MA 32: Postersession II: Spinstruct./Phase Trans. (1-10); Spinelectronics (11-15); Thin Films (16 - 36); Particles/Clusters (37-45); Multiferroics (46-54); Spindynamics/Spin Torque (55 - 76); Post Deadlines (77-79)

Time: Friday 11:15–14:00 Location: Poster E

MA 32.1 Fri 11:15 Poster E

Neutron scattering studies on frustrated $s = 1/2$ spin chain cuprates — •W. Lorenz[1,2], W.-D. Stein[2], A. Schneidewind[3], T. Unruh[3], B. Pedersen[3], C. L. Zhang[4], S.-W. Cheong[4], O. Volkova[5], A. Vasiliev[5], S.-L. Drechsler[1], C. Hess[1], R. Klingeler[1], B. Büchner[1], and M. Loewenhaupt[2] — [1]IFW Dresden, Helmholtzstr. 20, 01069 Dresden, Germany — [2]IFP (Institut für Festkörperphysik), TU Dresden, 01062 Dresden, Germany — [3]Forschungsneutronenquelle Heinz Maier-Leibnitz , D-85748 Garching, Germany — [4]Rutgers University, Piscataway, New Jersey 08854, USA — [5]Moscow State University, 119992 Moscow, Russia

We report on neutron scattering studies on the frustrated $s = 1/2$ spin chain cuprates $LiCu_2O_2$ and Li_2ZrCuO_4 and discuss these results against the background of their macroscopic properties. In both compounds, the interplay between nearest and next-nearest neigbor interactions yields a helical ground state. For $LiCu_2O_2$, results on the nuclear as well as on the magnetic structure have been determined, as well as preliminary data on the magnetic excitations. We will also present magnetic excitation spectra measured on Li_2ZrCuO_4 which is a new spin chain compound close to the critical frustration between helical and ferromagnetic in-chain order.

MA 32.2 Fri 11:15 Poster E

Magnetic properties of the $(Co_xMn_{1-x})_4Nb_2O_9$ solid solution series. — •Björn Schwarz[1], Daniel Kraft[2], Ralf Theissmann[3], and Helmut Ehrenberg[1] — [1]Institute for Complex Materials, IFW Dresden, Helmholtzstrasse 20, D-01069 Dresden, Germany — [2]Institute for Materials Science, Darmstadt University of Technology, Petersenstrasse 23, D-64287 Darmstadt, Germany — [3]Institute for Nano Structures and Technology (NST), University of Duisburg-Essen, Bismarckstr. 81, D-47057 Duisburg, Germany

α-Fe_2O_3 (Hematite) is an antiferromagnetic material below the Morin transition at 260 K, and a canted antiferromagnet or weakly ferromagnetic above the Morin transition and below its Néel temperature at 948 K, above which it is paramagnetic. $(Co,Mn)_4Nb_2O_9$ crystallizes isostructural to α-Fe_2O_3 and the end members order collinear antiferromagentically, whereas the results of magnetization measurements (powder samples and single crystals) and powder neutron diffraction experiments for samples of the solid solution series indicate the realization of weak ferromagnetism, too. A Morin transition induced by a change in cation composition in this system would have presented a qualitatively new approach for understanding the fundamentals of the Morin-transition. Comparative experiments performed on samples of the $(Co,Mn)_4Nb_2O_9$ solid solution series that were prepared by arc melting instead of subsolidus reaction reveal, however, that the experiments performed on samples prepared by the latter method, even on single crystals, were decisively affected by additional $(Co,Mn)_3O_4$ phases possessing complex magnetic properties.

MA 32.3 Fri 11:15 Poster E

Spin-strain coupling in $NiCl_2$-4SC$(NH_2)_2$ — •O. Chiatti[1], A. Sytcheva[1], J. Wosnitza[1], S. Zherlitsyn[1], V. S. Zapf[2], M. Jaime[2], and A. Paduan-Filho[3] — [1]Forschungszentrum Dresden-Rossendorf, Hochfeld-Magnetlabor Dresden (HLD), 01314 Dresden, Germany — [2]National High Magnetic Field Laboratory, Los Alamos National Lab, Los Alamos, NM — [3]Instituto de Fisica, Universidade de São Paulo, Brazil

We report results of sound-velocity and sound-attenuation measurements in the quantum $S = 1$ spin-chain magnet $NiCl_2$-4SC$(NH_2)_2$, in magnetic fields up to 18 T. This material is discussed in the context of Bose-Einstein condensation of magnons. The longitudinal c_{33} acoustic mode, which has a propagation direction along the spin chains, shows pronounced spin-lattice effects. This mode demonstrates a softening in the vicinity of the field-induced antiferromagnetic ordering (below $T = 1.2$ K), accompanied by an energy dissipation in the acoustic wave. A broad maximum has been observed in the temperature dependence of the sound velocity at 44 K. The low-temperature sound-velocity and sound-attenuation behavior is subject to fluctuations of Ni spin degrees of freedom resulting in frequency-dependent effects. The $B - T$ phase diagram obtained from the ultrasonic measurements is compared with results extracted from other experimental investigations. The ultrasonic results are analyzed with a theory based on exchange-striction spin-phonon coupling.

MA 32.4 Fri 11:15 Poster E

Study of iron spin states in the low dimensional polymeric system PAC by ESR and static magnetometry — •A. Alfonsov[1], Ch. Golze[1], V. Kataev[1], U. Pietsch[2], Y. Bodenthin[3], G. Schwarz[4], D. G. Kurth[4], and B. Büchner[1] — [1]IFW Dresden, Helmholtzstr. 20, 01069 Dresden — [2]University of Siegen — [3]PSI Villingen, Switzerland — [4]MPI-KG Potsdam

Tunable high-field Electron Spin Resonance (ESR) and magnetization measurements were used to determine the presence and the properties of the spin-crossover effect in the iron based polyelectrolyte - amphiphile complex (PAC). This metallosupramolecular complex is the result of a self-assembling process of Fe(II), 1,4-bis(2,2':6',2"-terpyridin-4'-yl)benzene with dihexadecyl phosphate. The magnetically active ion, Fe(II), is sixfold coordinated by nitrogen ions. This pseudo octahedral ligand crystal field (CF) affects the splitting of the 3d-levels of the iron ion. Depending on the strength of the CF, the splitting may give rise to a low spin (LS, S=0) or a high spin (HS, S=2) ground state of Fe. Transitions from LS to HS have been produced by a heat treatment of PAC which is detected by magnetization and ESR measurements of the polycrystalline samples. The transition temperature (380K) was determined by magnetization measurements. Furthermore, in the absorption spectrum of the powder sample a splitting of the main ESR signal into two separate ESR lines has been observed at high frequencies (> 80 GHz), which indicates g-factor anisotropy. We discuss a relationship between the structural transformation and magnetic properties occurring in Fe-PAC samples.

MA 32.5 Fri 11:15 Poster E

Crystal growth and properties of $Nd_{2-x}Ca_{2+x}Cu_5O_{10}$ and $Y_{2-x}Ca_{2+x}Cu_5O_{10}$ — •Nadja Wizent[1], Günter Behr[1], Wolfgang Löser[1], Mircea Apostu[2], and Bernd Büchner[1] — [1]IFW Dresden, Institute for Solid State Research, Germany — [2]Al.I. Cuza University, Iasi, Romania

The copper oxide-based compounds are known for interesting properties like superconductivity, spin and charge ordering. Single crystals of cuprates with Nd/Y and different Ca-doping were grown by a Floating Zone method under air and elevated oxygen pressure.

Because single crystalline samples of $Y_{2-x}Ca_{2+x}Cu_5O_{10}$ have not been available for a long time the structure has not been solved until recently [1,2]. The compound is also interesting because of its change from antiferromagnetic ordering through spin glass to a spin gap state at higher Ca-doping ($1.4 \leq x \leq 1.67$) [3].

Further investigations by neutron diffraction and magnetic measurements on doped samples of $Y_{2-x}Ca_{2+x}Cu_5O_{10}$ and $Nd_{2-x}Ca_{2+x}Cu_5O_{10}$ are under way.

[1] J. Thar: Diploma Thesis, Aachen (2005)
[2] Y. Gotoh et al.: J. Alloys & Comp. 408 (2006)
[3] K. Kudo et al.: Phys. Rev. B 71 (2005) 104413

MA 32.6 Fri 11:15 Poster E

Longitudinal fluctuations in itinerant-electron systems — •Leonid Sandratskii — Max Planck Institute of Microstructure Physics, Halle, Germany

The recent successes in the understanding of the thermodynamics of the itinerant-electron systems are to a large extent related to the so-called adiabatic treatment of the atomic moments. This concept allows to introduce disorder of the atomic moments within the itinerant-electron picture and solves the problems of the Stoner model. A most used mathematical approach is the mapping of the itinerant-electron system on a Heisenberg-type Hamiltonian with subsequent application of a statistical-mechanics scheme to evaluate the temperature dependence of the magnetization and the Curie temperature.

Despite important successes with respect to the Stoner theory it becomes increasingly clear that many physical effects in the itiner-

ant magnets cannot be described, even on the qualitative level, without taking into account the longitudinal fluctuations of the atomic moments in addition to the transversal fluctuations described by the Heisenberg-type Hamiltonians. The examples of such effects are the short range magnetic order in Ni above the Curie temperature or metamagnetic order-order phase transition in FeRh. Another important physical problem is the relation between longitudinal magnetic fluctuations and half-metalicity.

In this presentation we will report on recent studies of the role of the longitudinal fluctuations in itinerant-electron systems.

MA 32.7 Fri 11:15 Poster E

Importance of magnetism for the thermal expansion of transition metals: an ab initio study — •Fritz Körmann, Alexey Dick, Blazej Grabowski, Tilmann Hickel, and Jörg Neugebauer — Max-Planck-Institut für Eisenforschung GmbH, Postfach 140444, 40074 Düsseldorf, Germany

Recently, extensive efforts have been made to combine density functional theory with thermodynamic concepts. For this purpose the Gibbs free energy has conventionally been calculated employing the quasiharmonic approximation. This method allowed to perform ab initio predictions on, e.g., the thermal expansion of the nonmagnetic system and yielded an excellent agreement with experiment [1]. In magnetic materials the ab initio analysis has also to take into account magnetic excitations and their interplay with the vibronic degrees of freedom. However, most studies treat the magnetic and lattice excitations separately. We therefore performed a systematic investigation of the influence of magnetic configurations on the vibronic degrees of freedom. The calculations have been performed for elementary Fe and Ni in the bcc and the fcc phase. Based on these results, we derived the dependence of the temperature induced magnetic disorder and the change of local magnetic moments on thermodynamic quantities of Fe and Ni, with emphasis on thermal expansion and heat capacities.

[1] B. Grabowski, T. Hickel, and J. Neugebauer, Phys. Rev. B **76**, 024309 (2007).

MA 32.8 Fri 11:15 Poster E

Study of $EuCu_2(Ge_{1-x}Si_x)_2$ across a quantum critical point — •Mahmoud A. Ahmida[1], Dirk Johrendt[2], Zakir Hossain[3], Christoph Geibel[4], and Mohsen M. Abd-Elmeguid[1] — [1]II Physikalisches Institut, Universität zu Köln, Köln, Germany — [2]Department Chemie and Biochemie der Ludwig-Maximilians-Universität München, München, Germany — [3]Department of Physics, Indian Institute of Technology, Kanpur, India — [4]Max Planck Institut für Chemische Physik fester Stoffe, Dresden, Germany

The intermetallic series $EuCu_2(Ge_{1-x}Si_x)_2$ crystallizing in the tetragonal $ThCr_2Si_2$-type structure combines the antiferromagnetic (AF) compound $EuCu_2Ge_2$ (T_N=14 K) with the homogenous intermediate valent (IV) compound $EuCu_2Si_2$. Therefore, the system offers the opportunity to investigate the crossover from a magnetically ordered state to a nonmagnetic IV state through a quantum critical point (QCP) at x $\approx$ 0.65. To gain a microscopic insight into the change of the magnetic and valence states and their competition at the QCP, we have performed systematic ^{151}Eu Mössbauer effect measurements on $EuCu_2(Ge_{1-x}Si_x)_2$ as a function of concentration ($0 \leq x \leq 1$) at different temperatures (300 to 4 K). The analysis of the results shows that the collapse of AF ordering for x > 0.50 is associated with a simultaneous sharp increase of the valence state of Eu towards the Eu^{+3}state. It is shown that the simultaneous valence /magnetic phase transition across the QCP is of first-order.

MA 32.9 Fri 11:15 Poster E

Crystal structure and magnetic fluctuations in $La_{1-x}A_xCoO_3$ (A = Ca, Sr, Ba) — •Thomas Finger[1], Marco Reuther[1], Daniel Senff[1], Matthias Cwik[1], Thomas Lorenz[1], Markus Braden[1], Klaudia Hradil[2], Anatoliy Senychyn[3], and Yvan Sidis[4] — [1]II. Physikalisches Institut, Universität zu Köln — [2]Georg-August Universität Göttingen / FRM2 Munich — [3]Technische Universität Darmstadt / FRM2 Munich — [4]LLB, Saclay

The phase diagram of perovskite cobaltites is closely related to those of the CMR-manganites as they both show ferromagnetism and metallic behaviour at intermediate doping. We have studied the crystal structure of the series with Ca and Ba doping and will discuss the corresponding phase diagrams. Furthermore, magnetic excitations were studied by inelastic neutron scattering for A = Sr at different doping levels. We report on the magnetic correlations in the ferromagnetic and in the spin-glass phase and present the magnon dispersions which are remarkably different. In the metallic compound we find a very steep ferromagnetic dispersion, with a stiffness constant twice higher than that in $La_{0.7}Sr_{0.3}MnO_3$ and a small anisotropy gap, without any evidence for a splitting of the magnon branches. In contrast the magnetic excitations in the spin-glass phase exhibit a sizeable spin gap and a much more complex low-energy magnetic excitation spectrum. This is the first clear evidence that the spin-glass phase cannot be considered as a short-range analogue of the ferromagnetic phase.

MA 32.10 Fri 11:15 Poster E

Ordered orbital momentum in antiferromagnets from sum rules in soft x-ray resonant diffraction — •Marcel Buchholz[1], Chun Fu Chang[1], Maurits W. Haverkort[1], Christian Schüssler-Langeheine[1], Matthias Cwik[1], Hsueh-Hung Wu[1,2], Thomas Willers[1], Zhiwei Hu[1], Arata Tanaka[3], Enrico Schierle[4], Detlef Schmitz[4], and L. Hao Tjeng[1] — [1]II. Physikalisches Institut, Universität zu Köln — [2]NSRRC, Taiwan — [3]ADSM, Hiroshima University, Japan — [4]HMI c/o Bessy

Using sum rules applied to x-ray magnetic circular dichroism (XMCD) is a well established technique to extract, e.g., the orbital contribution to the magnetic moment in ferromagnets. For antiferromagnets (AF) such an extraction is a more difficult task because XMCD, which requires a net magnetic moment of the sample, cannot be applied here. A novel experimental approach particularly well suited for AF is the use of the sum rules valid for resonant soft x-ray magnetic diffraction. These rules allow to determine the ordered orbital momentum directly from the energy dependence of a magnetic diffraction peak near an electronic resonance [1]. The potential of this method for $3d$ and $4f$ systems is explored by application of sum rules to magnetic diffraction data from $La_{1.5}Sr_{0.5}CoO_4$ and metallic Ho. The results are compared to those obtained by a microscopic modeling of the resonance spectra. Supported by the DFG through SFB 608 and by the BMBF.

[1] M. W. Haverkort, C. Schüßler-Langeheine, A. Tanaka, to be published

MA 32.11 Fri 11:15 Poster E

Ab initio investigations of Fe/GaAs(110) interfaces with respect to electronic transport — •Anna Grünebohm, Heike C. Herper, and Peter Entel — Fachbereich Physik, Universität Duisburg-Essen, Duisburg

Fe/GaAs is a candidate for spintronic devices because of the high Curie temperature of iron, the optical properties of GaAs and the small lattice mismatch (< 2%). However, measured spin injection varies widely between 1% and 30% depending on growth conditions and temperature. Though the structural properties of Fe/GaAs(100) have been intensively studied, detailed transport calculations are lacking. We investigate different interface configurations of GaAs and Fe using VASP within the projector augmented wave method thereby the GGA/PBE has been adopted for the exchange correlation potentials [1]. Spatial relaxations are performed and the relaxed structures are taken as input for transport calculations. Therefore, we make use of the Green's Function technique [2] and the Kubo-Greenwood equation. Here, we focus on systems grown in (110) direction, which seem to be of particular interest for spin injection and have been less investigated than the (110) direction.

[1] VASP, G.Kresse, J.Furthmüller, Phys. Rev. B **54**, 11169 (1996)
[2] H.Akai, Machikaneyama2002

MA 32.12 Fri 11:15 Poster E

Transport properties of CoFeB/MgO/CoFeB magnetic tunnel junctions — •Marvin Walter, Kai Ubben, Gerrit Eilers, and Markus Münzenberg — IV. Physikalisches Institut, Georg-August-Universität Göttingen, 37077 Göttingen

Magnetic tunnel junctions showing a high tunnel magneto resistance are important for the fabrication of MRAM devices when combined with current induced switching.

Here we present our investigations on CoFeB/MgO/CoFeB magnetic tunnel junctions. The junctions are prepared by means of magnetron sputtering of CoFeB and e-beam evaporation of stoichiometric MgO. Structuring of the multilayer is done using a photolithography process and Argon ion-milling.

We characterize the tunnel junctions by $R(H)$ measurements, I/V-spectroscopy and magneto-optical Kerr effect measurements. Our investigations include the switching properties of the two CoFeB layers depending on their thickness, since no antiferromagnetic layer is used to pin one of the electrodes through the exchange bias effect. Furthermore, a comparison between two different electrode compositions will

be made and the dependence on MgO barrier thickness and annealing temperature will be shown.

In the future, we plan to do further downscaling of the size of the magnetic tunnel junctions to achieve sufficient high current densities to observe and investigate current induced switching in this system.

Research is supported by DFG SFB 602.

MA 32.13 Fri 11:15 Poster E

Ion bombardment induced magnetic patterning of reference electrodes in magnetic tunnel junctions with MgO barrier — Volker Höink[1], Xinli Kou[1], •Jan Schmalhorst[1], Günter Reiss[1], Tanja Weis[2], Daniel Lengemann[2], and Arno Ehresmann[2] — [1]Thin Films and Physics of Nanostructures, Department of Physics, University of Bielefeld, P.O. Box 100131, 33501 Bielefeld, Germany — [2]Institute of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), Kassel University, Heinrich-Plett-Str.40, 34132 Kassel, Germany

For some applications as, e.g., a special type of reconfigurable magnetic logic [1] it is necessary to manipulate the direction of the exchange bias coupling of the reference layer in a magnetic tunnel junction (MTJ). It has been shown in the past that a magnetic patterning of reference layers is possible without a significant loss of tunnel magnetoresistance (TMR) in MTJs with alumina barrier [2,3]. Recently, high TMR amplitudes of up to 500% have been reported for CoFeB / MgO / CoFeB based MTJs [4]. Here, the influence of the ion bombardment on the TMR amplitude, the resistance, and inelastic electron tunnelling spectra of two types of CoFeB / MgO / CoFeB based MTJs is investigated.

[1] Appl. Phys. Lett. 91 (2007) 162505
[2] J. Appl. Phys. 94 (2003) 5556
[3] Appl. Phys. Lett. 86 (2005) 152102
[4] Appl. Phys. Lett. 90 (2007) 212507

MA 32.14 Fri 11:15 Poster E

Reconfigurable magnetic logic for all basic logic functions produced by ion bombardment induced magnetic patterning — •Volker Höink[1], Dirk Meyners[1], Jan Schmalhorst[1], Günter Reiss[1], Dörte Jung[3], Dieter Engel[2], and Arno Ehresmann[2] — [1]Thin Films and Physics of Nanostructures, Department of Physics, University of Bielefeld, P.O. Box 100131, 33501 Bielefeld, Germany — [2]Institute of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), Kassel University, Heinrich-Plett-Str.40, 34132 Kassel, Germany — [3]now at: Universität des Saarlandes, P.O. Box 15 11 50, D-66041 Saarbrücken, Germany

In most common logic gates based on transistors, different logic functions have to be realized by applying a large number of logic gates, which are capable of performing only one function. A promising approach to overcome this obstacle with the additional advantage of a nonvolatile output is a reconfigurable logic based on small arrays of magnetic tunnel junctions. Here, an approach utilizing an ion bombardment induced patterning of the reference layer is proposed where the same logic unit consisting of only two magnetic tunnel junctions can be used for the AND, OR, NAND, NOR, and X(N)OR, functions.

MA 32.15 Fri 11:15 Poster E

On the influence of bandstructure on transport properties of magnetic tunnel junctions with $Co_2Mn_{1-x}Fe_xSi$ single and multilayer electrode — Jan Schmalhorst[1], •Daniel Ebke[1], Alexander Weddemann[1], Andreas Hütten[1], Andy Thomas[1], Günter Reiss[1], Andrej Turchanin[2], Armin Gölzhäuser[2], Benjamin Balke[3], and Claudia Felser[3] — [1]Thin Films and Physics of Nanostructures, Department of Physics, Bielefeld University, 33501 Bielefeld, Germany — [2]Department of Physics, Bielefeld University, 33501 Bielefeld, Germany — [3]Institut für Anorganische und Analytische Chemie, Johannes Gutenberg Universität, 55099 Mainz, Germany

The transport properties of magnetic tunnel junctions with different (110)-textured Heusler alloy electrode such as Co_2MnSi, Co_2FeSi or $Co_2Mn_{0.5}Fe_{0.5}Si$, AlO_x barrier and Co-Fe counter electrode are investigated. The bandstructure of $Co_2Mn_{1-x}Fe_xSi$ is predicted to show a systematic shift of the position of the Fermi energy E_F through the gap in the minority density of states, while the composition changes from Co_2MnSi towards Co_2FeSi. Although, this shift is indirectly observed by X-ray photo emission spectroscopy, all junctions show a large spin polarization of around 70% at the Heusler alloy / Al-O interface and are characterized by a very similar temperature and bias voltage dependence of the tunnel magnetoresistance. This suggests, that the transport properties of all junctions are dominated by inelastic excitations and not by the electronic bandstructure.

MA 32.16 Fri 11:15 Poster E

Structural and magnetic properties of Co– and Mn–doped ZnO thin films — •Gillian Mayer[1], Sönke Voss[1], Mikhail Fonin[1], Ulrich Rüdiger[1], Reinhard Schneider[2], Dagmar Gerthsen[2], and Eberhard Goering[3] — [1]Fachbereich Physik, Universität Konstanz, 78457 Konstanz — [2]Laboratorium für Elektronenmikroskopie, Universität Karlsruhe, 76128 Karlsruhe — [3]Max Planck–Institut für Metallforschung, 70569 Stuttgart

Diluted magnetic oxides have attracted much attention because of their possible application in spintronic devices. Especially d–metal doped ZnO is a promising candidate as proposed by Dietl et al. [1]. Structural and magnetic properties of Co– and Mn–doped ZnO thin films prepared by rf magnetron sputtering from composite Zn/Co and Zn/Mn targets have been studied. X–ray absorption measurements at the Co and Mn $L_{2,3}$ absorption edges indicate that Co^{2+} and Mn^{2+} are incorporated at Zn sites in ZnO. In SQUID investigations, as prepared Co–doped samples show pure paramagnetism, while vaccum–annealed samples and some of the Mn–doped samples show a ferromagnetic behavior. A detailed X–ray magnetic circular dichroism study of Co–doped ZnO at different temperatures reveales that Co contributes only paramagnetically to the magnetism in vacuum–annealed samples. Transmission electron microscopy investigation of Co–doped ZnO shows that postannealing of the samples leads to the formation of Co–rich clusters that however do not contribute to ferromagnetism. The possible contribution of the substrate to the ferromagnetic behavior is also discussed. [1] Dietl *et al.*, Science **287**, 1019 (2000).

MA 32.17 Fri 11:15 Poster E

Magnetoresistive effects in ultrathin magnetic films — •Stephen Krzyk, Alexander von Schmidsfeld, Mathias Kläui, and Ulrich Rüdiger — Fachbereich Physik, Universität Konstanz, 78457 Konstanz

Inspired by the successful industrial application of the giant magnetoresistance effect (GMR), magnetoresistance properties of nanoscale structures are the subject of intense research. Recent experiments [1] have shown that decreasing the cross section of a nanocontact leads to a significantly increased magnitude of the anisotropic magnetoresistance.

A possible approach to small contact sizes are ultrathin films near the percolation threshold. We investigate magnetotransport through permalloy ($Ni_{80}Fe_{20}$) and iron films grown on isolating substrates such as MgO. Deposition of films in the monolayer range was carried out in an MBE chamber designed for in situ magnetoresistance measurement during film growth. Magnetic fields of up to 100 mT can be applied in the sample plane, and the resistances between fixed sample locations can be measured during growth. The field angle and strength is varied for the purpose of distinguishing between TMR and AMR effects. The measurements can be carried out by increasing the thickness with sub-monolayer resolution.

[1] K. I. Bolotin et al., Phys. Rev. Lett. 97, 127202 (2006)

MA 32.18 Fri 11:15 Poster E

Modulated magnetization depth profile in dipolarly coupled $Co_{80}Fe_{20}/Al_2O_3$ multilayers — •Subhankar Bedanta[1], Emmanuel Kentzinger[2], Oleg Petracic[1,3], Jan Rhensius[1], Wolfgang Kleemann[1], Theo Kleinefeld[1], Amitesh Paul[2], Thomas Brückel[2], Ulrich Rücker[2], Susana Cardoso[4], and Paulo Freitas[4] — [1]Angewandte Physik, Universität Duisburg-Essen, Germany — [2]Institut für Festkörperforschung, Forschungszentrum Jülich, Germany — [3]Institut für Experimentalphysik IV, Ruhr-Universität Bochum, Germany — [4]INESC, Rua Alves Redol 9-1, Lisbon, Portugal

Polarized neutron reflectivity (PNR), magnetometry, and magneto-optic Kerr microscopy studies have been performed on two metal-insulator multilayers (MIMs) $[Co_{80}Fe_{20}(t_n)/Al_2O_3(3nm)]_9$ with t_n = 1.6 and 1.8 nm. MIMs exhibit dominant dipolar coupling between the ferromagnetic CoFe layers. Our PNR measurements at the coercive field reveal a novel and unexpected magnetization state of the sample exhibiting an oscillating magnetization depth profile from CoFe layer to layer with a periodicity of five and eight bilayers along the multilayer stack for the t_n = 1.6 and 1.8 nm samples, respectively [1]. Domain imaging by Kerr microscopy reveals different grey scales which evidence the heterogeneity of layer-by-layer magnetization in the multilayer stack [2]. With the help of micromagnetic simulations we demonstrate that competition between long and short-ranged dipolar interactions apparently gives rise to this unusual phenomenon [1].

[1] S. Bedanta et al., Phys. Rev. B **74**, 054426 (2006).
[2] S. Bedanta et al., Physica B **397**, 65 (2007).

MA 32.19 Fri 11:15 Poster E

Simulation of a nano-scale magnetic switch — •Volker Pankoke and Sibylle Gemming — Forschungszentrum Dresden-Rossendorf, Germany

We used ab-initio methods in the LDA with pseudo potentials and a plane wave basis to simulate the growth of thin palladium films on the piezo electric oxide PMN ($Pb(Mg/Nb)O_3$). It is known that the palladium ground state is similar to the ground state of ferromagnetic nickel. A magnetic switch of nano-scale dimension might be possible if the palladium ground-state can be forced to get also ferromagnetic. The piezo electric property of PMN oxides can be used to achieve this by an expansion of the lattice constant. First calculations on bulk-Pd with all-electron and pseudo-potential methods lead to differing results with respect to the magnetic ground state, but it seems, that the projector augmented wave method PAW describes the magnetism correctly. In PAW calculations pure fcc-palladium films remain non-magnetic during expansion, but a doping with cobalt can help to induce a magnetic state.

MA 32.20 Fri 11:15 Poster E

2-Dimensional-Magnetism of Fe-Monolayers in Pd — •Daniel Schumacher, Ulrich Rücker, and Thomas Brückel — IFF-Streumethoden, Forschungszentrum Jülich, 52425 Jülich

Pd almost fulfils the Stoner-criterion to be ferromagnetic. The aim of the work reported here is to explore in detail, how an ultrathin ferromagnetic layer inside a Pd thin film polarizes the surrounding Pd layer. As a function of the thickness of the Fe layer, we investigate the transition from 3d to 2d behaviour inside a Pd matrix.

Samples have been grown by molecular beam epitaxy (MBE) on GaAs substrates using an Ag buffer layer. The epitaxial growth and the surface qualities have been characterized by in-situ LEED and AUGER analysis to optimize the parameters of the preparation process. In addition, the surface quality has been analysed by X-ray-reflectometry. After that some wedge patterned Fe layers in Pd were produced. Thus different layer thicknesses have been obtained all grown at constant parameters (e.g. temperature, pressure, growth rate). The first step to explore the magnetic properties of these samples was done by MOKE measurements.

Polarized neutron scattering under grazing incidence is the method of choice to investigate the magnetization density profile as well as lateral magnetic correlations. By using neutron reflectometry magnetic correlations can be determined as a function of applied field, external temperature and dimensionality.

MA 32.21 Fri 11:15 Poster E

Das Wechselspiel elektrischer und magnetischer Felder in den kolossalen Widerstandseffekten von Ca-dotierten PrMnO3 — •Jörg Hoffmann, Peter Moschkau und Christian Jooss — Institut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, D 37077 Göttingen

Das Ca-dotierte PrMnO3 (PCMO) gehört zu der Klasse von Manganaten, die über den gesamten Temperaturbereich ein elektrisch isolierendes Verhalten zeigen. Dabei führen elektrische und magnetische Felder bei hinreichend tiefen Temperaturen zu kolossalen Widerstandseffekten. Diese Phänomene sind eng mit einer Phasenseparation zwischen strukturell ähnlichen Phasen verbunden, die sich bzgl. der Spin-, Orbital- und Ladungsordnung unterscheiden.

In diesem Beitrag vergleichen wir die elektrisch und magnetisch induzierten Widerstandsänderungen in polykristallinen Proben. Bestimmt wurde die temperatur- und frequenzabhängige Leitfähigkeit in magnetischen Feldern bis zu 9 T. Begleitet wurde dies durch Untersuchungen zur elektrisch induzierten Strukturänderung in einem analytischen Transmissionselektronenmikroskop.

Bei hinreichend hohen Temperaturen überwiegt die elektronisch ungeordnete Phase und die Transporteigenschaften sind durch kleine Holstein-Polaronen bestimmt. Magnetische Felder führen in der polaronen-geordneten Tieftemperaturphase zu einer hohen Leitfähigkeit (CMR). Diese Delokalisierung der Ladungsträger steht in Konkurrenz zu einer rein elektrisch induzierten Mobilisierung (CER), die keine langreichweitige Ordnung erfordert.

MA 32.22 Fri 11:15 Poster E

Magneto-optical Kerr effect measurements of $Fe_{3-x}Zn_xO_4$ thin films — •Matthias Pelkner, Deepak Venkateshvaran, Andrea Boger, Andreas Brandlmaier, Matthias Opel, Sebastian T. B. Goennenwein, and Rudolf Gross — Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, Walther-Meissner-Str. 8, 85748 Garching

Magnetite (Fe_3O_4) is a very attractive candidate regarding spintronic devices, since it has a very high Curie temperature ($T_C = 860$ K) and is considered a half metallic ferrimagnet. To tune its electronic and magnetic properties (carrier concentration and Curie temperature) it is attractive to replace a fraction of the Fe atoms by nonmagnetic ions, e.g. Zn.

We have prepared $Fe_{3-x}Zn_xO_4$ thin films on MgO (100) single crystal substrates using pulsed laser deposition with different Zn concentration ($x = 0$, 0.05, 0.1 and 0.5). The films were grown in Ar atmosphere at a pressure of 3.7×10^{-3} mbar and a substrate temperature of 320°C. The crystalline quality of the films was checked with x-ray diffraction, and the magnetic properties were investigated by means of magneto-optical Kerr effect measurements at room temperature and SQUID magnetometry. We present a comparison of the magnetic properties of the films with different Zn content x, grown under identical conditions, and critically compare our findings with the properties of bulk Zinc ferrite spinels reported in the literature.

This work is supported by the DFG via SPP 1285.

MA 32.23 Fri 11:15 Poster E

Growth and Characterization of $La_{1-x}Ca_xMnO_3$ thin films with different Ca concentrations using PLD with in-situ RHEED — •Alexander Hirsch, Heiko Fasold, Ralf Koppert, Frank Ludwig, and Meinhard Schilling — TU Braunschweig, Institut für Elektrische Messtechnik und Grundlagen der Elektrotechnik, Hans-Sommer-Straße 66, D-38106 Braunschweig, Germany

The growth of doped perovskite manganites is interesting for both basic research and potential applications. These materials, which show the colossal magnetoresistance effect, have promise for new sensor applications, in particular as layers in multiferroic superlattices.

Using pulsed laser deposition (PLD), $La_{1-x}Ca_xMnO_3$ (LCMO) thin films were grown. All targets were prepared by standard ceramic synthesis. As substrates $SrTiO_3$ (100) and $NdGaO_3$ (110) are used. The surface of the $SrTiO_3$ substrates is atomically flat and TiO_2 terminated after chemical and subsequent annealing treatment. To obtain atomically flat and single terminated $NdGaO_3$ surfaces an annealing treatment is applied. The growth of the films is monitored by in-situ reflection high energy electron diffraction (RHEED). The characterization is supplemented by X-ray diffraction and atomic force microscopy.

The LCMO films were grown with five different Ca concentrations between 33 % and 50 %. Optimal growth conditions lead to high quality crystalline magnetic films with rms roughnesses below 1nm for layer thicknesses up to 500 nm. The influence of the Ca concentration, the substrate and the film thickness on the properties of the thin films is analyzed.

MA 32.24 Fri 11:15 Poster E

Characterization of hybrid amorphous-partially crystalline thin films — •Norbert Martin[1], Christine Hamann[1], Jeffrey McCord[1], Jürgen Fassbender[2], Eckhard Quandt[3], Andreas Gerber[4], Nadja Bigall[5], Alexander Eychmüller[5], and Ludwig Schultz[1] — [1]IFW Dresden, Dresden, Deutschland — [2]FZD, Dresden, Deutschland — [3]CAU Kiel, Kiel, Deutschland — [4]Caesar, Bonn, Deutschland — [5]PC2 TU Dresden, Dresden, Deutschland

Amorphous FeCoBSi thin films with uniaxial anisotropy have been laterally structured by Co ion implantation into stripe arrays. The resulting multiphase samples were investigated regarding the magnetic properties. Hysteresis measurements revealed a large increase in coercivity of the implanted areas. By means of TEM investigations this could be attributed to formed crystallites in the amorphous matrix. Magneto-optical imaging was used to correlate the domain structure to the magnetic hysteresis. It is demonstrated that stripe orientation with respect to the magnetic easy axis governs the coupling between implanted and non implanted areas.

MA 32.25 Fri 11:15 Poster E

Magnetic properties of FeCo(110) on GaAs (110) cleaved edges — •Florian Nitsch, Björn Muermann, and Günther Bayreuther — Institut für Experimentelle und Angewandte Physik, Universität Regensburg, 93040 Regensburg, Germany

By cleaving a (001)-oriented GaAs wafer in UHV atomically flat and chemically clean GaAs(110) surfaces can be produced. To investigate

a possible influence of surface roughness on the magnetic anisotropy of bcc $Fe_{1-x}Co_x$(110) films, layers grown by molecular beam epitaxy on such cleaved edges and on (110)-oriented GaAs wafers were investigated by alternating gradient magnetometry, magneto-optic Kerr effect and ferromagnetic resonance. Film thickness varied between 10 and 80 ML (monolayers) for compositions of x = 0.30 and x = 0.66. RHEED patterns showed a much lower step density of the cleaved edges compared to the GaAs(110) wafer surfaces prepared by UHV-annealing and Ar^+ etching. The superposition of the cubic anisotropy (constant K_1) and a uniaxial anisotropy (K_U) is observed. Both anisotropy constants show a systematic thickness dependence resulting from the superposition of volume and interface contributions. A comparison with films grown on GaAs(001) indicates that in (110)-oriented films the uniaxial component is mainly of magneto-elastic origin. Both K_1 and K_U have about the same values for films grown on (110) wafers and on cleaved edges. It is concluded that for a thickness up to 80 ML the lattice relaxation due to the formation of misfit dislocations is not affected by the surface roughness of the substrates used in the present work.

MA 32.26 Fri 11:15 Poster E

Investigation of the magnetic phase transition in thin $Fe_{50}Pt_{50-x}Rh_x$ films by neutron diffraction — •Jochen Fenske[1], Dieter Lott[1], Gary J. Mankey[2], Wolfgang Schmidt[3], Karin Schmalzl[3], and Andreas Schreyer[1] — [1]GKSS Research Centre, Geesthacht — [2]MINT Center, The University of Alabama, Tuscaloosa, AL, USA — [3]JCNS, Jülich, Germany

In the last years perpendicular recording plays a major role in the development of novel magnetic data storage. Here, materials with high anisotropy are used which delivers good thermal stability. However in order to write the bits a high magnetic field is necessary. By the use of soft underlayers the write field can be significant reduced. $Fe_{50}Pt_{50-x}Rh_x$ is a promising candidate for such an underlayer. Magnetization measurements of the bulk samples for x=10 refer to a antiferromagnetic (AF)/ferromagnetic (FM) phase transition at about 150K when heated. Additional magnetostriction measurements indicate that the phase transition could also be induced by applying a magnetic field [2]. The FM state lowers the high anisotropy and therefore the high write field. The AF state helps to stabilize the recording media via exchange interaction. For technical applications the use of thin films are essential to save space and costs for the next generation of magnetic storage devices. Here we present results on several thin $Fe_{50}Pt_{50-x}Rh_x$ films with different concentration of Rh. The films were examined by polarized and unpolarized neutron diffraction in dependence of temperature and magnetic field. [2] P.A. Algarabel, et. al, J.Appl. Phys. 79 (8), 1996

MA 32.27 Fri 11:15 Poster E

Magnetic phase transitions at interfaces studied by resonant magnetic soft x-ray scattering — •Enrico Schierle[1], Detlef Schmitz[1], Gunther Springholz[2], and Eugen Weschke[1] — [1]Hahn-Meitner-Institut , Berlin, Germany — [2]Institut für Halbleiterphysik, Johannes Kepler University, Linz, Austria

Properties of magnetic thin films are strongly influenced by the near-interface regions, where modifications of bulk magnetic order [1] and roughness occur. Using resonant magnetic soft x-ray scattering at the Eu-M_5 resonance, we studied the temperature-dependent magnetization of the individual layers in monocrystalline films of the magnetic semiconductor EuSe with thicknesses of 20 and 40 monolayers. These films exhibit AFM, ferri- (FiM) and FM phases depending on temperature and applied magnetic field [2]. Due to the high magnetic sensitivity at resonance [3], very intense AFM and FiM Bragg peaks could be recorded that are characterized by pronounced Laue oscillations over a large range of momentum transfer. These permit a detailed characterization of temperature-dependent interface-induced disorder for different types of magnetic structures (AFM, FiM) in a single material. Preliminary analyses point to a much stronger influence of the interface on the FiM structure than on AFM order.

[1] K. Binder, P. C. Hohenberg, Phys. Rev. B 9, 2194 (1974)
[2] R. T. Lechner et al., Phys. Rev. Lett. 94, 157201 (2005)
[3] E. Weschke et al., Phys. Rev. Lett. 93, 157204 (2004)

MA 32.28 Fri 11:15 Poster E

Magnetic properties of epitaxial Fe/GaAs(110) — •Igor Barsukov, Cihan Tomaz, Ralf Meckenstock, Jürgen Lindner, and Michael Farle — Fachbereich Physik and Center for Nanointegration (CeNIDE) Universität Duisburg-Essen, Lotharstrasse 1, 47048 Duisburg, Germany

Epitaxial Fe films in a thickness range from 15 to 30 monolayers (ML) were grown by in-situ molecular beam epitaxy on GaAs(110) at room temperature. The growth and structure of the films were characterized by Auger spectroscopy, low energy electron diffraction (LEED) and IV-LEED. In-situ angular dependent ferromagnetic resonance measurements (FMR) were performed to obtain a full set of anisotropy parameters. Beside the well known film thickness dependent magnetic reorientation transition [1], the investigation shows a characteristic change of anisotropies due to thermal tempering, by direct heating or by covering with flash-evaporated Ag atoms. The comparison of the two characteristic FMR angular dependences reveals that the magnetic transition is driven by a 90° rotation of uniaxial anisotropy axis; the higher order parameters being unchanged. A morphologic explanation of this phenomenon is discussed. This work was supported by DFG, SFB491.

[1] J. Appl. Phys. 89, 11, 7136-7138

MA 32.29 Fri 11:15 Poster E

Effects of wet-chemical etching on MnAs/GaAs hybride structures probed by HX-PES — •Benjamin Schmid[1], Sebastian Engelbrecht[1], Michael Sing[1], Jan Wenisch[2], Charles Gould[2], Karl Brunner[2], Lorenz Molenkamp[2], Wolfgang Drube[3], and Ralph Claessen[1] — [1]Experimentelle Physik IV, Universität Würzburg, Würzburg, Germany — [2]Experimentelle Physik III, Universität Würzburg, Würzburg, Germany — [3]HASYLAB, DESY, Hamburg

Ferromagnet-semiconductor hybride structures represent a promising approach to spintronic applications. Utilizing not only the charge but also the spin degree of freedom would lead to a new generation of computing devices. One promising candidate for spin-injectors or aligners compatible with conventional semiconductors is MnAs. It provides a high Curie temperature of 317 K and a compatibility to GaAs. Moreover, thin films of MnAs can be grown epitaxially on GaAs by MBE with monolayer accuracy.

In order to fabricate tailor-made spintronic devices it is essential to test established surface preparation methods. Obtaining clean surfaces during the fabrication process of heterostructures by wet-chemical etching is a standard method in today's semiconductor industry. We investigated the effects of etching with either HCl or H_2SO_4 on MnAs thin films using photoemission spectroscopy in the hard X-ray regime (HX-PES). HCl removes contaminations such as oxygen and carbon. After etching the surface appears to be covered with an As layer. In contrast, H_2SO_4 leads to a complete destruction of the MnAs thin film.

MA 32.30 Fri 11:15 Poster E

Recovery of the metal-insulator transition in electron-doped $La_{0.7}Ce_{0.3}MnO_{3-\delta}$ films by photoexcitation — •Andreas Thiessen[1], Elke Beyreuther[1], Stefan Grafström[1], Kathrin Dörr[2], and Lukas M. Eng[1] — [1]Institut für Angewandte Photophysik, TechnischeUniversität Dresden, D-01062 Dresden — [2]Institut für Metallische Werkstoffe, IFW Dresden,Postfach 270116, D-01171 Dresden

The question whether electron-doped mixed-valence manganites, such as $La_{0.7}Ce_{0.3}MnO_3$, can be synthesized as single-phase compounds has been under debate for a decade. Meanwhile it has become clear that electron doping can indeed be achieved in epitaxial thin films [Mitra et al., JAP 89 (2001) 524]. However, as-prepared films often suffer from overoxygenation and concomitant hole doping, which can be overcome by deoxygenation through a post-deposition annealing procedure. Disappointingly, those reduced samples do not exhibit the typical metal-insulator transition (MIT) any longer [Wang et al., PRB 73 (2006) 144403].

In the present work, we show that the MIT of $La_{0.7}Ce_{0.3}MnO_{3-\delta}$ films can be recovered by exposition to visible light. Our films turn out to be highly photoconductive: Laser illumination at 514 nm with a power of 400 mW gave rise to a dramatic resistance drop of around seven orders of magnitude at 100 K as compared to the dark state, while illumination had no impact on the conductivity of an as-prepared reference film.

MA 32.31 Fri 11:15 Poster E

Epitaxial strain and magnetic anisotropy in $LaCoO_3$ thin films — •Erhan Arac[1,2], Dirk Fuchs[1], and Rudolf Schneider[1] — [1]1 Forschungszentrum Karlsruhe, Institut für Festkörperphysik, — [2]Physikalisches Institut, Universität Karlsruhe

$LaCoO_3$ (LCO) thin films do show a strain induced ferromagnetic phase transition below 85K. In order to elucidate the coupling between strain and magnetization, we have grown epitaxial LCO thin films on (001), (111) and (110) oriented $(LaAlO_3)_{0.3}(Sr_2AlTaO_6)_{0.7}$ single crystal substrate with different film thickness. The films were grown by pulsed laser depositions and are differently strained because of the grown direction. The magnetization reversal loops were recorded by light modulated magneto-optical Kerr effect (MOKE) magnetometry whereas strain characterization was carried out by reciprocal space mapping on a four-circle x-ray diffractometer. The magnetic anisotropy as a function of strain is studied . Preliminary results will be presented.

MA 32.32 Fri 11:15 Poster E

Scanning tunneling spectroscopy on $La_{0.75}Ca_{0.25}MnO_3$ thin film in external magnetic fields — •Thomas Mildner, Sigrun Köster, Bernd Damaschke, Vasily Moshnyaga, and Konrad Samwer — I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Manganite thin films show a colossal magnetoresistance effect (CMR) combined with a metal-insulator transition (MIT). The MIT is observed not only as a function of temperature but also in an external magnetic field. The transition may be discussed in terms of an electronic phase separation with possible contributions of polaronic ordering.

In this work an A-site ordered $La_{0.75}Ca_{0.25}MnO_3$ thin film was grown by metalorganic aerosol deposition (MAD) technique on a MgO substrat. The scanning tunneling spectroscopy measurements were performed in UHV at various temperatures in the vicinity of the MIT and external magnetic fields. Regions with different tunneling conductivity at the Fermi level increases with external magnetic fields leading to a CMR-like effect also in the tunneling conductivity.

The work is supported by the DFG via SFB 602, TP A2

MA 32.33 Fri 11:15 Poster E

Exchange shift of stripe domains in antiferromagnetically coupled superlattices — Nikolay S. Kiselev[1,2], Igor E. Dragunov[2], •Ulrich K. Rössler[1], and Alexei N. Bogdanov[1,2] — [1]IFW Dresden — [2]Donetsk Institute for Physics and Technology

Recently synthesized antiferromagnetically coupled superlattices with perpendicular anisotropy display qualitatively new physical properties. Competition between the weak interlayer exchange and dipolar coupling yields unusual domain structures and magnetization processes. Understanding and control of these properties may lead to new applications of such perpendicular multilayers. Within a general phenomenological approach we calculate the existence regions and the geometrical parameters of equilibrium stripe and bubble domains, and their evolution in a bias field. A *shifted* phase characterized by a redistribution of magnetization between adjacent magnetic layers exists in a broad range depending on the ratio of magnetic and nonmagnetic layer thicknesses and strengths of interlayer coupling [1]. The transition from the antiferromagnetic monodomain state to the *shifted* phase and coexistence of metastable states was observed in recent experiments [2]. Qualitative and quantitative methods have been developed [3] for the analysis of magnetic force microscopy (MFM) images from this novel class of nanomagnetic systems.

[1] N.S. Kiselev, I. E. Dragunov, U. K. Rößler, A. N. Bogdanov, Appl. Phys. Lett. 91 (2007) 132507; [2] O. Hellwig et al. J. Magn. Magn. Mater. 319 (2007) 13; [3] N.S. Kiselev, I. E. Dragunov, V. Neu, U. K. Rößler, A. N. Bogdanov, J. Appl. Phys. submitted.

MA 32.34 Fri 11:15 Poster E

Thermal stability of GMR stack systems: Influence of the cap layer — •Matthias Hawraneck[1,2], Jürgen Zimmer[1], Wolfgang Raberg[1], Klemens Prügl[1], Thomas Bever[1], Stefan Flege[2], and Lambert Alff[2] — [1]Infineon Technologies AG, Am Campeon 1-12, 85579 Neubiberg — [2]Institut für Materialwissenschaft, TU Darmstadt, Petersenstr. 23, 64287 Darmstadt

In a wide range of applications GMR stack systems can be used as magnetic field sensors. For these applications, like angle und speed sensing, a stable magnetic behavior is a crucial criterion. For unstructured GMR stacks two degradation effects can be considered: First interlayer diffusion within the stack, and second the influence of the environment on the stack. To evaluate the impact of the environment on the GMR stack, especially bottom-pinned spin-valves (SV), we focused on the influence of the cap layer on the thermal stability. From our studies, we conclude that a TaN cap layer acts as an effective diffusion barrier for oxygen, which means it is preventing effectively the GMR stack from being oxidized.

MA 32.35 Fri 11:15 Poster E

Low temperature ion bombardment combined with in-situ ac-susceptibility measurements — •Moritz Trautvetter, Ulf Wiedwald, and Paul Ziemann — Universität Ulm

As has been demonstrated previously, ion bombardment of magnetic films at optimized temperatures allows fine tuning of various magnetic properties like Curie-temperature, hysteretic behavior, exchange bias fields as well as magnetically relevant structural phase transitions. In many cases, it is desirable to find a relation between certain types of defects or of disorder and corresponding changes of a specific magnetic property. For this purpose, a new low temperature (T > 6K) ac-susceptometer was developed and combined with the beam-line of a 300 keV ion accelerator. The design of this system will be introduced and its performance demonstrated by first measurements on FePt films and nanoparticles.

MA 32.36 Fri 11:15 Poster E

Epitaktische PCMO Schichten auf (001) orientierten und vizinalen STO Substraten: — •Peter Moschkau, Jörg Hoffmann, Julia Fladerer und Christian Jooss — Materialphysik Universität Göttingen, Göttingen, Germany

PCMO zeigt im elektronischen Transportverhalten einen ausgeprägten kolossalen magnetoresistiven Effekt (CMR). Dieser wird zusätzlich, je nach Ordnungsgrad, durch die für die Messung benötigten elektrischen Ströme beeinflusst. Dies soll anhand von Strom-Spannungs-Kennlinien als Funktion der Temperatur und des Magnetfeldes diskutiert werden. Die Transporteigenschaften sind in weiten Bereichen durch das Model thermisch aktivierter Polaronen (TAP) deutbar. Der metallische Zustand in hohen Magnetfeldern wird als Übergang zu bandartigen leichten Polaronen interpretiert. Des Weiteren spielen, wie TEM-Ergebnisse zeigen, Defekte eine große Rolle für die Ausbildung einer Polaron-geordneten Phase. Untersuchungen an herstellungsbedingten Defekten (gepulste Laserdeposition, quenched disorder) sowie künstlichen periodischen Defekten (Verwendung vizinaler Substrate) und ihrer Ausheilung durch nachträgliche Auslagerung wurden durchgeführt. Es soll der Zusammenhang zwischen Struktur und elektrischen Transporteigenschaften sowie der Ordnung der Polaronen diskutiert werden.

MA 32.37 Fri 11:15 Poster E

An ab initio study of the surface energy of Fe, Co, Pt and their alloys — •Antje Dannenberg, Markus Ernst Gruner, and Peter Entel — Fachbereich Physik, Universität Duisburg-Essen, 47048 Duisburg, Germany

$L1_0$ ordered FePt and CoPt are considered as promising materials for ultra- high density magnetic recording applications due to their extraordinarily high magnetocrystalline anisotropy energy in the bulk phase. For nanoparticles this quantity is influenced by the shape and the structure of the cluster. Since the energies of surfaces and internal interfaces play an important role in determining the equilibrium shape of the particles, their analysis is of fundamental interest. Beginning with the elemental components Fe, Co and Pt, we present as a first step a systematic study of surface energies and electronic structure of low-indexed surfaces, which we extend to the binary alloys FePt and CoPt. The energies are calculated within density functional theory using the VASP code employing the PAW approximation and the GGA exchange-correlation potential. The surfaces were modeled within the slab approach using up to 16 layers whereby the periodic images were separated by a vacuum region corresponding to 8 layers.

MA 32.38 Fri 11:15 Poster E

Temperature dependent fast switching of magnetic nanoparticles — •Alexander Sukhov[1,2] and Jamal Berakdar[2] — [1]Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, D-06120 Halle/Saale, Deutschland — [2]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, Heinrich-Damerow-Straße 4, D-06120 Halle/Saale, Deutschland

We study the temperature-dependent spin dynamics of single-domain magnetic nanoparticles in the presence of a time-dependent magnetic field [1, 2] and/or spin-polarized currents [3, 4]. Our aim is to determine the conditions under which a fast magnetization switching is achievable with weak external drivings. Our work is based on the numerical and analytical solutions of the Landau-Lifshitz-Gilbert equation with temperature effects being implemented on the level of the

Langevin dynamics.
[1] C. Thirion *et al.*, Nat. Mater. **2**, 524-527 (2003).
[2] A. Sukhov, J. Berakdar, Phys. Rev. B, submitted.
[3] J. C. Slonczewski, J. Magn. Magn. Mater. **159**, L1-L7 (1996).
[4] L. Berger, Phys. Rev. B **54**, 9353-9358 (1996).

MA 32.39 Fri 11:15 Poster E

Surface anisotropy and vortex states in ferromagnetic nanowires and nanotubes — •Andrei A. Leonov[1,2], Ulrich K. Rössler[1], and Alexei N. Bogdanov[1,2] — [1]IFW Dresden — [2]Donetsk Institute for Physics and Technology

In ferromagnetic nanowires and nanotubes magnetic couplings induced by lateral surfaces can overcome the stray-field forces and stabilize inhomogeneous states where the magnetization vector rotates along or perpendicular to radial directions as Néel or Bloch vortex, respectively [1]. Depending on the surface anisotropy constants vortices are formed by a continuous rotation of the magnetization vector away from the homogeneous state with collinear longitudinal magnetization. Depending on the material and geometrical parameters different types of Néel and Bloch vortices can exist in nanowires and nanotubes. The phase diagram of the solutions includes stability regions of different vortex states and homogeneous phases with longitudinal or transverse magnetization separated by first- or second-order transition lines. Signatures of vortex states are discussed in relation to experimental observations on magnetization processes in magnetic nanowires. In particular, vortex states may be responsible for certain features of the magnetoresistance in nanowires. For nanotubes solutions for twisted states exist similar to the inhomogeneous phases in ferromagnetic nanolayers [2].

[1] U.K. Rößler, A. N. Bogdanov, K.-H. Müller, IEEE Trans. Magn. 38 (2002) 2586; [2] A. N. Bogdanov, U.K. Rößler, K.-H. Müller, J. Magn. Magn. Mat. 238 (2002) 155.

MA 32.40 Fri 11:15 Poster E

The oxidation behavior of FePt nanoparticles in $A1$ and $L1_0$ phase — •Luyang Han, Kuerbanjiang Balati, Ulf Wiedwald, Lianchen Shan und Paul Ziemann — Institut für Festkörperphysik, Universität Ulm, A.-Einstein-Allee 11, 89081 Ulm, Germany

Self-assembled arrays of FePt nanoparticles attract great attention due to their potential application as magnetic data storage media[1]. For an application the chemical stability of metallic nanoparticles against environmental conditions is critical. To prepare FePt nanoparticles, a micellar method is used, with which the composition and size of the particles can be well controlled[2,3]. The oxidation behavior of the nanoparticles is investigated using X-ray photoelectron and X-ray absorption spectroscopy. The 8 nm chemically disordered $A1$ FePt nanoparticles show surface passivation after exposure to ambient condition for a few hours and possibly a core-shell structure is formed. After annealling at $T > 600°C$ the metallic particles can be transformed partially to the chemically ordered $L1_0$ state, which exhibits increased resistance to oxidation.

[1]S. Sun, *Adv. Mater.*, **18**, 393, (2006)
[2]A. Ethirajan et al., *Adv. Mater.*, **19**, 406, (2007)
[3]U. Wiedwald et al., *Appl. Phys. Lett.*, **90**, 062508, (2007)

MA 32.41 Fri 11:15 Poster E

X-ray Absorption Fine Structure analysis of magnetite nanoparticles — •Masataka Kitagami[1], Masako Sakamaki[1], Takuma Kaneko[1], Takehisa Konishi[1], Takashi Fujikawa[1], Lin Lin[2], Jauyn Grace Lin[3], and Dimitri Arvanitis[4] — [1]Chiba University, Chiba, Japan — [2]National Changhua University of Education, Changhua, Taiwan — [3]National Taiwan University, Taipei, Taiwan — [4]Uppsala University, Uppsala, Sweden

Magnetite (Fe_3O_4) is an important magnetic material for applications, in particular for medicine and biology. The structural, electronic and magnetic state of the near surface region of magnetite nano-particles (of order 2-10 nm) is particularly important in this context. The magnetite nano-particles were characterized in particular, among other techniques, by means of X-ray diffraction, and magnetic susceptometry[1]. Here we present a X-ray Absorption Fine Structure (XAFS) characterization using both soft and hard X-rays at synchrotron radiation laboratories. Soft X-rays allow in particular to assess the nano-particle cleanness and stoichiometry. L-edge Fe XAFS indicates a different electronic state for the Fe atoms in the near surface region for small nanoparticle sizes. The results of the structural hard X-ray XAFS analysis are indicating a different local structure for the nanoparticles versus the bulk. In particular Fe K-edge XAFS indicates a octahedrally coordinated Fe atom rich nano-particle surface, in agreement with the Fe L-edge results. [1] K. H. Hsu *et al.*, J. Appl. Phys. **97**, 114322 (2005)

MA 32.42 Fri 11:15 Poster E

Quantitative Lorentz transmission electron microscopy of structured thin permalloy films — •Sergej Nepijko[1], Gerd Schönhense[1], and Josef Zweck[2] — [1]Institute of Physics, University Mainz, Staudingerweg 7, 5518 Mainz, Germany — [2]Institute of Experimental and Applied Physics, University Regensburg, 93040 Regensburg, Germany

Defocusing of the image, during of investigation of ferromagnetic particles with transmission electron microscope (Lorentz microscopy), gives the ability to determine the distribution of the magnetic field of the specimen, quantitatively. Measurements were done on permalloy disk-shaped particles with diameter of 50 nm and squares 70x70 nm2 and thickness of 10 nm. Disk-shaped particles exhibit a vortex structure, which was characterized with magnetic induction of 1.1 T. Square particles contained four domains, which produce a Landau-Lifshitz flux-closure structure. Value of magnetic induction of domain was also 1.1 T and the width of the 90 degrees Néel boundary between them was 4.5 nm. Stray field in edges of square particle reached 0.35 T.

MA 32.43 Fri 11:15 Poster E

On the magnetic properties of composites containing $CoFe_2O_4$ nano-particles — Béatrice Hallouet, •Carsten Volz, and Rolf Pelster — Universität des Saarlandes, Fachrichtung 7.2 Experimentalphysik, Campus E 2.6 , D-66123 Saarbrücken, Germany

We investigate ferrofluids consisting of nanoscaled single-domain magnetic particles ($CoFe_2O_4$, diameter 5-10nm) in an ethandiole matrix. These are characterized by means of temperature-dependent broadband magnetic spectroscopy up to 6 GHz. We focus on the behavior of the magnetic resonances, especially on the question how these depend on the microstructure, i. e. on the spatial distribution and the orientation of the particles. Non-random systems are obtained by applying a static magnetic field during sample preparation.

MA 32.44 Fri 11:15 Poster E

Fabrications and Detections of Biosensors Based on Giant Magneto-Resistance — •Ning-Ning Liu, Karsten Rott, Alexander Weddemann, Inga Ennen, Günter Reiss, and Andreas Hütten — Thin Films and Physics of Nanostructures, Department of Physics, Bielefeld University, 33501 Bielefeld, Germany

Giant magneto-resistance (GMR) materials, which are widely used for read-heads and are good candidates for sensors, attracted more and more peoples. The objective of this contribution is to present a biosensor chip for single molecule detection. In this work, the fabrications of Copper/Permalloy and Copper/Cobalt multilayered GMR-sensors-chips employing e-beam lithography have been reported. 1μm sized Dynal MyOne beads have been used for the first detection. The design of the GMR sensor as well as the resulting GMR characteristics have shown and discussed.

Controlling bead coverage on the GMR sensors a calibration curve GMR versus relative coverage of Co nanoparticle has been determined. The sensor output signal linearly depends on the number of beads and single molecule detection could be demonstrated. We will show the characteristics of this biosensor chip for detecting relatively small magnetic nanoparticles, e.g., 5 to 15 nm sized Cobalt nanoparticles.

Physical aspect and possibilities related to the integration of this biosensor into the fluidic environment will be discussed in detail as well.

MA 32.45 Fri 11:15 Poster E

Interactions of magnetic particles in a rotational magnetic field and applications for particle manipulation — •Alexander Weddemann, Ahmed El-Gendy, and Simone Herth — Universität Bielefeld

Magnetic nanoparticles have a growing number of different applications in many different physical, chemical or medical fields. Nevertheless, in many cases several difficulties have to be overcome: Depending on the way of fabrication, the size distribution of the particles is often unknown making it not easy to make proper predictions on the particle behaviour within a physical or biological system. Particle-particle interactions are very strong at short distances leading to agglomerations of the particles. Such clustering of beads can result in a vanishing total magnetic moment, making them useless for certain applications. We introduce a new method to overcome such problems applying time

dependent rotational or alternating magnetic fields to particle distributions. The behaviour has been analysed by simulations and in experiments in respect to frequency leading to different characteristic areas of particle behaviour. The influence of the particle diameter on particle movement is discussed as well. Applications of these studies include the avoidance of particle agglomeration, the alignment of elongated macromolecules by loading with magnetic particles, and a new way to determine particle size distributions.

MA 32.46 Fri 11:15 Poster E

Trends in spin exchange interactions and ferroelectric polarization in the orthorhombic RMnO$_3$ series — Kunihiko Yamauchi[1], Frank Freimuth[2], Stefan Bluegel[2], Biplab Sanyal[3], Ivan Sergienko[4], Elbio Dagotto[4], and •Silvia Picozzi[1] — [1]CNR-INFM, L'Aquila (Italy) — [2]IFF, Forschungzentrum Jülich, Germany — [3]Uppsala Univ., Sweden — [4]Oak Ridge Natl. Lab. and Univ. Tennessee, TN (USA)

Recently, magnetic ferroelectricity induced by Heisenberg-type interactions has been theoretically predicted in E-type antiferromagnetic (AFM) HoMnO$_3$ [1]. In order to fully clarify this unconventional microscopic mechanism, we've studied the structural, magnetic and ferroelectric properties for the entire family of orthorhombic RMnO$_3$ (R= rare earth ions), based on first-principles density functional calculations. The ferromagnetic exchange interaction between nearest-neighbor Mn sites decreases with the ionic radius of R (concomitantly with the in-plane Mn-O-Mn bond angle), whereas the antiferromagnetic next-nearest neighbor interaction stays rather constant in the series. The competition of these exchange interactions results in a complicated magnetic phase diagram. The decrease in the Mn-O-Mn angle also affects the hopping integrals between Mn ions (as determined from Wannier functions), so that the calculated electric polarization in E-type AFM RMnO$_3$ is remarkably reduced throughout the rare earth series.

[1] S. Picozzi et al., Phys. Rev. Lett. (in press).

MA 32.47 Fri 11:15 Poster E

Magnetic and thermodynamic studies of R(Mn,Fe,Co)$_2$O$_5$, (Bi,Sm)MnO$_3$ and Bi(Fe,Ni)O$_3$ — •Norman Leps[1], Nadja Wizent[1], Dmitri Souptel[1], Rüdiger Klingeler[1], Christian Hess[1], Natalia Tristan[1], Günter Behr[1], Matthias Lutz[1], Sang Wook Cheong[2], and Bernd Büchner[1] — [1]IFW-Dresden, P.O. Box 270116, D-01171 Dresden — [2]Department of Physics and Astronomy, Rutgers, The State University of New Jersey, 136 Frelinghuysen Road, Piscataway, NJ 08854-8019 USA

The simultaneous appearance of magnetic and electric ordering in frustrated spin systems offers the potential for novel electromagnetic building blocks. Among the frustrated spin systems rare earth manganates RMn$_2$O$_3$ (R=Y, Tb, Ho) and the perovskites BiMnO$_3$ and BiFeO$_3$ exhibit multiferroic properties. The magneto-electric coupling, however, is very small in all cases and the frustrated antiferromagnetism delimits the achievable tuning of the magnetization via an external electrical field, or vice versa, the spontaneous polarization via a magnetic field. We hence have systematically studied the effect of different doping on both the magnetic and the A-sites of the respective materials. To be specific, the influence of the cations was investigated by partially substituting Mn by Fe or Co in RMn$_2$O$_5$ and Ni in BiMnO$_3$, respectively. The role of the electronic subsystem was investigated by partial substitution of Bi by Sm in BiFeO$_3$. Our magnetization and specific heat measurements of the doped materials provide the phase diagrams which are discussed with respect to the multiferroic properties.

MA 32.48 Fri 11:15 Poster E

Resonant soft x-ray scattering from DyMnO$_3$ — •Enrico Schierle, Victor Soltwisch, Detlef Schmitz, Ralf Feyerherm, Dimitri Argyriou, and Eugen Weschke — Hahn-Meitner-Institut, Berlin, Germany

The multiferroic compound DyMnO$_3$ was studied by resonant x-ray scattering at the Dy-M$_5$ and Mn-L$_2$ resonances in the temperature range between 5 K and 50 K. The element-selective resonant method permits to study ordering of the Dy-4f and Mn-3d moments seperately, revealing noticeable differences in the character of the ordered moments in the sinusoidal and the helical ferroelectric phase. From the energy dependence of the scattering cross section across the resonances details about ordering of magnetic moments and orbital wave functions can be inferred.

MA 32.49 Fri 11:15 Poster E

Multiferroic effect in epitaxial TbMnO$_3$ films — •Joost de Groot[1], Emmanuel Kentzinger[1], Jürgen Schubert[2], Stefan Mattauch[1], and Thomas Brückel[1] — [1]Forschungszentrum Jülich Gmbh D52425 Jülich IFF-4: Streumethoden — [2]Forschungszentrum Jülich Gmbh D52425 Jülich IBN 1-IT

TbMnO$_3$ belongs to a class of rare earth manganites showing multiferroic behaviour. The strong magnetoelectric effect is expected to depend on the dimensionality of the system and on epitaxial strain in thin films. We have grown epitaxial TbMnO$_3$ films of different thicknesses (5-100nm) using Pulsed Laser Deposition on LaAlO$_3$ and SrTiO$_3$ substrates. We analysed the films by x-ray diffraction on a four-circle diffractometer and determined the twinings effects quantitatively. We will report on the thickness dependence of magnetization and electrical polarization as well as on scattering experiments using soft x-ray resonant magnetic scattering and polarized neutron reflectometry.

MA 32.50 Fri 11:15 Poster E

Atomic Layer Deposition and Characterization of BiFeO$_3$ Thin Films — •Philipp Leufke[1], Jens Ellrich[1], and Horst Hahn[1,2] — [1]Institut für Nanotechnologie, Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany — [2]Fachbereich Material- und Geowissenschaften, Petersenstrasse 23, TU Darmstadt, 64287 Darmstadt, Germany

We report on the deposition of multiferroic thin films of bismuth ferrite (BiFeO$_3$) [1] by ALD (atomic layer deposition) using different Fe and Bi precursors at various deposition conditions.

Surface morphology and crystal structure of the prepared thin films are investigated by means of scanning electron microscopy and X-ray diffraction. Energy-dispersive X-ray spectroscopy is employed for chemical analysis.

The magnetic properties are explored via superconductive quantum interference device magnetometry, measurement of the magnetooptical Kerr effect and depth selective conversion electron Mößbauer spectroscopy, with regard to the disagreements raised by former studies on pulsed laser deposited BiFeO$_3$ thin films [2].

[1] W. Eerenstein et al., *Nature* **442**, 759-765 (2006)
[2] (a) J. Wang et al., *Science* **299**, 1719-1722 (2003); (b) W. Eerenstein et al., *Science* **307**, 1203a- (2005); (c) J. Wang et al., *Science* **307**, 1203b- (2005)

MA 32.51 Fri 11:15 Poster E

Coupling of structure and magnetism in multiferroic RFe$_3$ (BO$_3$)$_4$: Magnetostriction and thermodynamic studies — •Liran Wang[1,2], Rüdiger Klingeler[1], Natalia Tristan[1], Christian Hess[1], Bernd Büchner[1], Martin Philipp[1], Leschner Janet[1], Norman Leps[1], Olga Kataeva[1,3], Elena Popova[4], Alexander Vasiliev[4], and L.N Bezmaternykh[5] — [1]Leibniz-Institute for Solid State and Materials Research IFW Dresden,Dresden,Germany — [2]IMPRS,Dynamical Processes in Atoms Molecules and Solids,Nöthnitzer Str.38,Dresden,Germany — [3]A.E.Arbuzov Institute, Russian Academy of Science,Arbuzov Str.8,Kazan,Russia — [4]Physics Faculty,Moscow State University,Moscow,Russia — [5]L.V.Kirensky Institute of Physics,Siberian Branch of RAS, Kransnoyarsk, Russia

Rare earth ferroborates exhibit a rich phase diagram owing to the interplay 3d- and 4f-electrons. This interplay gives rise to an interesting structural and magnetic properties and it was found recently that at least two compounds of this series, i.e. R = Gd, Nd, exhibit multiferroism at low temperatures. Here, we present magnetostriction, thermodynamic and dielectric measurements on TbFe$_3$(BO$_3$)$_4$, DyFe$_3$(BO$_3$)$_4$ and NdFe$_3$(BO$_3$)$_4$ single crystals. The data show that, in the antiferromagnetically Fe-spin ordered phase below T_N at nearly 40K, there is a field induced spin-flop of the Fe spins superimposed by a spin-flip of the rare earth moments. This transition is accompanied by significant structural changes. The results are discussed in terms of a mean-field coupling model between the 3d- and the 4f-subsystem.

MA 32.52 Fri 11:15 Poster E

Investigation of multiferroic properties in MnWO$_4$ by SHG-spectroscopy — •Michael Maringer[1], Dennis Meier[1], Thomas Lottermoser[1], Gouliang Yuan[1], Petra Becker[2], Ladislav Bohatý[2], and Manfred Fiebig[1] — [1]HISKP, Universität Bonn — [2]Institut für Kristallographie, Universität zu Köln

Magnetoelectric multiferroics, i.e. compounds displaying magnetic and

ferroelectric order in the same phase, attract considerable attention from the point of view of potential device application as well as fundamental physics. In the so-called spin-spiral compounds the interaction is particularly pronounced. Here we introduce optical second harmonic generation (SHG) as a powerful tool for the study of magnetic and eletronic properties and their magnetoelectric interaction in spin-spiral compounds, taking $MnWO_4$ as an example. SHG gives detailed information about the symmetry of crystalline phases and about symmetry changes caused by phase transitions. In particular, in $MnWO_4$ the (anti)ferromagnetic incommensurate phase and the magnetically induced ferroelectric, state are investigated. Although the magnetically induced spontaneous polarization is about four orders of magnitude weaker than in a conventional ferroelectric, a pronounced SHG signal is obtained.

This work was supported by the DFG through SFB 608

MA 32.53 Fri 11:15 Poster E

Magnetoelastic coupling of $La_{0.7}Sr_{0.3}MnO_3$ films near the structural phase transition in $SrTiO_3$ — •Michael Ziese[1], Annette Setzer[1], Pablo Esquinazi[1], Ionela Vrejoiu[2], and Dietrich Hesse[2] — [1]Division of Superconductivity and Magnetism, University of Leipzig, Leipzig, Germany — [2]Max Planck Institute of Microstructure Physics, Halle, Germany

$La_{0.7}Sr_{0.3}MnO_3$ (LSMO) films were grown on vicinal (miscut angle 0.1°) $SrTiO_3$ (100) substrates by pulsed laser deposition at an oxygen partial pressure of 200 mTorr and a substrate temperature of 600°C. XRD and TEM cross-sectional investigations showed heteroepitaxial growth with excellent structural quality of the LSMO layer. Three films with thickness of 40, 15 and 5 nm, respectively, were selected for further magnetic characterization by SQUID magnetometry and ac susceptometry. In agreement with the high structural quality the films were found to be magnetically very soft with coercive fields below 1 mT near 100 K. These low coercivities enabled a detailed study of the coupling between the magnetic properties of the LSMO films and structural distortions that occur below the structural transition in the $SrTiO_3$ substrates. Below 105 K the development of a two-step transition in the magnetic response is clearly observed. This is discussed in terms of the formation of two different types of magnetic domains with different coercivities in the LSMO film as a response to twinning in the $SrTiO_3$ substrate.

MA 32.54 Fri 11:15 Poster E

Structure and magnetism of multiferroic hexagonal $HoMnO_3$ — •Jong-Woo Kim[1], Kathrin Dörr[1], Konstantin Nenkov[1], Ludwig Schultz[1], Bas B. van Aken[2], and Manfred Fiebig[2] — [1]Institute for Metallic Materials, IFW, Dresden, Germany — [2]HISKP, Universität Bonn, Germany

Multiferroics which show more than two ferroic orders simultaneously in the same phase have got considerable attention recently due to their academic and industrial significance. Among the candidates, hexagonal $HoMnO_3$ has been revealed as most promising single-phase multiferroics for its strong magnetoelectric effect [1,2]. We have grown twin-free epitaxial $HoMnO_3$ films of thicknesses from 25 nm to 1 μm on (111) Y:ZrO_2 (YSZ) substrates by pulsed laser deposition (PLD). Magnetization measurements reveal several anomalies related with magnetic Ho ordering in the magnetic field vs temperature phase diagram. These anomalies differ in details from those of single crystals, possibly due to the effect of epitaxial strain. We depict a rough phase diagram of both a $HoMnO_3$ film and a single crystal. With non-linear optics (second harmonic generation), the ferroelectric polar order of the films has been observed [3]. For the investigation of magnetoelectric properties, trilayer capacitor structures using an epitaxial Pt bottom electrode have been prepared. The electric polarization measurements show ferroelectric switching at 300 K.

[1] F. Yen, et al., Phys. Rev. B 71, 180407 (2005)
[2] T. Lottermoser, et al., Nature 430, 541 (2004)
[3] J.-W. Kim et al., Appl. Phys. Lett. 90, 012502 (2007)

MA 32.55 Fri 11:15 Poster E

Current and Field Induced Domain-Wall Motion in Permalloy Nanowires — •Gesche Nahrwold, Lars Bocklage, Hannah Ziehlke, Toru Matsuyama, Ulrich Merkt, and Guido Meier — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstraße 11, 20355 Hamburg

Magnetic domain walls in nanowires have attracted a lot of interest because of their possible application in logic and memory devices. A novel concept is based on electric currents that push magnetic domain walls along nanowires. This motion can be detected by measuring the anisotropic magnetoresistance (AMR)[1]. We present results obtained in curved permalloy wires where domain walls are pushed by current pulses with durations in the nanosecond range. By an externally applied magnetic field the domain wall is induced at a well defined position in the curved region of the wire. Measurements of the AMR verify the presence of the walls. The resistance values before and after a current pulse indicate whether the domain wall has been depinned and moved out of the wire or not. We observe a strong dependence of the depinning efficiency on the pulse length with a threshold of 1 ns. We found indications that deposition at elevated substrate temperatures is promising to attain a higher quality of the permalloy which is essential to avoid unwanted pinning centres for domain walls. Films sputtered at 400 °C have a dramatically smaller specific resistance compared with those sputtered at room temperature. [1] L. Thomas, M. Hayashi, X. Jiang, R. Moriya, C. Rettner, and S. S. P. Parkin, Nature 443, 197 (2006).

MA 32.56 Fri 11:15 Poster E

Current induced switching in MgO-based MTJs with applied bias fields — •Markus Schäfers, Andy Thomas, Karsten Rott, and Günter Reiss — Bielefeld University, Universitätsstraße 25, D-33615 Bielefeld, Germany

The spin-torque effect in magnetic tunnel junctions can be used in future MRAM applications to minimize the size of the memory cell. To provide high read and write performance of such an MRAM modul the switching behaviour of the free layer in the magnetic tunnel junction must be well understood.

We prepared sub-μm-sized MTJs based on CoFeB/MgO/CoFeB by e-beam lithography and argon ion beam etching. The dependence of critical current density for switching the free layer on the applied bias field was investigated.

MA 32.57 Fri 11:15 Poster E

Magnetization dynamics triggered by THz magnetic field pulses — •Jakob Walowski[1], Zhao Wang[1], Benjamin Lenk[1], Malte Scherff[1], Markus Münzenberg[1], Mihail I. Lepsa[2], and Arno Förster[3] — [1]IV. Physikalisches Institut, Universität Göttingen, Germany — [2]Forschungszentrum Jülich (IBN-1) — [3]Fachhochschule Aachen

A gapped Al strip line structured on low temperature GaAs delivers a metal-semiconductor-metal contact, which acts as a fast photo conductive switch. Using ultrashort light pulses ($\sim$ 60 fs) from a Ti:Sapphire laser (pump beam), excites the carriers of the semiconductor (GaAs) and induces short electric pulses. A short magnetic pulse ($1-5$ ps, $\sim$ 400 mT, $\sim$ 20 mA depending on the gap shape) is generated during the current. This pulse triggers the magnetization dynamics of a thin film structured on top of the Al strip line. Changing the path length of the laser pump beam one can probe the magnetization dynamics by recording the Kerr rotation up to 1 ns after excitation (TRMOKE).

Increasing the area of the contact, by structuring the strip line interruption in a finger like shape, increases the current pulse and therewith the field pulse strength and delivers shorter pulses. A sub 10 ps response of the magnetic film is shown.

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MA 32.58 Fri 11:15 Poster E

Femtosecond laser Kerr microscopy — •Jie Li, Min-Sang Lee, Wei He, Björn Redeker, and Thomas Eimüller — Junior Research Group Magnetic Microscopy, Ruhr-University Bochum, D-44780 Bochum, Germany

We present a new femtosecond laser Kerr microscope which has both scanning and full-field imaging capabilities. This instrument combines a lateral resolution in the sub-micrometer regime with a temporal resolution of better than 100 fs. The magnetic sample is thermally pumped by the fundamental beam and probed by the frequency-doubled beam via the magneto-optical Kerr effect (MOKE) in polar or longitudinal geometry. Double lock-in technique using a photo-elastic modulator (50 kHz) and an optical chopper (80 Hz) leads to very high sensitivity. In the scanning mode a three-axis piezo stage with a sub-nanometer resolution and 400 μm scan range in all directions is used. Full-field Kerr microscopy is possible by destroying the lateral coherence of the laser light with a rotating disc and detecting the image with a CCD camera. A cryostat allows measurements in the temperature range from 3.5 to 450 K. Instrument controlling software, developed on Visual Studio .Net, enables multi-dimensional scans, e.g., the MOKE signal can be recorded for arbitrary combination of six parameters

(sample position, magnetic field, pump-probe delay time, and temperature). First time-resolved studies on Fe/Gd, Co/Ni and Co/Pt multilayer systems will be presented.

Financial support by the DFG via project SFB491-N1 is gratefully acknowledged.

MA 32.59 Fri 11:15 Poster E

Layer resolved magnetization dynamics in coupled ferromagnetic bilayers using time resolved X-ray magnetic circular dichroism — •Tobias Martin[1], Georg Woltersdorf[1], Christian Stamm[2], Hermann Dürr[2], Roland Mattheis[3], Christian Back[1], and Günther Bayreuther[1] — [1]Universität Regensburg, 93040 Regensburg — [2]Bessy, 12489 Berlin — [3]IPHT Jena e. V., 07745 Jena

Two ferromagnetic layers antiferromagnetically coupled by interlayer exchange, usually called a synthetic antiferromagnet, evolve to important layer systems for storage applications, e.g. as free layer in toggle-switching magnetic random access memory or as storage medium in hard disk drives. Because of the growing operation speed of such devices, the investigation of the magnetization dynamics in interlayer exchange coupled magnetic bilayers with layer resolution is of interest.

Here, interlayer exchange coupled $Co_{90}Fe_{10}/Ru/Ni_{81}Fe_{19}$ bilayers are investigated using time resolved X-ray magnetic circular dichroism in transmission. By detecting the dichroic signal at the Ni or Co L_3 absorption edge with time resolution, the magnetization dynamics of the individual magnetic layers is observed separately. Two different waveguide stack geometries allow for in-phase and anti-phase excitation of both layers using both, pulsed and continuous wave (cw) excitation. Using cw-excitation the layer resolution allows the direct observation of in-phase or anti-phase precession for acoustical and optical mode, respectively. With pulsed excitation we were able to observe a phase shift of the precessional signal due to coupling.

MA 32.60 Fri 11:15 Poster E

Spin dynamics in permalloy antidot lattices: Experiment and simulation — •Sebastian Neusser[1], Bernhard Botters[1], Jesko Topp[2], Jan Podbielski[2], Detlef Heitmann[2], and Dirk Grundler[1] — [1]Fakultaet fuer Physik E10, Technische Universitaet Muenchen, D-85748 Garching, Germany — [2]Institut fuer angewandte Physik, Universitaet Hamburg, Jungiusstr. 11, D-20355 Hamburg, Germany

Spin wave modes in a submicron antidot lattice structured into a polycrystalline Ni80Fe20 thin film are being investigated with both a broadband ferromagnetic resonance (FMR) technique in a coplanar waveguide setup [1] and time-dependent micromagnetic simulations. Comparison between experiment and simulations allows us to correlate FMR absorption lines with the spatio-temporal evolution of spin dynamics and magnon interference phenomena [1]. In our study we focus on the expected magnon mode splitting [2] in a periodic lattice. The authors thank the DFG for financial support via SFB668 and the "Nanosystems Initiative Munich (NIM)" funded within the German Excellence Initiative.

[1]J. Podbielski, F. Giesen, and D. Grundler, Phys. Rev. Lett. 96, 167207 (2006)

[2]J. Podbielski, D. Heitmann, and D. Grundler, unpublished.

MA 32.61 Fri 11:15 Poster E

Brillouin light scattering observation of the spin wave dynamics in magnonic crystals — •Andrii Chumak, Alexander Serga, and Burkard Hillebrands — FB Physik and FSP MINAS, TU Kaiserslautern, Germany

Artificial media based on periodic magnetic structures, so-called magnonic crystals, offer wide tunability of their electromagnetic parameters and are an excellent object for the investigation of linear and nonlinear spin-wave dynamics. We report on the design and test of one-dimensional yttrium-iron-garnet (YIG) film-based magnonic crystals. The periodical structure of grooves on the film surface was produced using photolithography and chemical etching techniques. The grooves were perpendicularly oriented with respect to the spin-wave propagation direction. The microwave spectra were measured for different crystal geometrical parameters and, in particular, for different depth of the grooves. Spectrum rejection bands were clearly observed. The bands width and deepness increase with increasing grooves depth. This can be explained by an increase of the interaction of the "pure" magnonic crystal (groove structure on the YIG film surface) with the underlaying uniform magnetic film. The reflection of spin wave packets, compression and localization (storage) in the magnonic crystal area were detected using the space- and time-resolved Brillouin light scattering technique.

MA 32.62 Fri 11:15 Poster E

Very fast domain wall (dw) propagation in permalloy nanowires under the influence of strong transversal fields — •Sascha Glathe and Roland Mattheis — IPHTJena e.V., A.-Einstein-Str.9, D-07745 Jena

The field driven dw movement was explored in 150 nm wide, 15 nm thick and 45000 nm long permalloy films, which are the sense layer of GMR-stacks. In addition to the usually applied longitudinal fields parallel to the wire axis we applied strong fields orthogonal to the wire axis. Under the influence of a transversal field of Ht = 50 kA/m we observed very high dw velocities of about 7000 m/s. This is about 4-5 times the maximum field driven velocity puplished in the literature [1]. We explain this fast dw propagation with the influence of the transversal field on the dw.

MA 32.63 Fri 11:15 Poster E

Non-linear influences of inhomogeneous current distribution on vortex dynamics — •Stellan Bohlens and Daniela Pfannkuche — I. Institut für Theoretische Physik, Universität Hamburg, Jungiusstraße 9, 20355 Hamburg

For the development of new memory devices it is important to investigate the mechanisms of coupling between magnetization and electrical current. The orientation of the local magnetization influences the current flow via the anisotropic magneto resistance (AMR). Vice versa the current influences the magnetization via its Oersted field and the spin-transfer-torque. We investigate the effect of inhomogeneous current distributions on different magnetization patterns by micromagnetic simulations. The mutual influence of inhomogeneous current distribution and magnetization pattern causes non-linear effects. Taking these effects into account interesting deviations occur compared to the homogeneous case. A vortex pattern excited by a homogeneous alternating current performs harmonic oscillations. If inhomogeneous current paths are taken into account the amplitude of the oscillation is strongly enhanced and deviations from the ellipsoidal orbit occur.

MA 32.64 Fri 11:15 Poster E

Brillouin light scattering microscopy on magnetization dynamics in spin torque nanocontacts — •Sebastian Hermsdörfer[1], Xavier Janssens[2], Sven Cornelissen[2], Maarten van Kampen[2], Helmut Schultheiss[1], Britta Leven[1], Andrei N. Slavin[3], Liesbet Lagae[2], and Burkard Hillebrands[1] — [1]Fachbereich Physik and FSP MINAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany — [2]IMEC, Kapeldreef 75, Leuven, Belgium — [3]Oakland University, Rochester, Michigan, USA

Here we report on investigations of the magnetization dynamics in spin-torque nanocontacts under the influence of an applied ac and dc current. The magnetic resonances are determined with Brillouin light scattering microscopy for different externally applied magnetic fields. For the observed resonance frequencies the spin-wave radiation patterns are studied with high spatial resolution. Furthermore, nonlinear effects are observed and can be explained by three-magnon-scattering. A shift of the power threshold for these nonlinear processes is observed when a dc current is applied in addition to the ac current. We demonstrate that the threshold and efficiency of the three-magnon-scattering can be strongly enhanced or reduced depending on the direction of the dc current. This is clear evidence that internal damping due to magnon scattering can be tuned by a dc current. Support by the DFG within the SPP 1133 and by the EC-MRTN SPINSWITCH (MRTN-CT-2006-035327) and EC-Dynamax (IST-033749) is acknowledged. MvK acknowledges the IWT Flanders for financial support.

MA 32.65 Fri 11:15 Poster E

Ferromagnetic resonance study of interlayer exchange-coupled NiFe/Ru/NiFe films. — Mohamed Belmeguenai[1], •Tobias Martin[1], Georg Woltersdorf[1], Vincent Baltz[2], Anna Suszka[2], Bryan Hickey[2], and Günther Bayreuther[1] — [1]Institut f. Exper. und Angew. Physik, Universität Regensburg, 93040 Regensburg — [2]University of Leeds, Leeds, UK

Vector network analyzer ferromagnetic resonance spectroscopy (VNA-FMR) was used to study the different excited modes of sputtered symmetric [NiFe(30nm)/Ru(d_{Ru})/NiFe(30nm)] and asymmetric [NiFe(13.6nm)/Ru(d_{Ru})/NiFe(27.2nm)] exchange-coupled Permalloy films with variable Ru thicknesses, d_{Ru}. Always an optic and an acoustic precessional mode is observed. For the conventional geometry with dc bias field and rf field perpendicular to each other the optic

mode was only observed over a limited field range. This restriction was overcome by orienting the bias and rf field parallel to each other. The variation of the mode frequencies with the dc field was directly related to the different magnetic states of the two NiFe layers. Interestingly, in asymmetric trilayers characteristic jumps were observed for the resonance field as a function of the dc bias field. This "anti-crossing"behavior is well reproduced by numerical simulations, as well as the effect of the biquadratic coupling on the mode frequency.

MA 32.66 Fri 11:15 Poster E

Femtosecond X-ray Spectroscopy on Ni — •Niko Pontius, Christian Stamm, Torsten Kachel, Marko Wietstruk, Hermann A. Dürr, and Wolfgang Eberhardt — BESSY m.b.H., Albert-Einstein-Str. 15, 12489 Berlin, Germany

We use fs x-ray pulses as a probe to investigate spin and electron dynamics of a thin Ni film that is excited by a fs laser pulse. Spin and orbital magnetic moments can be determined individually using sum rules of the x-ray magnetic circular dichroism (XMCD). In our pump-probe experiment, we unambiguously find that fs laser excitation is causing an ultrafast quenching of the spin moment, which is not compensated by a corresponding increase of orbital moment. As angular moment is conserved, we conclude that the quenched spin moment is transferred to the lattice on the fs time scale.

The experiments were performed at the BESSY Femtoslicing source. It is capable of generating x-ray pulses of about 100 fs duration with linear as well as circular polarization. The photon energies range from 400-1200 eV, allowing for x-ray absorption measurements of the 3d transition and rare-earth elements.

MA 32.67 Fri 11:15 Poster E

Bias dependence of the spin transfer torque in Fe/MgO/Fe — •Christian Heiliger[1,2], Paul M. Haney[1], and Mark D. Stiles[1] — [1]Center for Nanoscale Science and Technology, National Institute of Standards and Technology, Gaithersburg, MD 20899-6202 — [2]Maryland NanoCenter, University of Maryland, College Park, MD, 20742

Recent experiments [1,2] have reached contradictory conclusions regarding the out-of-plane component of the spin transfer torque in Fe/MgO/Fe tunnel junctions. We use ab initio calculations as well as model calculations to investigate the bias dependence of the spin transfer torque in tunnel junctions. We use the non-equilibrium Keldysh formalism implemented in a Korringa-Kohn-Rostoker method to calculate the spin transfer torque [3]. We find that under certain circumstances one can estimate the bias dependence of the spin transfer torque at small biases in terms of the non-equilibrium torques at the Fermi level for zero bias. In ideal Fe/MgO/Fe junctions we find a small linear dependence of the out-of-plane torque on voltage. However, this torque oscillates rapidly with layer thicknesses and should cancel in samples with realistic roughness. This work has been supported in part by the NIST-CNST/UMD-NanoCenter Cooperative Agreement.
[1] A. A. Tulapurkar et al., Nature 438, 339 (2005).
[2] J. C. Sankey et al., Phys. Rev. Lett. 96, 227601 (2006).
[3] C. Heiliger et al., J. Appl. Phys. (in press); arXiv:0711.2082.

MA 32.68 Fri 11:15 Poster E

Current-Induced Excitations in ferromagnetic Tri-Layer Nanopillars — •Malte Scherff, Markus Münzenberg, Anne Parge, Tore Niermann, and Michael Seibt — IV.Phys. Inst., Georg-August-Universität Göttingen

In this work we would like to present the results of angular momentum transfer studies of ferromagnet/ normal metal/ ferromagnet trilayer junctions with high magnetic fields. Magnetic field sweeps at different temperatures and orientations will be shown and compared with GMR-measurements for consistence.

All experiments have been performed on nanopillars with a diameter of ˜100 nm,which are fabricated in a simplified one step process: Holes are created into a thin PMMA film by e-beam lithography and filled with different metal layers by evaporation.

To improve the preparation parameters, structural analysis has been done by simple cross sectional views as well as accurate TEM measurements of lamella-samples prepared by focused ion beam.

The transport properties were obtained in a four point measurement configuration, where the differential resistance dV/dI was measured by a lock-in technique in an external magnetic field. For sufficiently large DC current densities anomaly changes of resistance were observed(up to 20%). The dynamic and static changes of resistances at fields up to 5T suggest the existence of strong current driven inhomogenious magnetisation with vortex states in the layer system.

Also electrical aging effects of pillars during longer measurement periods are discussed. This work was supported by DFG, SPP 1133.

MA 32.69 Fri 11:15 Poster E

Spin tunneling in molecular magnets on a dissipative environment — •Juan Manuel Florez, Patricio Vargas, and Alvaro Nuñez — Physics Department, Universidad Técnica Federico Santa María, P.O.Box 110-V,Valparaíso, Chile

We report on our latest progress on the theoretical study of dissipative effects on the tunneling properties of the spin degree of freedom in molecular magnets. Starting from a simple microscopic model of the interaction between the molecule and an environment we characterize generic consequences of the dissipative effects on the tunneling process. The dynamic changes of the spin degree of freedom are evaluated within a suitable generalized instanton approximation in order to characterize the sensitivity of the tunneling variables to the degrees of freedom of the thermal environment. In particular the tunneling rates and their field dependence are described in detail.

MA 32.70 Fri 11:15 Poster E

Unusual NMR linebroadening and spin lattice relaxation in the Ca-doped S=1/2 spin chain compound $SrCuO_2$ — •Franziska Hammerath, Hans-Joachim Grafe, Anja Wolter, Vladislav Kataev, Patrick Ribeiro, Christian Hess, and Bernd Büchner — IFW Dresden, Institut für Festkörperforschung, Postfach 270116, 01171 Dresden

We present ^{63,65}Cu Nuclear Magnetic Resonance (NMR) measurements on undoped $SrCuO_2$ and Ca doped $Sr_{0.9}Ca_{0.1}CuO_2$ single crystals. The crystal structure contains one dimensional CuO_2 double chains that are magnetically decoupled. The system orders magnetically only below 1.5 K. Nevertheless, the Cu NMR spectra broaden already at temperatures below 100 K and show an anomalous two peak structure at low temperatures. For the Ca doped sample, this broadening is reduced. The reason for this unusual broadening is not known, but a similar broadening has been reported for the single chain compound Sr_2CuO_3. The spin lattice relaxation rate, $1/T_1$, is temperature independent. This is typical for spin chains and has also been reported for Sr_2CuO_3. Surprisingly, non-magnetic Ca induces a gap like behaviour in $1/T_1$.

MA 32.71 Fri 11:15 Poster E

Spin diffusion in metals: ab initio treatment of impurity scattering — •Peter Zahn, Martin Gradhand, Dmitry Fedorov, and Ingrid Mertig — Dept. of Physics, Martin Luther University Halle-Wittenberg, D-06099 Halle, Germany

One of the main issues of spintronics is the spin relaxation, which determines the spatial extension of spin accumulation in Spin Hall experiments, and the spin diffusion length in spin injection experiments. We consider the Elliott-Yafet mechanism caused by the scattering at point defects. The electronic structure of the metallic host and the perturbation of the potential in the vicinity of the defects is calculated in the framework of density-functional theory using a multiple scattering Green's function Korringa-Kohn-Rostoker scheme. The spin-orbit coupling is treated as a perturbation in first order of the Born series expansion of the transition matrix. In the first implementation of the formalism its action is restricted to the impurity site. Our calculations give the momentum and spin relaxation time of conduction electrons in Cu containing different types of impurities in good agreement with residual resistivity measurements and CESR results. The situation is less satisfying for the case of Al and Mg hosts with defects of comparable core charge. In these cases a relativistic treatment is necessary to obtain the so-called spin hot spots on the Fermi surface correctly. These states with a strong spin-mixed character cause a strong spin relaxation due to the chemical potential scattering by the defects. First results are discussed.

MA 32.72 Fri 11:15 Poster E

Rabi Oscillations in a Mn doped Quantum Dot — •Doris E. Reiter[1], Svea Sauer[1], Vollrath Martin Axt[2], and Tilmann Kuhn[1] — [1]Institut für Festkörpertheorie, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str.10, 48149 Münster — [2]Institut für Theoretische Physik III, Universität Bayreuth, 95440 Bayreuth

The understanding of spin flips in diluted magnetic semicondutors is of fundamental interest for the application to quantum technologies. Re-

cent experimental results prove the fabrication of a single semiconductor quantum dot with a single Mn atom. When an exciton is present in this system the PL line splits up, clearly showing the influence of the Mn spin. We analyze the ultrafast dynamics of exciton and Mn spin after optical excitation in the presence of the Mn-exciton exchange interaction. The temporal behavior of both exciton state and Mn state exhibits a spin flip, which can also be described by Rabi oscillations between a bright and a dark exciton state accompanied by oscillations in the spin orientation of the Mn atom. By means of ultrashort laser pulses the Mn spin can thus be raised or lowered by one on a time scale of a few picoseconds.

MA 32.73 Fri 11:15 Poster E

Investigation of multiferroics with ultrafast nonlinear optics — •Tim Günter[1], Tim Hoffmann[1], Takuya Satoh[2], Thomas Lottermoser[1], and Manfred Fiebig[1] — [1]HISKP, Universität Bonn, Germany — [2]Institute of Industrial Science, University of Tokyo, Japan

The dynamic properties of multiferroics and thin multiferroic films (except $BiFeO_3$) have been rarely studied so far. Here, a femtosecond laser setup is introduced that allows us to investigate both aspects. High time resolution is required for the investigation of dynamical properties and high peak intensities are needed for obtaining detectable SHG signal from thin films. In our fs-laser setup we use an amplified 130 fs Ti:Sapphire laser with 2,5 mJ pulse energy for operating two independent workplaces. Each branch is supplied with an optical parametric amplifier covering a wavelength range from 520 nm to 2600 nm. In the first branch, we use a pump-and-probe setup where optical second harmonic generation (SHG) is employed as probe process because many multiferroics are antiferromagnetic. Delays of up to 12 ns are set by use of a four-pass delay line. By setting different polarization configurations for each delay time, both the amplitude and the phase of the SHG signal are determined with high accuracy. In the second branch, the domain topography of thin multiferroic films is investigated. For this purpose, a transmission and reflection SHG setup with a CCD camera as detector is used. First experiments on the magnetization dynamics of magnetoelectric Cr_2O_3 and the magnetic properties of multiferroic $HoMnO_3$ films are reported.

MA 32.74 Fri 11:15 Poster E

The role of bandstructure on the ultrafast magnetization dynamics — •Daniel Steil, Tobias Roth, Mirko Cinchetti, and Martin Aeschlimann — TU Kaiserslautern, Erwin-Schrödinger Str. 46, 67663 Kaiserslautern

Herein we report on the effect of the electronic bandstructure on the spin dynamics. In a comparative study the 3d ferromagnet Co and the Heusler alloy Co_2MgSi, both with strongly deviating bandstructures, were investigated by means of the time resolved MOKE. The focus was put on the ultrafast magnetization dynamics following an optical excitation with a high intensive femtosecond laser pulse. The behaviour of the first ultrafast demagnetization step is similar for both materials. In contrast, the process of thermalization between the participating subsystems is delayed in the case of the Heusler alloy. We ascribe this as a distinct signature of a blocked Elliot-Yafet like scattering due to the bandgap in Co_2MgSi.

MA 32.75 Fri 11:15 Poster E

Investigating the Spin Dynamics in Nanostructures at Finite Temperature — David Bauer, Samir Lounis, Phivos Mavropoulos, and •Stefan Blügel — Institut für Festkörperforschung, Forschungszentrum Jülich

Reading and writing magnetic information on the nanometer scale is one of the key issues in magnetism for information technology. We investigate the dynamics of the magnetization in nanoscale systems on the basis of a classical spin model including e.g. Heisenberg exchange, magnetic anisotropy and an external magnetic field. The spin-system is coupled to a heat-bath through a stochastic force within the Langevin approach [1]. This requires the solution of the stochastic Landau-Lifschitz equations. The pairwise exchange interaction parameters entering our atomistic model are extracted from density functional theory (DFT) calculations. We present preliminary results on the spin dynamics of different nano-objects like monoatomic chains and small islands and investigate the relaxation of the spin-system upon different external parameters such as change of temperature or external magnetic field. Moreover, the thermodynamical properties are shown to be in excellent agreement to those obtained by Monte Carlo simulations. We gratefully acknowledge financial support from ESF project Self-Assembled Nanoscale Magnetic Networks.

[1] V. P. Antropov, S. V. Tretyakov, and B. N. Harmon, J. Appl. Phys. **81**, 3961 (1997).

MA 32.76 Fri 11:15 Poster E

Current-induced effects in exchange-biased layers — •Alina M. Deac[2,1], Yuichi Otani[1], Takekazu Yamane[2], Akio Fukushima[1], Hitoshi Kubota[1], Shinji Yuasa[1], and Yoshishige Suzuki[1,2] — [1]Nanoelectronics Research Institute, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan — [2]Graduate School of Engineering Science, Osaka University, Osaka, Japan

Exchange-biasing a magnetic layer might improve the peak-shape of microwave signals induced by a spin-polarized current. FM/AFM bilayers also constitute systems which may provide experimental proof of spin-transfer induced effects in AFM layers. We analyzed spin-transfer effects in two types of pillars: (A) IrMn5/CoFe5/Cu4/CoFe3/IrMn5 and (B) IrMn5/CoFe5/Cu4/CoFe3/Cu3/IrMn5 (thickness in nm) [3]. For structure A, both CoFe layers are pinned; for B, the exchange bias between the top CoFe and IrMn layers is cancelled by inserting the 3 nm Cu layer, so the top CoFe layer is free. The top IrMn layer was kept in B (reference) to insure that the current polarization throughout the pillar remains the same as for A samples, and the measured magnetoresistance is similar. While B pillars exhibit the typical trends of current-induced effects in free layers, the behavior of A samples is consistently different. By applying enough current, both exchanged-biased layers can be switched, partially or completely. Above a given current threshold, these effects become irreversible, indicating that an area of the antiferromagnetic layer has changed orientation. The initial state can be recovered by field re-annealing the samples.

MA 32.77 Fri 11:15 Poster E

Exchange coupling in Fe/NiO bilayers grown on vicinal Ag(001) surface — Yizheng Wu[1,2], Jia Li[1,2], Xiuli Fu[1], Fikret Yildiz[1], Xiaodong Ma[1], •Marek Przybylski[1], and Jürgen Kirschner[1] — [1]Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle, Germany — [2]Department of Physics, Fudan University, Shanghai, China

Exchange bias is known as a magnetic coupling phenomenon at ferromagnetic (FM) - antiferromagnetic (AFM) interfaces with strong implications for magnetic field sensor applications, read heads, and modern approaches to spintronics. For complete understanding of the physical origin of the exchange bias, it requires the capability to measure and manipulate the anisotropy of the AFM spins. For example, different out-of-plane anisotropy is reported for AFM films grown on different substrates. We found that the in-plane anisotropy can be tailored by atomic steps if growing the AFM films on a stepped surface. We report on the exchange coupling in Fe/NiO bilayers grown on a Ag(10,1,1) surface with 8^o vicinal angle. The step induced anisotropy in the NiO film was confirmed by XMLD technique. MOKE measurements show that there is perpendicular coupling between Fe and NiO spins. The magnetic anisotropy in the NiO film makes the exchange bias strongly dependent on the cooling field direction. The magnetization of Fe films tilts by a small angle out of the surface plane when the film is grown on a Ag vicinal surface. Placing an antiferromagnetic NiO layer between the Fe film and the Ag(10,1,1) substrate further forces the Fe spins to be oriented away from the surface plane.

MA 32.78 Fri 11:15 Poster E

Spin structure in PLD-grown Fe films on Cu(001) in- and out-of-plane magnetic profile from soft x-ray resonant magnetic reflectivity — J.-M. Tonnerre[1], Y. Gabi[1], H. C. N. Tolentino[1], H. L. Meyerheim[2], F. Yildiz[2], X. L. Fu[2], •M. Przybylski[2], A. Ramos[3], E. Bontempi[3], U. Staub[4], and J. Kirschner[2] — [1]Institut Neel, CNRS and Universite Joseph Fourier, B.P 166, 38042 Grenoble, France — [2]Max-Plank-Institut für Mikrostrukturphysik, 06120 Halle, Germany — [3]Universita di Brescia, via Branze, 25123 Brescia, Italy — [4]Swiss Light Source, Paul Scherrer Institut, 5232 Villigen, Switzerland

X-ray resonant magnetic reflectivity in the soft x-ray range (SXRMR) allows the investigation of the magnetic profile in thin films with chemical and orbital selectivity. We investigated the spin reorientation transition in pulsed laser deposited (PLD) Fe films on Cu(001). Three samples were prepared (4, 6 and 8 monolayers (ML) thick) capped by 3 nm of Au. From magneto-optic Kerr effect (MOKE) measurements it is known that at 160 K the 4 ML sample exhibits an in-plane easy magnetization axis while out-of-plane easy axis is found for 8 ML. At 6 ML coverage both in-plane and out-of-plane hysteresis loops are found.

The SXRMR experiments were carried out at the Swiss Light Source (SLS). The photon energy dependent dichroic difference $I^+ - I^-$ and the asymmetry ratio $R = (I^+ - I^-)/(I^+ + I^-)$ were collected in the vicinity of the Fe $L_{2,3}$ edges either by reversing the helicity of the light or the applied magnetic field. While for the 4 ML film in-plane ferromagnetic order is derived, the spectra for the 6 and 8 ML films can be interpreted by a noncollinear spin structure.

MA 32.79 Fri 11:15 Poster E

Strong perpendicular anisotropy in $Fe_{1-x}Co_x$ alloy films grown on Pd(001), Ir(001) and Rh(001) — •Fikret Yildiz, Feng Luo, Xiaodong Ma, Aimo Winkelmann, Marek Przybylski, and Jürgen Kirschner — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle, Germany

The orbital magnetic moment and magnetic anisotropy can be increased due to a tetragonal distortion in a system with bulk-like coordination. A model system is provided by $Fe_{1-x}Co_x$ alloy films which are distorted due to their pseudomorphic growth on substrates of mismatching lattice constant like Pd, Ir or Rh. We have shown that the $Fe_{1-x}Co_x$ alloy films of the composition around $x = 0.5$ show a maximum perpendicular anisotropy when their cubic lattice is tetragonally distorted. With increasing film thickness the well ordered tetragonally distorted film fraction contributes less to the film volume causing the easy magnetization axis to be oriented in the film plane. Moreover, anisotropy depends strongly on the temperature. In the case of the $Fe_{1-x}Co_x$ films grown on Pd(001) it results in the easy magnetization axis oriented out-of-plane only at low temperatures even for the 15 ML thick films. Only the films grown on Rh(001) show out-of-plane easy magnetization axis at room temperature in a broad thickness and composition range. This allows studying how the orbital moment and the magnetic anisotropy develop with increasing film thickness and with varying temperature of the sample.