], Shingo Ito[2], Shinjiro Hara[2], Hans-Albrecht Krug von Nidda[3], and Peter J. Klar[1] — [1]1. Physikalisches Institut, Justus-Liebig University, Heinrich-Buff-Ring 16, 35392 Gießen — [2]Research Center for Integrated Quantum Electronics, Hokkaido University, Sapporo, Japan — [3]Experimentalphysik V, University of Augsburg

Using selective-area MOVPE on pre-patterned substrates different arrangements of ferromagnetic MnAs nanoclusters and cluster chains were prepared. The single nanoclusters have a length of 730 nm and a width of 300 nm. FMR and MFM measurements confirm an orientation of the cluster magnetization along the clusters' main axes of elongation. Magneto-transport measurements were performed in the temperature range from 15 to 280 K in external magnetic fields up to 10 T. A strong dependence of the magnetoresistance effects on cluster arrangement can be observed. At low temperatures also angle-dependent measurements of the transport through the paramagnetic matrix were investigated. In-plane as well as in out-of-plane geometry the magnetoresistance behaviour shows deviations from an expected sine-dependence of the matrix. This behaviour can be described qualitatively by a simple model taking an average behaviour of the nanoclusters' magnetizations into account.

MA 36.6 Wed 16:00 HSZ 103

FePtCu films on SiO_2 spherical particle arrays — •Fabian Ganss, Christoph Brombacher, Beate Mainz, Michael Hietschold, and Manfred Albrecht — Chemnitz University of Technology, Institute of Physics, Germany

Following the concept of bit patterned media for data storage application [1], FePt/Cu bilayers were sputter deposited at room temperature onto hexagonal close packed arrays of spherical silica particles with a diameter of 100 nm. Rapid thermal annealing at various temperatures was performed to transform the bilayers into an $(Fe_{52}Pt_{48})_{86}Cu_{14}$ alloy with perpendicular magnetic anisotropy [2, 3] and to achieve decoupled film caps on top of the particles by dewetting, thus forming hard magnetic nanostructures. The dewetting behaviour of the film in dependence on the annealing temperature was studied by SEM and cross-section TEM. Hysteresis loops measured by SQUID magnetom-

etry reveal an increasing perpendicular anisotropy at higher annealing temperatures and a coercivity of almost 2 T. The magnetic characterization was complemented by MFM at different remanent states, showing the magnetic decoupling between the caps. Points of a remanence curve were extracted from the MFM images and are compared to SQUID measurements.

[1] B. D. Terris, J. Magn. Magn. Mater. 321, 512 (2009)
[2] M. L. Yan et al., J. Appl. Phys. 99, 08G903 (2006)
[3] D. Makarov et al., Appl. Phys. Lett. 96, 062501 (2010)

MA 36.7 Wed 16:15 HSZ 103

Magnetoimpedance of Permalloy nanowires — •Saleh Getlawi, Haibin Gao, Michael Koblischka, and Uwe Hartmann — Inst. of Experimental Physics, Saarland University, P.O. Box 151150, 66041 Saarbrücken

The magneto-impedance (MI) effect was studied extensively on amorphous wires, ribbons, and on multilayer thin films. This effect involves huge changes of the complex impedance of soft magnetic materials upon applying an external magnetic field. In this contribution we explore the MI effect on Permalloy nanowires. Nanowires of lengths of 40-60 mu and widths of 200-400 nm were prepared by electron beam lithography (EBL) and a lift-off process. Electrodes for the transport measurements and platinum contacts were fabricated by focused-ion-beam(FIB)-based methods. Magnetic force microscopy (MFM) was employed to observe the magnetic domain structures of the nanowires. For high frequency measurement, the sample was placed on a microwave transmission line consisting of two gold microstrip lines. MI measurements were performed in the range from 10 MHz to 3 GHz.

MA 36.8 Wed 16:30 HSZ 103

Magnetic Films on Nanoperforated Templates for Percolated Perpendicular Media — •Carsten Schulze[1], Marco Faustini[2], Herbert Schletter[1], Matthias U. Lutz[3], Michael Hietschold[1], Denys Makarov[1,3], and Manfred Albrecht[1] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]Laboratoire de Chimie de la Matière Condensée de Paris, Université Pierre et Marie Curie-Paris 6, CNRS, 75252 Paris cedex 05, France — [3]IFW Dresden, Helmholtzstr. 20, 01069 Dresden, Germany

A study on the magnetization reversal in Co/Pt multilayers with perpendicular magnetic anisotropy deposited onto membranes with densely distributed perforations is presented. It was shown that the magnetic domain walls are pinned at the inhomogeneities provided by perforations with sizes down to 17 nm [1, 2], suggesting a possible application of such a system for magnetic data storage as a recording scheme called percolated perpendicular medium (PPM) [3]. However, for the application as a recording medium the size of the perforations has to be further reduced. In this regard, the influence of the perforation size with respect to the domain wall width on the pinning strength will be discussed.

[1] D. Makarov *et al.*, IEEE Trans. Magn. **45** (2009) 3515.
[2] C. Schulze *et al.*, Nanotechnology **21** (2010) 495701.
[3] D. Suess *et al.*, J. Appl. Phys. **99** (2006) 08G905.