MA 33: Poster II

Time: Friday 11:00–14:00 Location: Poster B1

MA 33.1 Fri 11:00 Poster B1

Exact-exchange spin density functional study of quantum rings: Successive spin Wigner transitions and spin magnetization of the ground state. — •Thorsten Arnold, Marc Siegmund, and Oleg Pankratov — Lehrstuhl für Theoretische Festkörperphysik, Universität Erlangen-Nürnberg, Staudtstr. 7/B2, 91058 Erlangen, Germany

We employ exact-exchange spin density functional theory to study correlated electrons on one-dimensional (1D) and two-dimensional (i.e. with finite width) quantum rings. The rings are threaded by a magnetic flux confined to the ring center, which induces a persistent current. A weak impurity potential is introduced to break the rotational symmetry. The strength of electron-electron interaction relative to kinetic energy described by parameter r_s is varied. The Fermi liquid state and the Wigner crystal state can be distinguished by resorting to the spin-resolved densities, currents and electron localization functions. Fixing the spin magnetization to admissible non-vanishing values, we found the amplitude of the spin density wave, the magnitude of the persistent current drop and the degree of electron localization to be different for spin-up and spin-down electrons. The transition point of Wigner crystallization is found at $r_s < 1$. It crucially depends on the (effective) width of the ring. Relaxing the constraint of the spin magnetization, (for the case of the 1D ring), three ground state regimes are identified: an unpolarized Fermi liquid, an antiferromagnetic Wigner crystal and a fully polarized Fermi liquid. The transitions between these states occur in the range of rather small r_s values ($r_s < 1$).

MA 33.2 Fri 11:00 Poster B1

Electronic and Magnetic Properties of Transition Metal Fluorides from first principles — •Guntram Fischer[1], Waheed Adeagbo[1], Hossein Hashemi[1], Arthur Ernst[2], Martin Lüders[3], Zdzislawa Szotek[3], Walter Temmerman[3], and Wolfram Hergert[1] — [1]Institute of Physics, MLU Halle-Wittenberg, Von-Seckendorff-Platz 1, 06120 Halle, Germany — [2]Max Planck Institute for Microstructure Physics, Weinberg 2, 06120 Halle, Germany — [3]Daresbury Laboratory, Daresbury, Warrington, WA4 4AD, UK

We performed a multi-code *ab initio* investigation of the electronic and magnetic properties of the insulating and antiferromagnetic transition metal fluorides MnF_2, FeF_2, CoF_2, and NiF_2. To treat the strong correlations adequately we used self-interaction corrections within a KKR multiple scattering approach[1] and the LDA+U method with the plane-wave pseudopotential code VASP[2]. Heisenberg interaction parameters were calculated via a magnetic force theorem[3] and also via total energy differences. Resulting critical temperatures were obtained using Mean Field Approximation, Random Phase Approximation and Monte Carlo simulations and compared to experiment and other theoretical results. Spinwave dispersions were calculated as well and discussed.

[1] M. Lüders et al., Phys. Rev. B **71**, 205109 (2005)
[2] G. Kresse and J. Furthmüller, Phys. Rev. B **47**, 558 (1993)
[3] A.A. Liechtenstein et al., JMMM **67**, 65 (1987)

MA 33.3 Fri 11:00 Poster B1

Low-voltage gating of ferromagnetic GaMnAs structure — Sam Owen[1,2], Joerg Wunderlich[1,3], Andrew Irvine[2], Zbynek Soban[3], Kamil Olejnik[1,3], Tomas Jungwirth[3], and •Vit Novak[3] — [1]Hitachi Cambridge Laboratory, Cambridge, UK — [2]Microelectronic Research Centre, Cavendish Laboratory, University of Cambridge, UK — [3]Institute of Physics ASCR, Praha, Czech Republic

We report on low-voltage control of magnetic properties of a p-n junction field effect transistor via depletion effect in the ferromagnetic semiconductor channel. We show variable Curie temperature and anisotropic magnetoresistance, and demonstrate magnetization switchings induced by short electrical pulses of a few volts. The gatable ferromagnetic device is realized in an all-semiconductor epitaxial structure and offers a pricipally faster operation than the metal-oxide-semiconductor structures reported so far.

MA 33.4 Fri 11:00 Poster B1

Ferromagnetic resonance study on highly doped $(Ga_{1-x}Mn_x)As$ films — •Matthias Kiessling[1], Georg Woltersdorf[1], Vít Novák[2], and Christian Back[1] — [1]University of Regensburg, Universitätsstrasse, 31, 93053 Regensburg, Germany — [2]Institute of Physics ASCR, Cukrovarnická 10, Prague, 16253, Czech Republic

We studied highly doped $(Ga_{1-x},Mn_x)As$ films grown by low temperature molecular beam epitaxy (LT-MBE) having a Mn concentration of $x = 12.5\%$ and a nominal thickness of 20 nm. All samples were annealed in air for 6 hours at 160°C. SQUID measurements reveal Curie temperatures of about 184 K. Ferromagnetic Resonance measurements performed from 8 to 18 GHz show that the magnetic anisotropy is dominated in the temperature range (10 - 180 K) by a large uniaxial anisotropy (K_u) pointing along the [1-10] crystallographic direction. $K_u = 1.64 * 10^4$ erg/cm^3 at 35 K is an order of magnitude larger than the fourfold magnetocrytalline anisotropy. The frequency dependence of the FMR line width $\Delta H(\omega)$ is used to study the magnetic relaxation. The Gilbert damping parameter α is found to be very small ($\alpha = 0.003$ - 0.0044 at 60 K) compared to previous studies [1,2]. Inhomogeneous broadening of the line width $\Delta H(0)$ due to variation of the magnetic properties in the sample or due to two magnon scatter observed at 10 K decrease with increasing temperature. In order to distinguish between magnetic inhomogeneities and two magnon scattering measurements are performed in the perpendicular configuration. [1] J. Sinova, PRB 69, 085209 (2004); [2] Y.H. Matsuda, Physica B 376-377, 668-671 (2006)

MA 33.5 Fri 11:00 Poster B1

Cross-sectional STM investigations of manganese diffusion in GaAs based heterostructures — •Gerhard Münnich, Martin Utz, Dieter Schuh, and Jascha Repp — Institute of Experimental and Applied Physics, University of Regensburg, 93040 Regensburg, Germany

GaMnAs is a ferromagnetic semiconductor that has recently attracted a lot of scientific interest [1]. One possible application of GaMnAs may be using it for spin-injection into GaAs-based functional heterostructures. Recent studies addressed the influence of a non-equilibrium ($T \approx 250°C$) grown GaMnAs layer on the performance of such heterostructures below.

These investigations showed that photoluminescence was quenched as a result of the GaMnAs layer, even though the GaMnAs layer was 10nm away from the optically active layer. This was attributed to possible back-diffusion of manganese into adjacent layers [2].

We addressed this issue in real space by using cross-sectional STM. As a first result of our work, we can give an upper boundary of the Mn content to diffuse into the GaAs.

[1] Sanghoon Lee et. al., Mater. Today **12**, 14 (2009)
[2] R. Schulz et. al., Physica E **40**, 2163 (2008)

MA 33.6 Fri 11:00 Poster B1

Magnetic aftereffect in compressively strained GaMnAs resolved by Kerr microscopy — •Liza Herrera Diez[1], Jan Honolka[1], Klaus Kern[1], Helmut Kronmüller[2], Ernesto Placidi[3], Fabrizio Arciprete[3], Andrew Rushforth[4], Richard Campion[4], and Bryan Gallagher[4] — [1]Max-Planck-Institut für Festkörperforschung, Stuttgart, Germany — [2]Max-Planck-Institut für Metallforschung, Stuttgart — [3]Dipartimento di Fisica, Università di Roma "Tor Vergata" — [4]School of Physics and Astronomy, University of Nottingham

The correlation between carrier density and magnetic properties like Tc [1] or the magnetic anisotropy [2] in GaMnAs enables the tuning of magneto-transport properties and opens new ways for magneto-logic devices[3]. However, a full control over magnetic reversal dynamics mediated via nucleation and propagation of domain walls (DWs) is required. While magneto-transport measurements like e.g. the planar Hall effect only give spatially averaged information about DW dynamics we use Kerr microscopy to track individual in-plane domains in space and time[4]. In this work we specifically address the influence of the magnetic aftereffect on the dynamics.

References

[1] T.Dietl et al., Science 287, 1019 (2000). [2] T.Dietl, H.Ohno, and F.Matsukura, Phys. Rev. B 63, 195205 (2001). [3] D.Chiba, M.Yamanouchi, F.Matsukura, H.Ohno, Science 301, 943 (2003). [4] L. Herrera Diez et al., Phys. Rev. B 78, 155310 (2008).

MA 33.7 Fri 11:00 Poster B1

Electronic localization and variable-range-hopping transport in GaMnN and GaGdN epitaxial layers — •Amilcar Bedoya-Pinto, Martin Roever, Dong-Du Mai, Joerg Malindretos, and Angela Rizzi — IV. Physikalisches Institut, Georg-August-Universität Göttingen, Germany

The interplay between magnetic and transport phenomena has been found to be a key issue to understand the origin of ferromagnetic coupling in dilute magnetic semiconductors (DMSs), as in the case of GaMnAs. Regarding III-V nitride DMSs, while there is a considerable number of reports based on magnetometry, only a few studies are devoted to the electrical transport behavior. In this sense, GaMnN and GaGdN epitaxial layers have been grown by molecular-beam epitaxy on both 6H-SiC and GaN:C highly-resistive substrates. Magnetic characterization was performed by SQUID-magnetometry. Temperature-dependent resistivity measurements of GaMnN layers show a transition from n-type activated transport to variable-range-hopping (VRH) as the Mn-concentration is increased. Regarding GaGdN layers, on the other hand, the observation of VRH-transport at low Gd-concentrations ($\sim 10^{16}\mathrm{cm}^{-3}$) and the evaluation of the inferred hopping parameters suggest that not Gd itself, but Gd-induced defect states are the effective source for electronic localization. In both cases, the relation between magnetic and electrical transport properties is discussed taking into account the well-established models of ferromagnetic coupling in DMSs, as well as recent models proposing defect-induced magnetism in wide band-gap III-Nitrides.

MA 33.8 Fri 11:00 Poster B1

Hydrogen mediated ferromagnetism in ZnO single crystals — •Khalid Muhammad[1], Esquinazi Pablo[1], Spemann Daniel[2], Anwand Wolfgang[3], and Brauer Gerhard[3] — [1]Division of Superconductivity and Magnetism, University of Leipzig, 04103 Leipzig, Germany — [2]Division of Nuclear Solid State Physics, University of Leipzig, 04103 Leipzig, Germany — [3]Institut für Ionenstrahlphysik und Materialforschung, Forschungszentrum Dresden-Rossendorf, 01314 Dresden, Germany

We have investigated the magnetic properties of hydrogen (H) plasma treated ZnO single crystals. The H-concentration before and after H-plasma treatment has been determined by using nuclear reaction analysis. The H-concentration after treatment was found $\simeq 0.6$ at%. The magnetic properties of H-plasma treated ZnO single crystals have been investigated by SQUID magnetometry. Hysteresis loops applying magnetic fields parallel and perpendicular to the plane of the sample were measured at 5 and 300 K for each sample revealing magnetic anisotropy. We have observed a giant enhancement of magnetization in H-plasma treated ZnO samples. The ferromagnetic Curie temperature was found to be above 400 K. The saturation magnetization at 300 K was ~ 10 emu/g, several orders of magnitude higher than that reported in literature. In order to investigate the penetration of H-ions in the ZnO single crystals we have etched the surface of the samples. We found that most of the sample ferromagnetic moment vanishes after etching the first 20 nm layer in agreement with the expected H-penetration depth.

MA 33.9 Fri 11:00 Poster B1

Magnetic field induced changes of the magnetic phase transition in metastable zincblende MnS layers grown by MBE — •Manuel Demper[1], Limei Chen[1], Christine Bradford[2], Hans-Albrecht Krug von Nidda[3], Kevin A. Prior[2], Alois Loidl[3], and Wolfram Heimbrodt[1] — [1]1Department of Physics and Material Science Center, Philipps-University Marburg — [2]School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh — [3]Center for Electronic Correlation and Magnetism, University Augsburg

The continuous decrease of magnetic structures meets fundamental limits. Hence, it is essential to understand the magnetic interactions in low dimensions. Therefore, we investigated the 3D-2D transition on a series of MBE grown antiferromagnetic zincblende MnS-layers with various thicknesses by using magnetic photoluminescence techniques. The MnS photoluminescence spectra exhibit a strong yellow emission band which belongs to the internal $^4\mathrm{T}_1 \rightarrow {}^6\mathrm{A}_1$ transition of the manganese ions in a tetrahedral crystal field. The temperature evolution of this emission reveals a characteristic red-shift towards the Néel-Temperature due to the energy relaxation of the Mn d-states in the antiferromagntic phase. This optical access has been used to study the influence of the 3D-2D transition and the effect of an external magnetic field on the magnetic properties of the MnS layers. Surprisingly, no clear effect was found on the phase transition temperature with decreasing MnS-layer thickness but on increasing external magnetic fields for the thinnest layers. This unique behavior will be discussed in detail.

MA 33.10 Fri 11:00 Poster B1

Influence of exchange and correlation on the magnetic ground state of MnO — •Andreas Schrön, Claudia Rödl, and Friedhelm Bechstedt — Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany

Transition-metal oxides (TMOs) are of great interest for applications in e.g. dilute magnetic semiconductors (DMSs) which are supposed to allow for transparent ferromagnets with critical temperatures around room temperature. Although TMOs have been investigated a long time experimentally, their theoretical description is still unsatisfying. (Semi-)local approximations like local spin-density approximation (LSDA) or generalized-gradient approximation (GGA) to density functional theory (DFT) work well for many materials, but fail for TMOs, since they do not account sufficiently for the electron correlation effects.

We present an *ab-initio* study of structural, electronic, and magnetic properties of MnO within the DFT framework. Results obtained within GGA are compared with findings taking into account an additional on-site Coulomb interaction U (GGA+U) and results using the non-local hybrid exchange-correlation functional HSE03. Besides the rock-salt structure, which is the natural ground-state structure of MnO, we focus especially on the properties of MnO in the hypothetical wurtzite structure, the ground-state structure of e.g. ZnO, a potential host material for DMSs. We present our results considering six different magnetic orderings for both crystal structures, respectively, and compare them with experimental and other theoretical data.

MA 33.11 Fri 11:00 Poster B1

Origin of Resonance Structures in Magneto-optical Spectra of InMnSb and InSb — •Christoph Thurn and Vollrath Martin Axt — Theoretische Physik III, Universität Bayreuth, D-95440 Bayreuth, Germany

We have calculated the magneto-optical Kerr and the magnetic circular dichroism spectra of ferromagnetic $\mathrm{In}_{0.985}\mathrm{Mn}_{0.015}\mathrm{Sb}$ and intrinsic InSb using an eight band $\vec{k}\cdot\vec{p}$ model accounting for the coupling to external magnetic fields $B = 0.4 \ldots 8$ T as well as for the mean-field exchange coupling between holes and Mn spins.

The numerical results show that for InSb the spectra exhibit narrow and distinct resonances which can be associated with dipole-allowed transitions between the Landau levels in conduction and valence bands. With increasing B the Landau and the Zeeman splitting increase, and the observed peaks change their position and amplitude accordingly.

Contrarily, the calculated spectra of the diluted magnetic semiconductor InMnSb show only one strong and broad resonance. The shape and position of this resonance does not change with B. It is found, however, that the amplitude depends linearly on the magnetization M of the samples. Nota bene: B can easily exceed $\mu_0 M$. An involved analysis of the band structure and the dipole transitions explains these features. In particular, the spectra of InMnSb are dominated by intravalence band transitions. Our results are in excellent agreement with measurements performed by A. Winter and H. Pascher.[1]

[1]C. Thurn, V. M. Axt, A. Winter, H. Pascher, H. Krenn, X. Liu, J. K. Furdyna, and T. Wojtowicz, Phys. Rev. B **80**, 195210 (2009)

MA 33.12 Fri 11:00 Poster B1

Electrodeposited $\mathrm{Fe}_{(100-x)}\mathrm{Ga}_x$ thin films with high magnetostriction — •Diana Iselt[1,2], Heike Schlörb[1], Sebastian Fähler[1], and Ludwig Schultz[1,2] — [1]IFW Dresden, Institute for Metallic Materials, Helmholtzstr. 20, 01069 Dresden — [2]TU Dresden, Faculty of Mechanical Engineering, 01062 Dresden

Magnetostrictive materials can be used to build up electromagnetic sensing and actuating devices. A promising candidate to overcome the mechanical limitations of Terfenol-D is $\mathrm{Fe}_{(100-x)}\mathrm{Ga}_x$ with 15 to 25 at.% Ga, which shows a high mechanical strength and low saturation fields. For the application as sensors thin films, ribbons and nanowires need to be produced in a cheap way over large areas. In this study a suitable deposition process for Fe-Ga alloy thin films has been developed using electrochemical pulse plating. By optimising the deposition parameters such as electrolyte composition, deposition potential, deposition time and pulse sequences, homogeneous (110)-oriented thin films with low oxygen content have been prepared. Preliminary inves-

tigations of magnetic properties correlated to magnetostriction will be presented and discussed in sense of shape anisotropy.

MA 33.13 Fri 11:00 Poster B1

Ni_2MnIn Heusler electrodes for spin valves — •Hauke Lehmann[1], Jeannette Wulfhorst[1], Andreas Vogel[1], Jan M. Scholtyssek[1,2], Guido Meier[1], and Ulrich Merkt[1] — [1]Institut für Angewandte Physik, Universität Hamburg, Jungiusstr. 11, 20355 Hamburg — [2]Institut für Elektrische Messtechnik und Grundlagen der Elektrotechnik, Technische Universität Braunschweig, Hans-Sommer-Str. 66, 38106 Braunschweig

Injection, manipulation, and detection of spin-polarized currents are fundamental issues in spintronics. We study the spin-dependent transport in lateral spin-valves [1, 2]. Nanopatterned, halfmetallic Ni_2MnIn Heusler electrodes are prepared by electron-beam lithography and lift-off processing. Post-growth annealing is utilized to achieve the ordered $L2_1$ crystal structure. Thin films grown on Si_3N_4 membranes are investigated in situ in a transmission-electron microscope using electron diffraction [3]. The local spin-valve effect is measured with a copper channel between the two Heusler electrodes. Transport measurements are performed at low temperatures around 2 K in external magnetic fields of up to $\pm$ 5 T. In further experiments we aim at the detection of the extrinsic spin-Hall effect which has attracted significant interest. All-electrically detection in spin valves is possible by two additional leads on the sides of the copper channel [4].

[1] A. Vogel et al., Appl. Phys. Lett. **94**, 122510 (2009)
[2] A. van Staa et al., Phys. Rev. B **77**, 214416 (2008)
[3] J. M. Scholtyssek et al., J. Crystal Growth **311**, 79 (2008)
[4] S. O. Valenzuela and M. Tinkham, Nature **442**, 176 (2006)

MA 33.14 Fri 11:00 Poster B1

Distortion of the magnetization dynamics by domain walls — •Philipp Pirro, Sebastian Hermsdörfer, Björn Obry, Helmut Schultheiss, Katrin Vogt, Peter Andreas Beck, Peter Clausen, Thomas Brächer, Britta Leven, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

Magnetic domain walls in soft magnetic thin film structures have attracted increasing attention during the last years due to their interaction with spin-polarized currents. The idea of new magnetic storage devices, the racetrack memories [1], was developed. An alternative solution to implement lateral spin transport are spin-waves which avoid a dissipative charge flow. New devices like spin-wave logic elements [2] can be constructed. In these devices, domain walls are supposed to play an important role [3]. The investigation presented is focused on the influence of magnetic domain walls on spin-waves. To analyze these interactions we use Brillouin Light Scattering Microscopy and Magnetic Force Microscopy. In the investigated $Ni_{81}Fe_{19}$-microstructures, domain walls can be nucleated and annihilated to study their influence on spin waves which are excited by the Oersted field of a microwave current flowing in a stripe antenna. Large effects of a domain wall on the spin-wave intensity are observed.

[1] S. S. P. Parkin, et al., Science 320,190 (2008)
[2] T. Schneider et al., Appl. Phys. Lett. 92, 022505 (2008)
[3] C. Bayer et al., IEEE Trans. Magn. 41, 3094 (2005)

MA 33.15 Fri 11:00 Poster B1

Noise characterization of a linearized submicron MTJ sensor array with CoFeB and Heusler alloy free-layers — •Peter Hedwig, Camelia Albon, Alexander Weddemann, and Andreas Hütten — Universität Bielefeld, Fakultät für Physik, Universitätsstr. 25, 33615 Bielefeld

Recently a lot of effort is put into the detection of magnetic particles and beads based on magnetoresistive elements, employing Spin-Valves, GMR and TMR elements. Most of these have a large size of several micrometers and are therefore of limited spatial resolution.

In our work, we present a submicron sensor-array based on linearized CoFeB/MgO/CoFeB-MTJs with a very high spatial resolution of below xy μm for the dynamic detection of magnetic markers, further extending the scope of possible applications as a "magnetic microscope".

The sensor-array is characterized by static bead measurements and also by measuring its noise performance. According theoretical calculations regarding the sensor-bead-interaction and the limits of detection under consideration of the signal-to-noise-ratio were carried out. Additionally first results for Heusler-Alloys as the free-layer material will be presented, indicating an improved noise performance over the standard CoFeB free-layer.

MA 33.16 Fri 11:00 Poster B1

Evolution of magnetoresistance in electromigrated ferromagnetic break junctions — •Arndt von Bieren[1], Ajit Kumar Patra[1], Stephen Krzyk[1], Jakoba Heidler[1], Jan Rhensius[1,2], Laura Heyderman[2], Regina Hoffmann[3], and Mathias Kläui[1] — [1]Fachbereich Physik, Universität Konstanz, Germany — [2]Laboratory for Micro- and Nanotechnology, Paul Scherrer Institut, Villingen, Switzerland — [3]Physikalisches Institut, Universität Karlsruhe, Germany

Recently, magnetotransport measurements of magnetic nanocontacts have led to a better understanding of the interactions between spin-polarized charge carriers and magnetization taking place at extremely small length scales. Here, we present the evolution of magnetoresistance (MR) in clean electrical break junctions. Ferromagnetic nanocontacts with variable constriction width are fabricated by performing in-situ controlled electromigration of notched magnetic half ring structures in UHV. Low temperature MR measurements, in agreement with micromagnetic simulations, indicate that the dominant contribution in Py ($Ni_{80}Fe_{20}$) contacts down to the size of a few nm is anisotropic magnetoresistance (AMR). Moreover, Ni shows enhanced AMR in constrictions approaching the atomic limit and high tunnelling anisotropic magnetoresistance (TAMR) after carefully opening the contact, suggesting that material-specific parameters such as the electron mean free path play a crucial role. By analyzing the angle-dependent MR we can furthermore extract the domain wall pinning strength of the constriction as a function of its size down to the atomic scale.

MA 33.17 Fri 11:00 Poster B1

Magnetic properties of ion beam induced ripple patterned Fe layers — •Felix Büttner, Hans Hofsäss, and Kun Zhang — II. Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen, Germany

There is a rapidly growing interest in nanopattered ferromagnetic films. Apart from fundamental investigations, one motivation is the search for materials which are ferromagnetic even at nanometer scale. It has been found that ion beam induced ripples of epitaxially grown Co induce a strong uniaxial magnetic anisotropy [1]. Comparable experiments with epitaxial Fe films on MgO [2] and polycrystalline Fe films on Si [3], both textured by ion beam erosion, showed similar magnetic properties. This study is about nanopattered thin epitaxial Fe layers grown on MgO by PLD. Pattering was done by grazing incidence sputter erosion using 5 keV Xe ions with a fluence of $1.8 \cdot 10^{17}$ ions cm^{-2}. We investigate the magnetic and structual properties of the nanopattered Fe layers as a function of the residual film thickness using MOKE, RBS and AFM. Both side polished MgO substrates were used to perform MOKE measurements of the Fe / MgO interface to determine the influence of the ion beam induced surface ripple patterns on the magnetic properties of the unirradiated underlying layer.

[1] D. Sekiba, R. Moroni, G. Gonella, F. Buatier de Mongeot, C. Boragno, L. Mattera and U. Valbusa, Appl. Phys. Lett. **84**, 762 (2004)
[2] Q. Zhan and K. Temst, Appl. Phys. Lett. **91**, 122510 (2007)
[3] K. Zhang, M. Uhrmacher, H. Hofsäss and J. Krauser, J. Appl. Phys. **103**, 083507 (2008)

MA 33.18 Fri 11:00 Poster B1

Mangnetic domain patterns in Co2MnGe Heusler thin film microstructures — Katherine Gross, •Philipp Szary, Melanie Ewerlin, Frank Brüssing, Alexandra Schumann, Oleg Petracic, Kurt Westerholt, and Hartmut Zabel — Institut für Experimentalphysik IV, Ruhr-Universität Bochum, 44780 Bochum, Germany

Cubic Heusler alloys like Co2MnGe are soft feromagnetic materials with a weak cubic crystalline magnetic anisotropy. Thin films of Co2MnGe can be grown on sapphire a-plane with a dominating growth-induced uniaxial magnetic anisotropy, which originate from the miscut of the single crystalline substrate. This feature makes this Heusler alloy ideally suited for the study of magnetic domain structures resulting from the competition between an uniaxial growth-induced magnetic anisotropy and the shape anisotropy in magnetic microstructures. Using electron beam lithography we have prepared rectangular stripes of Co2MnGe with the length to width aspect ratios m = l/b from m=1 to m=20. The magnetic domains are observed by magnetic force microscopy in the remanent state as well as with an applied magnetic field up to 600 Oe. We find regular, highly symmetric domain patterns in the stripes, changing systematically with the aspect ratio and

the applied magnetic field. When the uniaxial anisotropy is oriented perpendicular to the shape anisotropy, the domain width along the long axis of the stripes scales as 1/m. The essential features of the domain patterns we have observed could well be reproduced by OOMMF micromagnetic simulations.

MA 33.19 Fri 11:00 Poster B1

Anisotropy studies of individual micro structured elements using the magneto-optical Kerr effect (MOKE) — •Thomas Sebastian, Georg Wolf, Andrés Conca, Britta Leven, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

MOKE is a well established technique for the investigation of crystal- or induced anisotropies in homogenous magnetic films of layer stacks [1]. By the use of a micro focused probing laser-beam in combination with a positioning system in horizontal and vertical direction as well as a rotator with high resolution it is possible to expand this anisotropy studies to individual micron sized elements. The new rotating Kerr-microscope setup is the experimental realization of this concept.

On the micrometer-scale the influence of the demagnetizing fields - caused by the geometrical shape of the sample - is not negligible any longer and becomes even more important with decreasing size. With our new setup it is possible to observe the magnetization reversal for different orientations of the sample taking into account the contribution of the shape anisotropy. The poster presents first results obtained with this setup for CoFe- and NiFe-ellipses.

We acknowledge financial support by the BMBF VDI-TZ 13N9913: 'MultiMag-project'.

[1] J. Hamrle et al., Magnetic anisotropies and magnetization reversal of the $Co_2Cr_{0.6}Fe_{0.4}Al$ Heusler compound, J. Appl. Phys. 100, 103904 (2006)

MA 33.20 Fri 11:00 Poster B1

Antiferromagnetically coupled Fe/Cr/Fe micropatterns in a ferromagnetically coupled environment — •Roland Neb[1], Peter Andreas Beck[1], Thomas Sebastian[1], Philipp Pirro[1], Burkard Hillebrands[1], Stefan Pofahl[2], Rudolf Schäfer[2], Bernhard Reuscher[3], and Michael Kopnarski[3] — [1]FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany — [2]IFW Dresden, 01069 Dresden, Germany — [3]IFOS, 67663 Kaiserslautern, Germany

The exchange-coupled Fe/Cr/Fe-trilayer system is known to exhibit different kinds of coupling, depending on the thickness of the interlayer. We examine antiferromagnetically coupled trilayers which are magnetically patterned by focused ion beam irradiation with 30 keV Ga-ions. The irradiated regions become ferromagnetic, which allows us to create well defined areas with very low topographic inhomogenities where the two Fe layers couple ferromagnetically. We study antiferromagnetically coupled elements in a ferromagnetic environment using Kerr microscopy and MFM, showing that the coupling turns ferromagnetic when the elements are smaller than a few microns. The influence of the environment on the elements is analyzed by using different sizes and shapes of elements and environment, showing that the magnetic behavior of such elements is mainly driven by the surrounding ferromagnetic area.

Support from the Deutsche Forschungsgemeinschaft and Graduiertenkolleg 792 is gratefully acknowledged.

MA 33.21 Fri 11:00 Poster B1

Ensemble and single-object measurements of magnetic nanowires with modulated diameter — Kristina Pitzschel[1], Josep M. Montero Moreno[1,2], Stephan Martens[1], •Ole Albrecht[1], Julien Bachmann[1], and Kornelius Nielsch[1] — [1]Institute of Applied Physics and Microstructure Research Center Hamburg, University of Hamburg — [2]Electrodep., Dept. Physical Chemistry, Universitat de Barcelona

We utilize a porous alumina membrane as template with modulated diameter [1,2]. Filling the pores with Ni by electrodeposition delivers wires replicating the changes in diameter from 70 to 150 nm. These structures are ferromagnetic. Ensemble magnetic measurements by SQUID (Superconducting QUantum Interference Devic) and single-objetc measurements by Magneto-optical Kerr effect evidence a strong correlation between geometric parameters and magnetic properties. On the contrary to single-object measurements ensemble measuremets also show their dipolar interactions. Magneto-optical Kerr effect measurements on single wires reveal that motion of domain boundaries are blocked at certain changes in diameter. This demonstrates for the first time that domain wall motion can be controlled in nano-object prepared by a mass production method.[1] W. Lee et al., Nature Nanotech. 3, 234 - 239 (2008).[2] K. Pitzschel et al., ACS Nano 2009 3 (11), 3463-3468

MA 33.22 Fri 11:00 Poster B1

Magnetic and thermoelectrical measurement of multi-segmented Co/Cu nanowires — •Bastian Lie, Tim Böhnert, Johannes Kimling, and Kornelius Nielsch — Institut für Angewandte Physik, Universität Hamburg, Hamburg, Germany

Nanostructures, e.g. modulated nanowires, reveal quantum effects due to their size which are advantageous for thermoelectrical applications. The thermoelectric properties depend on phonon- and electron-scattering in a material. We prepared high aspect-ratio multisegmented cobalt/copper nanowires and measured the thermal conductivity and the giant magnetoresistance (GMR). The desired approach for the preparation is the bottom-up method. In our case the single-bath-electrodepostion of cobalt and copper in eloxated alumina templates is applied by means of galvanostatic and potentiostatic deposition to fabricate alternating segments with a thickness of several nm's. The thickness of the copper layer is varied to validate the oscillation of the GMR-ratio dependant on the spin diffusion length. We will present details of the sample processing, magnetoresistance measurements and 3ω-measurements.

MA 33.23 Fri 11:00 Poster B1

Structural, electrical and magnetic properties of single Au-Ni/NiO-Au nanowires — •Corinna Steinweg[1], René Sewcz[1], Sabrina Baldus[1], Saskia F. Fischer[1], Mihaela Daub[2], and Kornelius Nielsch[3] — [1]Werkstoffe und Nanoelektronik, Ruhr-Universität Bochum, Germany — [2]Max-Planck-Institut für Mikrostrukturphysik, Halle, Germany — [3]Multifunctional Nanostructures, Universität Hamburg, Germany

Ferromagnetic metallic nanowires are of high interest for magnetic sensing and storage applications. However, due to surface oxidation of the nanowires electrical contacts easily lead to high-contact resistances of a few kΩ. Here, we present multisegmented Au-Ni(NiO)-Au nanowires with a direct Au-Ni interface. Individual nanowires were laterally contacted in a four-terminal geometry via optical lithography, electron-beam lithography, thermal evaporation and lift-off patterning. The nanowires exhibit low-ohmic contacts of about 20 Ω. The resistivity decreases with the temperature (300 K to 4.2 K) and is in the order of that of high-purity bulk nickel [1]. The longitudinal anisotropic magnetoresistance (AMR) is about 1.5 % at 80 K and decreases with higher temperatures, 0.5 % at 300 K. The coercive field and the AMR are investigated for different angles between the current and magnetic field.

[1] T. FARRELL et al. J. PHYS. c (PROC. PHYS. SOC), ser. 2, 1359 (1968)

MA 33.24 Fri 11:00 Poster B1

Synthesis and characterization of boron-doped magnetic thin films and nanowires — •Martin Waleczek, Robert Zierold, Julien Bachmann, and Kornelius Nielsch — Institut für Angewandte Physik, Jungiusstr. 11, D-20355 Hamburg

Boron-doped magnetic thin films and nanowires can be fabricated by means of iron-boron electrodeposition from an alcaline electrolyte [1], using electropolished copper as substrate for the films and self-ordered porous alumina as template for the wires.

Due to the high pH of the electroplating bath, the alumina template has to be protected by a thin silica layer via atomic layer deposition (ALD) [2]. The Fe/B ratio can be optimized by changing the electrolyte composition, as well as the electrodeposition parameters. Diameter (40-300 nm) and length (micrometer-range) of the wires can easily be adjusted by controlling the template synthesis and the deposition time, respectively.

Investigation of the magnetic behaviour of the FeB thin films and of the nanowire arrays is done by SQUID and MOKE measurements.

The magnetic properties as well as the high boron content enclosed in a biocompatible and functionizable silica shell show this system's potential as a new approach to applications in boron neutron capture therapy (BNCT), where ^{10}B near or in tumor cells converts to ^{7}Li upon catching a thermal neutron and emits high energy particles, which have a very local, highly destructive effect on nearby tissue.

[1] Rakovich, E. V. et. al. : Russ. J. of Appl. Chem. **73** 7 (2000)
[2] Bachmann, J. et. al. : Angew. Chem. Int. Ed. **47** 33 (2008)

MA 33.25 Fri 11:00 Poster B1

Controlled reduction of the nucleation field in Co/Pt multilayer wires — •Judith Moser[1], André Kobs[1], Andreas Vogel[1], Theo Gerhardt[1], Markus Bolte[1], Mi-Young Im[2], Peter Fischer[2], Sebastian Wintz[3], Ulrich Merkt[1], Hans Peter Oepen[1], and Guido Meier[1] — [1]Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Germany — [2]Center for X-ray Optics, Lawrence Berkeley National Laboratory, Berkeley, CA, USA — [3]Institut für Ionenstrahlphysik und Materialforschung, Forschungszentrum Dresden-Rossendorf, Dresden, Germany

Due to their narrow domain walls, nanowires with high uniaxial out-of plane anisotropy are interesting candidates for spin-momentum transfer studies. Since high current densities can change or destroy the wires investigated, weak pinning potentials allowing the controlled and reliable depinning of domain walls at low current densities are desirable. A prerequisite for the preparation of a domain wall at such pinning sites are nucleation fields smaller than the fields required to depin the domain wall from the respective pinning site. We suggest two methods to tune the nucleation field of lithographically designed Co/Pt multilayer wires. The magnetization reversal of the wires is investigated by means of transmission X-ray microscopy. An up to fourfold reduction of the nucleation field could be achieved through altering the lateral shape of the wires or by depositing Fe stripes on top.

The authors gratefully acknowledge financial support by the DFG and the DOE.

MA 33.26 Fri 11:00 Poster B1

Superparamagnetism of Co/Pt nanodots with perpendicular anisotropy — •Alexander Neumann[1], Simon Hesse[1], André Kobs[1], Andreas Frömsdorf[2], and Hans Peter Oepen[1] — [1]Institut für Angewandte Physik, Universität Hamburg, Jungiusstr. 11, 20355 Hamburg, Germany — [2]Institut für Physikalische Chemie, Universität Hamburg, Grindelallee 117, 20146 Hamburg, Germany

In this paper we present measurements of the magnetic behavior of Co/Pt nanodots with a mean diameter and a mean distance of 19 nm/90 nm, respectively. The dots were fabricated from Co/Pt multilayers using SiO_2 particles as a shadow mask for Ar^+ sputtering at 500 eV. The nanodots exhibit an easy axis of magnetization that is perpendicular to the substrate surface [1].

We studied the temperature dependence of the hysteresis loops of nanodots made from single and double Co/Pt bilayer with Co thickness of 7 Å within the range of 80 K to 325 K. The magnetization curves are determined by means of the extraordinary Hall effect (EHE). To determine the blocking temperature T_B we used the temperature dependence of the coercive field. In case of the single Co/Pt bilayer nanodot a maximum of the ac-susceptibility is found that shifts to higher temperatures on frequency increase. From the results we calculated the nanodots switching time τ_0.

[1] H. Stillrich *et al.*, Adv. Funct. Mat. **18**, p76-81, (2008).

MA 33.27 Fri 11:00 Poster B1

Ultrafast magnetization dynamics of single antidot structures on nickel — •Darius G. Vahdat-Pajouh, Jakob Walowski, Andreas Mann, Henning Ulrichs, Gerrit Eilers, Benjamin Lenk, and Markus Münzenberg — I. Physikalisches Institut, Universität Göttingen

The time-resolved magnetization dynamics in a thin magnetic film can be investigated with femtosecond laser pulses. After optical excitation (pump pulse) the magnetic relaxation is recorded via the magneto-optical Kerr effect using a second laser pulse of lower intensity (probe pulse) which allows a depiction of $M(t)$.

The aim of this contribution is to find the influence of one single antidot on the magnetization dynamics depending on its diameter and the applied external field. Another point of interest concerns the magnetic mode spectrum and its resemblance to spectra of arrays structures consisting of many periodically arranged antidots. Time resolved magnetization dynamics measurements were performed for various distances from the single circular antidots of different diameters ranging from 5 to 20 micrometers.

The experimental findings indicate that the lower frequency modes generated in the dot vicinity can be accounted to field inhomogeneities arising from dipole surface modes around the structure. These can be predicted by analytical calculations and numerical simulations of the magnetic field in the nickel film.

MA 33.28 Fri 11:00 Poster B1

Spin wave propagation in $Ni_{80}Fe_{20}$ antidot lattices — •Hans Bauer[1], Georg Woltersdorf[1], Sebastian Neusser[2], Dirk Grundler[2], and Christian Back[1] — [1]Universität Regensburg, 93043 Regensburg, Germany — [2]Technische Universität München, 85747 Garching, Germany

Magnetic materials can be structured to form a two dimensional periodic antidot lattice. These artificial materials have properties different from the ones found in unpatterned thin films and open the door to the new field of magnonics, the magnetic analogon of photonics. We investigated a $Ni_{80}Fe_{20}$ antidot square lattice with a unit cell of 800 nm × 800 nm by time resolved Kerr microscopy. In our experiments the sample is excited by a coplanar wave guide at GHz frequencies and the spatial structure of the dynamic modes is observed at various bias field amplitudes and angles. Localized modes as well as extended modes are imaged with a spatial resolution of about 250 nm and are in good agreement with simulations performed on similar samples [1]. Finally, the spatio-temporal evolution of spinwave packets excited by nanosecond microwave bursts is imaged. The aim is to achieve field controlled propagation of spinwave pulses across the antidot lattice [2]. Part of the work was financially supported through the German Excellence Cluster "Nanosystems Initiative Munich".

[1] S. Neusser et al., Appl. Phys. Lett. 93, 122501 (2008)
[2] S. Neusser et al., Phys. Rev. B 78, 054406 (2008)

MA 33.29 Fri 11:00 Poster B1

Magnetic coupling in manganese doped silicon nanocrystals — •Christian Panse[1], Roman Leitsmann[2], and Friedhelm Bechstedt[1] — [1]Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany — [2]GWT-TUD GmbH, Abteilung Material Calculations, Annabergstr. 240, 09125 Chemnitz, Germany

To understand the magnetic properties on a nanoscale we examine transition metal doped semiconductors. In particular silicon nanocrystals doped with manganese are under investigation. We consider two different doping positions: substitutional and interstitial sites. Single doped systems tend to create high spin phases ($3\,\mu_B$) while the magnetic density is strongly localized at the Mn doping site.

Our fully unconstrained density-functional studies on pairwise-doped NCs show a clear dependency of the strength and type of the magnetic coupling on the Mn-Mn distance d. Due to the localized magnetic moments of the Mn atoms the system favors strong antiferromagnetic ordering for $d < 2.9$ Å. Larger distances yield weaker ferromagnetic coupling. Strong noncollinear spin effects could be found if the Mn atoms are separated by more than 5 Å. Unless the angle between both magnetic moments is less than 6° no significant energy gain due to noncollinearity occur.

A comparison of different doping sites show that the inclusion of at least one substitutional Mn atom will raise stability of the pairs significantly.

MA 33.30 Fri 11:00 Poster B1

Cell-size independent micromagnetic simulations including thermal effects — •Claas Abert[1], Benjamin Krüger[2], Jacek Swiebodzinski[2,3], Massoud Najafi[4], Gunnar Selke[4], André Drews[1], Guido Meier[1], and Markus Bolte[1,4] — [1]Institut für Angewandte Physik, Universität Hamburg, Germany — [2]Institut für Theoretische Physik, Universität Hamburg, Germany — [3]Theoretische Physik, Universität Duisburg-Essen, Germany — [4]Arbeitsbereich Technische Informatik Systeme, Department Informatik, Universität Hamburg, Germany

Micromagnetic simulations are a well established and powerful tool for zero temperature problems. Since experiments show that temperature strongly influences the magnetization dynamics, it is important to include thermal effects into the micromagnetic approach. This can be done by introducing an effective fluctuating field. The variance of this field is determined by solving the micromagnetic Fokker-Planck equation and demanding a Boltzmann distribution in thermal equilibrium [1]. A remaining challenge is the dependence of the simulation results on the simulation cell-size. This dependence can be eliminated by renormalizing simulation constants. Here a renormalization of the saturation magnetization and exchange constant is investigated using a finite difference micromagnetic simulation tool with a second-order Runge-Kutta stochastical integrator. A correction factor is found that solely depends on well-known simulation constants and which reduces the error by up to an order of magnitude as compared with previous approaches. [1] J. García-Palacios et al., Phys. Rev. B **58** 14937 (1998)

MA 33.31 Fri 11:00 Poster B1

Massively parallel micromagnetic FEM calculations with Graphical Processing Units — •Attila Kákay[1], Elmar Westphal[2], and Riccardo Hertel[1] — [1]Forschungszentrum Jülich GmbH, Institut für Festkörperforschung, Elektronische Eigenschaften — [2]Forschungszentrum Jülich GmbH, IFF-Netzwerke und Numerik

We have adapted our Finite Element Micromagnetic simulation software to the massively parallel architecture of Graphical Processing Units (GPUs) by employing NVIDIA's "Compute Unified Device Architecture" (CUDA)[1] software platform for high-performance computing. The performance of the code is demonstrated on the example of μMAG standard problem #4, where the computation time of a single GPU is compared with an OpenMP-parallelized version of our code using eight CPUs. In this comparison, the adaption of both the magnetostatic field calculation and the time integration of the Landau-Lifshitz-Gilbert equation to the GPU architecture can lead to a speedup factor of up to ten. The performance of the GPU code increases with increasing number of discretization points. The computation time required for high-resolution micromagnetic simulations of the magnetization dynamics in large magnetic samples can thus effectively be reduced by employing GPUs.

[1] CUDA Programming Guide, http://www.nvidia.com/

MA 33.32 Fri 11:00 Poster B1

The influence of size and aspect ratio on the switching properties of elliptical elements: an OOMMF Approach — •Andres Conca Parra, Ana Ruiz Calaforra, Britta Leven, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

The understanding and control of the switching properties in TMR elements is a critical point for certain applications such as MRAM memories. The magnetization dynamics depends on the size and shape of the element, the interlayer coupling in the TMR stack as well as the duration and amplitude of the magnetic field pulses used for switching. The elliptical shape is widely used due to the fact that the demagnetizing field induces a homogeneously magnetized state in remanence. However, depending on the thickness and the aspect ratio of the ellipse, the magnetic elements may show a domain structure in remanence or after excitation with magnetic field pulses.

We performed micromagnetic simulations for elliptical elements with different dimensions using the open code OOMMF. The simulations were performed for application relevant materials such as NiFe, CoFe and CoFeB. The magnetization state in remanence as well as the reaction of the elements to excitation with pulses with different amplitudes and duration were simulated. A comparison between elements and the most suitable strategy for a fast and reliable operation is discussed.

Support by the BMBF project MultiMag (VDI-TZ 13N9913) is acknowledged.

MA 33.33 Fri 11:00 Poster B1

Influence of the magnetostatic coupling on the depinning field of geometrically pinned domain walls in adjacent magnetic nanostrips — •Felipe Garcia-Sanchez, Attila Kakay, and Riccardo Hertel — Institut für Festkörperforschung, Elektronische Eigenschaften, Forschungszentrum Jülich GmbH

Magnetic domain walls in thin strips (DW) have attracted much attention due to potential applications in logic and magnetic storage devices [1]. Such applications require dense arrays of ferromagnetic nanowires and artificial pinning sites to control the DW position. Recently, it has been reported that transverse DWs with different configurations (head-to-head and tail-to-tail) in adjacent wires attract each other, resulting in a non-zero DW depinning field [2]. However, it is still unclear to which extent this interaction influences the depinning from artificially defined sites. In this work we study by means of micromagnetic simulations the separation-dependent interaction between DWs in two permalloy rectangular nanowires containing a double notch. We show that the DW configuration and the relative chirality affect the field required for depinning from the notch. In the case of repulsive interaction, we found that the DWs are unstable at small separation distances since they can depin even without applying external fields. We have also quantified the effect of this interaction on the stability by calculating the energy barrier connected with the depinning mechanism. [1] S. S. P. Parkin, M. Hayashi, and L. Thomas, Science 320, 190 (2008). [2] L. O'Brien et al., Phys. Rev. Lett. 103, 077206 (2009).

MA 33.34 Fri 11:00 Poster B1

Domain-wall types and switching fields in magnetic nanowires with perpendicular magnetic anisotropy determined by micromagnetic simulations — •Theo Gerhardt[1], Judith Moser[1], Andreas Vogel[1], André Kobs[1], Guido Meier[1], and Markus Bolte[1,2] — [1]Institut für Angewandte Physik, Universität Hamburg, Germany — [2]Arbeitsbereich Technische Informatik Systeme, Department Informatik, Universität Hamburg, Germany

Magnetic multilayers with perpendicular magnetic anisotropy are a well known material system with potential application e.g. in storage concepts based on current-driven domain-wall motion [1]. We present a systematic investigation of the influence of the material parameters of a thin nanowire, i.e., saturation magnetization M_S, anisotropy constant K_1, and exchange constant A, on the domain-wall type and the switching field via micromagnetic simulations. For low K_1 and high M_S, the multilayers have in-plane magnetization, while for high K_1 and low M_S, the magnetization of the wire points out-of plane with Bloch walls separating the domains. At the phase boundary, Néel walls predominate. The switching fields are found to decrease with increasing M_S and decreasing K_1, but are much larger than in comparable experiments, even when edge roughness is considered in the simulations. By introducing a local variation of the material parameters, as was recently done in Ref. [2], good agreement with experimental data is achieved. [1] S. S. P. Parkin et al., Science **320**, 190 (2008), [2] C. Burrowes et al., Nature Physics, Adv. Online Publication Nov. (2009), DOI:10.1038/NPHYS1436

MA 33.35 Fri 11:00 Poster B1

Micromagnetic simulations of depinning process of a head-to-head transverse domain wall by propagating spin waves on a magnetic nanowire — •June-Seo Kim[1], Luis Lopez-Diaz[2], Eduardo Martinez[2], and Mathias Kläui[1] — [1]Fachbereich Physik, Universität Konstanz, Universitätsstr. 10, D-78457 Konstanz, Germany — [2]Universidad de Salamanca, Plaza de la Merced s/n, E-37008, Salamanca, Spain

The recent discovery that a propagating spin-wave moves a domain wall has created a new possibility to manipulate magnetization [1]. This is now the subject of extensive research motivated not only by its fundamental interest but also by promising applications for novel spintronic devices. In this work, we investigate the domain wall motion induced by propagating spin waves (SWs) on a magnetic nanowire by using the objected oriented micromagnetic framework (OOMMF) code [2]. We observe that domain wall velocity gradually decreases due to the SW attenuation as it moves further from the spin wave source. We also study the depinning of the wall due to the combined effect of longitudinal applied field and propagating SWs. The depinning field depends on the frequency and amplitude of SWs. A correlation between SW frequency and the resonance frequency of local mode inside the domain wall is found. This work is supported by the EU-RTNs SPINSWITCH (MRTN-CT-2006-035327). [1] Dong-Soo Han et al., Appl. Phys. Lett. 94, 112502 (2009). [2] See http://math.nist.gov/oommf

MA 33.36 Fri 11:00 Poster B1

Modeling of intergrain exchange coupling for quantitative predictions of δm plots — •Volker Neu[1,2], Robert Biele[1,2], and Ludwig Schultz[1,2] — [1]IFW Dresden, Institute for Metallic Materials, P.O. Box 270116, D-01171 Dresden, Germany — [2]Dresden University of Technology, Institute for Solid State Physics, D-01062 Dresden, Germany

Exchange coupling of nanocrystalline materials or interface coupling of multilayers can be studied by means of δm-plots, which compare the irreversible magnetization processes in the magnetizing branch (starting from the thermally demagnetized state) and the demagnetizing branch (starting from the fully saturated state) of a hysteresis. Assuming nanocrystalline grains with sizes well below the single domain particle size, deviations from δm=0 are attributed to either short-range intergrain exchange interactions or long-range magnetostatic interactions. While numerous experimental studies lead to qualitatively sound results, quantitative analysis on δm-plots is missing. This paper studies the effect of intergrain exchange coupling (IGEC) by looking into the fundamental magnetization process of two coupled grains by a combined numerical and analytical model. It reconstructs hysteresis and δm-plots for such coupled pairs as a function of grain size, easy axis orientation and field direction. That way, it allows predictions of the influence of grain size distributions and texture spread on the shape and absolute values of δm-curves for realistic, nanocrystalline samples. Among other findings these calculations reveal, that IGEC can lead to negative δm-results without the effect of magnetostatic interactions.

MA 33.37 Fri 11:00 Poster B1

Micromagnetic simulation of three magnon scattering processes in spin-valve nanocontacts — •Florin Ciubotaru[1], Alexander A. Serga[1], Britta Leven[1], Elzbieta Jaromirska[2], Luis Lopez Diaz[2], and Burkard Hillebrands[1] — [1]FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany — [2]Departamento de Fisica Aplicada, University of Salamanca, I-37008 Salamanca, Spain

The spin-wave emission from point contact spin-valve structures subjected to microwave and direct electrical currents through the contact is a topic of intensive research due to the large potential for on-chip data transfer. We report on micromagnetic simulations of the spin-wave distribution and on the analysis of the three magnon scattering processes (confluence and splitting of magnons) which were observed experimentally in such devices [1]. The obtained results evidence the localization of the splitting process within the contact area. The thresholds for the generation of the nonlinear spin-wave modes behave similarly with the experiment. Spectral position of linear and nonlinear modes is determined in phase and frequency domains. The simulations were performed using the OOMMF open code [2]. Support from EC-MRTN SPINSWITCH (MRTN-CT-2006-035327) is gratefully acknowledged.

[1] H. Schultheiss et al. Phys. Rev. Lett. 103, 157202 (2009)

[2] M. J. Donahue, and D. G. Porter, Report NISTIR 6376, National Institute of Standards and Technology, Gaithersburg, MD (1999).

MA 33.38 Fri 11:00 Poster B1

Simulation of long range Kondo signatures in the local density of states for buried magnetic impurities — •Piet Eric Dargel[1], Robert Peters[1], Thomas Pruschke[1], Henning Prüser[2], Martin Wenderoth[2], Alexander Weismann[2], and Rainer G. Ulbrich[2] — [1]Institut für Theoretische Physik, Georg-August Universität Göttingen, Germany — [2]IV. Physikalisches Institut, Georg-August Universität Göttingen, Germany

Recent scanning tunneling spectroscopy (STS) studies of buried magnetic impurities in copper have shown strong signatures in the local density of states (LDOS) at the surface of the system above the impurities. We identify these signatures as long range fingerprints of the Kondo effect and choose the Single Impurity Anderson Model (SIAM) to model the system. Using an equation of motion (EOM) technique for the evaluation of the Green's function (GF) at the surface, we need to calculate the GF on the impurity with hybridization functions that depend on the free GF of the copper crystal at the impurity position. A linear combination of atomic orbitals (LCAO) approach is used for the free GF of the copper crystal and for the evaluation of the GF of the impurity we apply the Numerical Renormalization Group (NRG). The resulting LDOS at the surface shows a qualitatively very good agreement with the experimental data.

MA 33.39 Fri 11:00 Poster B1

Probing the long range signatures of single Kondo impurities — •Henning Prüser[1], Martin Wenderoth[1], Alexander Weismann[1], Rainer G. Ulbrich[1], Piet Dargel[2], Robert Peters[2], and Thomas Pruschke[2] — [1]IV. Physikalisches Institut, Georg-August Universität Göttingen — [2]Institut für Theoretische Physik, Georg-August Universität Göttingen

Scanning tunnelling spectroscopy (STS) has provided an approach to study the Kondo effect - one of the oldest many particle phenomena known in condensed matter physics - in real space. In spite of the high spatial resolution of scanning tunnelling spectroscopy recent studies have shown that the hallmark of the Kondo effect is only visible if the tip is placed directly above the impurity [1]. We follow a new way and investigated single isolated Co and Fe atoms buried below a Cu(100) surface using low temperature STS [2]. For both impurity atoms we observe, in contrast to previous works a long range Kondo signature which is periodic with the distance to the impurity. The periodicity of the oscillations is given by the Friedel wave length of the surrounding copper crystal. Comparing the experimental results with many body calculations combined with a realistic band structure of copper we show that the observed long range signature can be attributed to the Kondo effect. This work was supported by DFG SFB 602 TPA3.

[1] M. Ternes et al., Journal of Physics: Cond. Mat. 053001 (2009)

[2] A. Weismann et al., Science 323, 1190 (2009)

MA 33.40 Fri 11:00 Poster B1

Polarized Neutron scattering on the triple-axis spectrometer PANDA: first results — •Enrico Faulhaber[1], Astrid Schneidewind[1], Fei Tang[2], Peter Link[3], Dirk Etzdorf[3], and Michael Loewenhaupt[2,1] — [1]Gemeinsame Forschergruppe Helmholtz-Zentrum Berlin - Technische Universität Dresden, Helmholtz-Zentrum Berlin für Materialien und Energie, D-14109 Berlin, Germany — [2]Institut für Festkörperphysik, Technische Universität Dresden, D-01062 Dresden, Germany — [3]Forschungsneutronenquelle Heinz-Maier-Leibnitz (FRM II), D-85747 Garching, Germany

Typical applications of cold neutron triple-axis spectrometers comprise studies of spin and lattice dynamics, magnetic excitations and magnetic structures. In the past years, the PANDA spectrometer, located at the German research reactor FRM II, operated these fields in the conventional, unpolarized mode. To complement this normal mode of operation, a full polarization analysis of the neutrons was highly desired and, therefore, was recently implemented at PANDA.

First tests were made with neutron spins perpendicular to the scattering plane, utilizing static vertical guide fields between Heusler monochromator, spin flipper, sample and Heusler analyzer. Finally, an automated setup of split coils around the sample space was implemented, allowing for longitudinal polarization analysis in arbitrary configurations.

We will present recent results obtained by the completed set-up and discuss the status of the polarization analysis on PANDA in detail.

MA 33.41 Fri 11:00 Poster B1

Commissioning results of MAXYMUS at BESSY II — •Markus Weigand[1], Brigitte Baretzky[1], Michael Bechtel[1], Eberhard Goering[1], Corinne Grevent[1], Marcel Mayer[1], Gisela Schütz[1], Hermann Stoll[1], Christian Wolter[1], Rolf Follath[2], and Christian Jung[2] — [1]MPI für Metallforschung, Stuttgart, Germany — [2]HZB Bessy II, Berlin, Germany

MAXYMUS (MAgnetic X-raY Micro- and UHV Spectroscope), a next generation cutting-edge UHV scanning magnetic X-ray microspectroscope has been developed for high-resolution magnetic and nonmagnetic contrast imaging, local XMCD/XAS spectroscopy (less than 20nm lateral spectro-microscopy resolution). It has been installed in an especially build noise-reducing and temperature stabilizing cabin at the newly constructed PGM undulator beamline (UE 46-2) at BESSY II, Berlin which supplies soft X-rays of elliptical or rotatable linear polarization. First measurements already showed very promising results concerning reduced noise and high-resolution, due to its exceptional high scanning stability together with the unique ability of zoneplate scanning. The instrument is equipped with worldwide unique features. New insight into dynamic behavior of magnetic systems has been gained by applying pump-and-probe measurements with time resolution of less than 50 ps. Due to UHV conditions, TEY-measurements have been performed successfully. Thus, opaque targets can also be studied. First results concerning Fresnel Zone Plate development based on Atomic Layer Deposition will be presented. The microscope will be available for external users in the second half of 2010.

MA 33.42 Fri 11:00 Poster B1

High resolution magnetic imaging using scanning electron microscopy with polarization analysis — •Jakoba Heidler[1], Daniel Rüffer[1], Gregory Malinowski[1], Jan Rhensius[1,2], Laura Heyderman[2], Stephen Krzyk[1], and Mathias Kläui[1] — [1]Fachbereich Physik, Universität Konstanz, Germany — [2]Laboratory for Micro- and Nanotechnology, Paul Scherrer Institut, Villingen, Switzerland

Scanning electron microscopy with polarization analysis is a powerful tool to investigate the spin structure in magnetic nanostructure by measuring the spin polarization of secondary electrons. In this poster, we will describe the SEMPA technique and present examples of measurements of the domains and domain wall spin structure in different magnetic nanostructures. For instance, we used SEMPA to image a domain wall displacement along a ferromagnetic nanowire, the domain configuration in NiFe disks and the change of spin polarization of a thin Co layer when changing the capping layer from Pt to Al_2O_3. All these measurements provide essential informations to understand the relationship between the domain wall configuration, the material spin polarization and the domain wall displacement in current induced domain wall motion experiements.

MA 33.43 Fri 11:00 Poster B1

Improved spin-SEM for high quality imaging of magnetic structures — •Fabian Lofink, Sebastian Hankemeier, Robert Frömter, and Hans Peter Oepen — Universität Hamburg, Jungiusstr. 11, 20355 Hamburg, Germany

The unique feature of spin-SEM is the fact that it gives direct access to the magnetization orientation at the surface of a ferromagnetic sample. The high surface sensitivity allows for the investigation of ultrathin samples down to the monolayer regime. The latter property is often advantageously used when contaminated samples are to be investigated. In this case dusting with ultrathin ferromagnetic material is utilized to mirror the magnetic structure in the clean ferromagnetic film to make the magnetic structure accessible for spin-SEM. In this poster we present a new design of a spin-SEM where the LEED-detector performance is optimized with respect to the properties of underlying physics, the secondary electron emission process. The secondary electron emission process determines the energy and polarization distribution of electrons that are used for the imaging. With the improvement it is possible to take overview images in less than a minute and high quality images within 5-10 minutes. The simulated properties are compared to the results of experimental investigations. A very good agreement is found proving the optimized working condition in our set up.

MA 33.44 Fri 11:00 Poster B1

Advanced imaging and characterization of ferroic domains by optical second harmonic generation — Christian Wehrenfennig, •Dennis Meier, and Manfred Fiebig — Helmholtz-Institut für Strahlen- und Kernphysik, Nußallee 14-16, 53115 Bonn

In the investigation of magnetic and electric order in solid state systems, understanding the domain topologies is of prime significance, especially because it directly influences the performance in technical applications. The behavior of domains and domain walls reveals valuable information about the microscopic interactions and interaction paths leading to magnetic and electric ordering and, in particular, magnetoelectric couplings in multiferroics. With optical second harmonic generation (SHG), a powerful technique exists for probing all types of ferroic order using the same experimental setup. Most notably, it enables straightforward imaging even of antiferroic domains.

Here we present two advanced possibilities of domain characterization by SHG: **(1)** In antiferromagnetic compounds with incommensurate periodical modulation of the magnetic moment, conventional techniques fail to distinguish between adjacent translation domains, since they do not differ in the orientation of the order parameter. In contrast, SHG allows us to image those domains by phase sensitive detection. **(2)** Optical visualization of very small domains is naturally restricted by the resolution limit. Here we present a statistical model, which allows us to exploit the information in the remaining signal to estimate the average size of domains, even if it is orders of magnitude below the resolution limit.

MA 33.45 Fri 11:00 Poster B1

Quantitative Magnetic Force Microscopy with iron filled carbon nanotubes (Fe-CNT) — •Silvia Vock[1], Franziska Wolny[1], Ulrike Wolff[1], Christoph Hassel[2], Jürgen Lindner[2], Thomas Mühl[1], Volker Neu[1], and Ludwig Schultz[1] — [1]IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany — [2]Fachbereich Physik, Experimentalphysik, AG Farle, Universität Duisburg-Essen, 47048 Duisburg, Germany

The quantitative measurement of magnetic stray fields with Magnetic Force Microscopy (MFM) requires calibrated MFM tips. Conventional MFM probes are usually Si cantilevers with a sharp pyramidal tip, hard magnetically coated. The lateral extension of the magnetically active volume of the tip coating reduces the resolution and makes the overall quantitative description difficult. Using the simple point probe approximation, the tip parameters such as the size of the magnetic moment and its fictive position within the tip depend strongly on the measured stray field geometry. In contrast to that a Fe filled carbon nanotube (Fe-CNT), which is attached to a conventional force microscopy cantilever, constitutes an MFM tip with well defined geometry, a high aspect ratio and a homogenous magnetization. We will show that for such a tip the point probe parameters are independent of the measured magnetic structure. Calibration of both tip types was performed on perpendicularly magnetized CoPt stripes with varying width from 300 to 2200 nm. Quantitative MFM measurements were successfully performed on a [Co/Pt]/Ru multilayer sample by using the calibrated Fe-CNT tip revealing the correct sample magnetization.

MA 33.46 Fri 11:00 Poster B1

Quantitative characterisation of magnetic force microscopy (MFM) tips in high homogeneous external magnetic fields — •Denny Köhler, Peter Milde, Ulrich Zerweck-Trogisch, and Lukas M. Eng — Institut für Angewandte Photophysik, Technische Universität Dresden

Measuring quantitative magnetic moments becomes one of the major tasks in nanomagnetic research. We present here a novel way to characterise Magnetic Force Microscopy (MFM) tips in high homogeneous external magnetic fields. The applied measurement technique bases on the deflection of the cantilever caused by the mechanical torque [1] which is induced by the external magnetic field.

Low temperature measurements of the frequency-shift, damping and static deflection of the cantilever in a variable external magnetic field are used to access the horizontal and vertical components of the magnetic moment of the tip. Amplitude and orientation of the magnetic moment is calculated quantitatively based on the analytic model of a harmonic oscillator.

The new characterisation technique is applied on hard- and soft-magnetic cantilevers, i.e. a whisker- type and a Co-coated MFM tip.

[1] T. Mizoguchi, Jpn. J. Appl.Phys. 43 (2004) 4610.

MA 33.47 Fri 11:00 Poster B1

Conical magnetic structure in the kagome-related Swedenborgite CaBaFe4O7 — •Navid Qureshi, Martin Valldor, and Markus Braden — II. Physikalisches Institut, Universität zu Köln, Zülpicher Straße 77, 50937 Köln

Recently, a new type of metal oxides with magnetic kagome substructure was discovered, being closely related to the Swedenborgite mineral. Valldor et al. were able to synthesise the structural homologue YBaCo4O7 [1] and the spin-spin correlation proved to be strong and antiferromagnetic, which immediately raised the question about geometrical frustration in the magnetic Co substructure. Late last year, a new Swedenborgite homologue only containing Fe has been discovered: CaBaFe4O7 [2]. Macroscopic measurements showed that this compound undergoes a magnetic transition at 270 K into a ferrimagnetic state and a spin reorientation at 200 K into a multi-k structure, which could be confirmed by our neutron single crystal diffraction experiment. The temperature dependent investigation of the magnetic reflections (h k 0), (0 0 l) and (h+d k l) yielded first conclusions concerning the magnetic structures. At Tc the Fe magnetic moments order along the c axis with a small component within the a-b plane which does not break translation symmetry. Rietveld analysis shows that the c-component of the moments alternate between the Fe layers. Below 200 K the a-b component becomes modulated by k=(1/3 0 0) resulting in an interesting conical magnetic structure.

[1] Valldor et al., Solid State Sci. 2002, 4, 923 [2] Raveau et al., Chem. Mater. 2008, 20, 6295

MA 33.48 Fri 11:00 Poster B1

Structural and magnetic chirality of the transition metal silicides $Fe_{1-x}Co_xSi$ and $Mn_{1-x}Fe_xSi$ — •Dirk Menzel[1], Vadim Dyadkin[2], Sergey Grigoriev[2], Dmitry Chernishov[3], Vladimir Dmitriev[3], Evgeny Moskvin[2], Daniel Lamago[4], Thomas Wolf[5], Joachim Schoenes[1], Sergey Maleyev[2], and Helmut Eckerlebe[6] — [1]Institut für Physik der Kondensierten Materie, TU Braunschweig, Germany — [2]Petersburg Nuclear Physics Institute, Gatchina, Russia — [3]Swiss-Norwegian Beamline, ESRF Grenoble, France — [4]Laboratoire Léon Brillouin, Saclay, France — [5]Institut für Festkörperphysik, KIT Karlsruhe, Germany — [6]GKSS Forschungszentrum, Geesthacht, Germany

The crystallographic structure and the spin helix chirality of $Fe_{1-x}Co_xSi$ ($0.1 \leq x \leq 0.5$) and $Mn_{1-x}Fe_xSi$ ($0.06 \leq x \leq 0.29$) single crystals were determined by X-ray diffraction using synchrotron radiation and polarized neutron small angle diffraction, respectively. A close relationship between the crystalline and the magnetic structures is observed: A left-handed structural configuration found in $Fe_{1-x}Co_xSi$ corresponds to a right-handed magnetic helix and, vice versa, a right-handed structural helix reveals a left-handed spin helix. On the contrary, in $Mn_{1-x}Fe_xSi$ a left (right) handedness of the atomic structure coexists with a left (right) handedness of the spin helix. The origin of the complementary behavior is the sign of the Dzyaloshinsky-Moriya interaction which for a left-handed crystallographic configuration is positive in the $Fe_{1-x}Co_xSi$ system and negative in the $Mn_{1-x}Fe_xSi$ compound.

MA 33.49 Fri 11:00 Poster B1

Spin-waves decay in a helicoidal magnetic. — •Dmitri Efremov and Giniyat Khaliullin — MPIFKF, Stuttgart

We investigate Heisenberg magnetic with ferromagnetic nearest J_1,

and antiferromagnetic next-nearest J_2 and next-next-next nearest J_4 spin interactions. We show that the phase diagram consists on several phases: ferromagnetic, Neel antiferromagnetic, A-, helicoidal phases. We argue that spin waves in the helicoidal phase near to a transition point are highly damped. We compare the obtained results with the experiments on inelastic neutron scattering study of iron perovskite oxides such as $CaFeO_3$.

MA 33.50 Fri 11:00 Poster B1

The S=1/2 Heisenberg model on the 2D orthorhombic lattice: A numerical study — •Mohammad Siahatgar, Burkhard Schmidt, and Peter Thalmeier — Max-Planck-Institut für Chemische Physik fester Stoffe, Dresden, Germany

The ground state properties and finite temperature behavior of the $S = 1/2$ frustrated Heisenberg model on the 2D orthorhombic lattice are studied using exact diagonalization. This model, named as the $J_{1a,b} - J_2$ model, can be used to describe the low energy spin excitation of the parent compounds of newly discovered iron based superconductors, as well as two classes of layered vanadium phosphate, based on the data obtained from inelastic neutron scattering. Using the finite temperature Lanczos method, the ground state energy and the temperature dependence of the specific heat, magnetic susceptibility and staggered magnetization are calculated. For the latter different lattice sizes and geometries are used to investigate the finite size effect.

MA 33.51 Fri 11:00 Poster B1

Magnetic Properties of the quasi-2D S=1/2 Heisenberg antiferromagnet $[Cu(pyz)_2(HF_2)]PF_6$ — •Mykhaylo Ozerov — Hochfeld-Magnetlabor Dresden (HLD), Forschungszentrum Dresden - Rossendorf, Dresden, Germany

We report on electron spin resonance, high-field magnetization, and specific-heat studies of $[Cu(pyz)_2(HF_2)]PF_6$ single crystals, identified as a quasi-two-dimensional spin-1/2 Heisenberg antiferromagnet. Our measurements revealed $J_{inter}/J_{intra} \leq 0.063$ and $A/J \sim 0.003$, where J_{inter}, J_{intra}, J are the interplane, intraplane and mean exchange interactions, respectively, and A is the anisotropy constant. It is argued that the magnetic properties of this material (including high-magnetic-field magnetization and the temperature-field phase diagram) are strongly affected by two-dimensional spin fluctuations, despite of onset of 3D long-range magnetic ordering at $T_N \approx 4.4$ K. The ESR magnetic excitation spectrum in the 3D ordered phase is studied in detail.

The work was made in collaboration with E. Čižmár, R. Beyer, M. Uhlarz, Y. Skourski, S.A. Zvyagin J. Wosnitza, J.L. Manson, J.A. Schluter.

MA 33.52 Fri 11:00 Poster B1

Stability of ferromagnetic order in monoatomic transition-metal nanowires : A first-principles study of the effective exchange interactions between local moments — •Muhammad Tanveer, Pedro Ruiz Diaz, and Gustavo Pastor — Institut für Theoretische Physik, Universität Kassel, Heinrich Plett Straße 40, 34132 Kassel, Germany

A first principles study of the stability of the magnetism in transition-metal (TM) nanowires (NW) is presented. Constrained spin moment calculations of the effective exchange interactions between local moments in V, Fe and Co nanowires are performed in the framework of a generalized gradient approximation (GGA) to density-functional theory (DFT). In the case of V wires, ferromagnetic (FM) order is stable at the equillibrium nearest neighbor (NN) distance of the free standing wire. However, very small changes in the NN distance render FM order unstable. A transition from FM to spiral spin-density wave (SDW) order is found upon a contraction of about 1%. This remarkable result is interpreted in terms of the distance dependance of the effective exchange intractions J_{ij} between first, second, and third NN moments. Results are also given for the electronic density of states as a function of wave vector q of the spiral SDW state, which could be observed in STM experiments. Finally, the V results are contrasted with ongoing studies on Fe and Co wires.

MA 33.53 Fri 11:00 Poster B1

Magnetic fluctuations in FeRh. — •Leonid Sandratskii — Max Planck Institute of Microstructure Physics, Halle, Germany

FeRh experiences a first-order phase transition antiferromagnet-ferromagnet at about 350 K and can be treated as a natural magnetic multilayer system where large magnetoresistance can be easily realized. Recent time-resolved pump and probe experiments have shown an ultra-fast transition to the ferromagnetic state within femtosecond time scale. Despite much efforts devoted to the study of FeRh the nature of the phase transition remains the matter of debates. Although it is now clear that the Rh moments play crucial role in the stabilization of the ferromagnetic phase there is no consensus with respect to the selection of the magnetic degrees of freedom to describe the thermodynamical equilibruium. Some researches assume that the Rh moments are uniquely determined by the Fe environment and therefore should not be considered as separate degrees of freedom. Other groups consider the Rh moment as a separate Heisenberg or Ising variable. We use density-functional theory to study the spectrum of magnetic excitations in FeRh. Both transversal and longitudinal atomic fluctuations are considered. The study provides deeper insight into the nature of the Rh moment and the connection between the fluctuations of the Fe and Rh magnetization.

MA 33.54 Fri 11:00 Poster B1

Electrophysical and magnetoresistivity properties of granular multilayers based on Co, Ag, Au and Cu — •Dmytro Kutnyakhov[1], Sergej Nepijko[1], Iryna Cheshko[2], Larysa Odnodvorets[2], Nataliya Shumakova[2], Gerd Schönhense[1], and Ivan Protsenko[2] — [1]Institute of Physics, University Mainz, 55099, Mainz, Germany — [2]Sumy State University, 40007, Sumy, Ukraine

Aiming at a possible use as functional spintronics elements, we study the structural and electrical properties of thin films with spin-depending scattering of electrons based on Co nanoparticles embedded in a matrix of Ag, Au and Cu. Correlations of structure with electrophysical and magnetoresistive properties of these systems are shown, in particular for two- and multilayer films of metastable solid solutions (s.s.) of Ag/Co, Au/Co and Cu/Co. For the systems based on Cu/Co s.s. formed during condensation and partially disintegrated after annealing up to 700 K. For the systems based on Ag/Co or Au/Co s.s. formed during annealing near 700 K, whereas in non-annealed films no s.s. forms. In all systems grains of hcp-Co with 10 nm average size are observed. Formation of s.s. gives rise to change of resistivity, thermal coefficient of resistivity, gauge factor, and magnetoresistance. In the as-grown films no magnetoresistance was observed. After annealing up to 700 K a magnetoresistance of about 0.7% for Ag/Co and 0.4% for Au/Co systems was observed. This change was related with stabilization of granular state of hcp-Co in the matrix. Project funded by BMBF (UKR 08/022) and by Graduate School of Excellence MAINZ (D.K.)

MA 33.55 Fri 11:00 Poster B1

Magnetic and structure studies on thin films of co-evaporated Heusler compounds — •Jan Rogge, Fabian Schmid-Michels, and Andreas Hütten — Thin Films and Physics of Nanostructures, Department of Physics, Bielefeld University, Universitätsstr. 25, 33615 Bielefeld, Germany

Heusler compounds are promising candidates for spinelectronic devices like magnetic sensors or MRAM because of their unique magnetic properties. High Curie temperatures and low coercive fields, an indispensable pair for most applications, attract more and more attention to these materials. Above all the theoretically predicted 100% spin polarization [1] of many Heusler compounds shows great promise for reaching high MR ratios with magnetic tunnel junctions containing ferromagnetic Heusler electrodes.

We grow Heusler thin films by molecular beam epitaxy (MBE) co-evaporation, which enables us to produce alloyed Heusler layers with various compositions. We will present magnetic and structure studies on co-evaporated thin films of different Heusler compounds. The impact of stoichiometric variations on the examined properties will further be discussed.

[1] R.A. de Groot, F.M. Mueller, P.G. van Engen and K.H.J. Buschow, Phys. Rev. Lett. 50 (1983) 2024

MA 33.56 Fri 11:00 Poster B1

Magnetic anisotropy of (Ga,Mn)As epitaxial layers on GaAs — •Sergiy Mankovsky, Svitlana Polesya, and Hubert Ebert — Dept. Chemie und Biochemie/Phys. Chemie, Universität München, Butenandtstr. 11, D-81377 München, Germany

A study of the magnetic anisotropy of (Ga,Mn)As film deposited on GaAs substrate have been performed using the fully-relativistic spin-polarised KKR Green's function method. Experimentally observed in-plane magnetic anisotropy exhibiting two-fold and four-fold symmetry at different temperatures is attributed particularly to the effects of lat-

tice relaxation caused by the mismatch of GaAs and (Ga,Mn)As lattice parameters. In present work we have investigated the effect of tetragonal distortion in (Ga,Mn)As and the role of the (Ga,Mn)As/GaAs interface for the magnetic anisotropy as a function of the Mn concentration. Preliminary results suggest that the anisotropic exchange interaction contribute to the magnetic anisotropy as well in an appreciable way.

MA 33.57 Fri 11:00 Poster B1

Fabrication of CNT-based devices for spin transport measurements — •Caitlin Morgan, Karin Goss, Carola Meyer, and Claus Michael Schneider — Institute of Solid State Research, Electronic Properties, Forschungszentrum Jülich, 52425 Jülich, Germany

Due to their excellent electronic properties, carbon nanotubes (CNTs) are a material of interest in future computing applications. CNTs have been shown to exhibit ballistic transport, which is interesting for quantum transport studies. Furthermore, small spin-orbit interactions and relatively few spin nuclei (13C) allow for slow spin relaxation through carbon nanotubes when electron spins are injected through ferromagnetic contacts, making CNTs interesting for the field of spintronics.

Contacting CNTs for spin-injection purposes has presented a challenge because of poor interfaces and high contact resistivity between carbon and most ferromagnetic materials. In this work, cobalt-palladium alloys were studied to determine an optimal material for ferromagnetic contacts to CNTs. The alloys were tested via atomic force microscopy (AFM), x-ray diffraction (XRD), x-ray reflectivity (XRR), and magneto-optic Kerr effect (MOKE) experiments. Samples of contacted CNTs have been fabricated for quantum transport and spin injection measurements, performed in a cryostat. Initial results are discussed. As a long-term goal, we hope to be able to do transport measurements, Raman spectroscopy, and transmission electron microscopy (TEM) all on one CNT in order to determine the effects of chirality or number of walls on a CNTs electronic properties.

MA 33.58 Fri 11:00 Poster B1

Current-induced domain wall motion: Separating spin torque and Oersted-field effects in Co/Pt nanowires — •Jan Heinen[1], Olivier Boulle[1], Kevin Rousseau[1], Gregory Malinowski[1], Mathias Kläui[1], Henk J. Swagton[2], Bert Koopmans[2], Christian Ulysse[3], and Giancarlo Faini[3] — [1]Universität Konstanz, Fachbereich Physik, D-78457 Konstanz, Germany — [2]Eindhoven University of Technology, Department of Applied Physics, MB 5600, Netherlands — [3]CNRS, Phynano team, Laboratoire de Photonique et de Nanostructures, 91460 Marcoussis, France

We report on magnetotransport studies on perpendicularly magnetized nanowires with narrow domain wall (DW) structures. Using Co/Pt multilayer nanowires, we have previously shown that Joule heating is concealing most of the current induced domain wall effects, but using a constant sample temperature a large non-adiabacity factor β has been deduced[1]. Here, we carry out experiments for both applied field directions and current polarities, starting from different DW configurations within a Hall cross. We clearly show, using the different symmetries of spin torque and Oersted-field, that the much debated Oersted-field does not contribute to the DW depinning significantly. This allows us to extract the spin torque contribution and the non-adiabacity factor β, which turns out to be in line with previous measurements.

References: [1] O. Boulle et al., Phys. Rev. Lett. 101, 216601 (2008).

MA 33.59 Fri 11:00 Poster B1

Resistance tuning of GMR devices via domain wall motion — •Jana Münchenberger, Patryk Krzysteczko, Günter Reiss, and Andy Thomas — Bielefeld University, Department of Thin Films and Physics of Nanostructures, Universitätsstr. 25 33615 Bielefeld

We have investigated the possibilities of adjusting the resistance of a stuctured GMR system by controlling domain wall motion. The bottom pinned GMR systems are prepared by dc sputtering through a magnetic mask and are structured via e-beam lithography after the deposition. We obtain stripes with a length of 1μm and a width of 200nm. Depending on the used GMR stack we get GMR ratios up to 6% as prepared.

In such a long spin valve structure we expect domain wall movement in the free layer and the resistance of the device depends on the domain-wall position. In a first approach we want to control the domain-wall position with an applied magnetic field while on long terms we aim to control the resistance only with current induced domain wall motion.

MA 33.60 Fri 11:00 Poster B1

Imaging of field induced domain wall excitation in permalloy nanowires — Jan Rhensius[1,2], •Daniel Rüffer[2], Lutz Heyne[2], Stephen Krzyk[2], Laura Jane Heyderman[1], Frithjof Nolting[1], and Mathias Kläui[2] — [1]Paul Scherrer Institut, 5232 Villigen PSI, Switzerland — [2]Fachbereich Physik, Universität Konstanz, Universitätsstr. 10, D-78457 Konstanz, Germany

We present time resolved imaging of the spin structure of a magnetic head-to-head DW induced by an applied magnetic field pulse, using a pump-probe X-ray photoemission electron microscopy technique to determine the origin of the inertia. We find a clear inertia for the DW leading to a time lag between the field pulse and the reaction of the wall of 200 ps. By direct time-resolved magnetic imaging, we find that this is due to a change in the wall spin structure that stores exchange energy. This is caused by a transfer of Zeeman energy to exchange energy, for which the wall acts as a reservoir and this leads to an effective inertia of the wall (effective wall mass). We also see an oscillation of the DW around its equilibrium position after the excitation is switched off. Assuming a harmonic oscillator, an effective DW mass of $1.3 \cdot 10^{-24}\,kg \pm 1 \cdot 10^{-25}\,kg$ can be determined for the wall. This effective mass of our quasi particle is in line with results of micromagnetic simulations and with measurements that use transport techniques to determine the oscillation frequency.

MA 33.61 Fri 11:00 Poster B1

Depinning behaviours of domain walls at artificial notches in GMR nanostrips — •Björn Burkhardt[1], Sascha Glathe[1], Roland Mattheis[1], and Jeffrey McCord[2] — [1]IPHT Jena, Albert-Einstein-Str. 9, 07745 Jena — [2]IFW Dresden, Helmholtzstr. 20, 01069 Dresden

Domain wall (dw) motion can be described by the Landau-Lifshitz-Gilbert equation. During the motion, the dw can be trapped in local energy minima. Such a local energy minimum can be created by an artificial notch. The pinning behaviour of a dw at the notch (30% in depth of the stripe width) was measured in long narrow nanostrips (width=500nm, length=30um) using the giant magneto resistance between a sense layer (NiFe - 10nm thick) and a reference layer (CoFe - part of an AAF/AF-combination). We examine the pinning process in dependence of a longitudinal and a transverse magnetic field. The depinning of the dw occurred under a specified longitudinal field. Below this critical field we found a reversible change of the resistance as a result of a dw, elongated in the longitudinal direction, which is still partly pinned at the pinning site. Decreasing the field to zero, the elongated dw relaxes to the starting configuration. This behaviour is analyzed by magneto-optical Kerr-measurements and confirmed by means of micro magnetic simulations.

MA 33.62 Fri 11:00 Poster B1

Current-induced domain-wall depinning in substractive argon-sputtered permalloy nanowires — •Sedat Dogan, Gesche Nahrwold, Lars Bocklage, Toru Matsuyama, Ulrich Merkt, and Guido Meier — Institut für Angewandte Physik, Jungiusstr. 11, 20355 Hamburg

The realization of magnetic race-track memory [1] requires a good understanding of domain-wall dynamics. Domain-wall motion in permalloy nanowires can be achieved by current induced spin-transfer torque [2]. We detect depinning of a domain wall in a curved permalloy by the anisotropic magnetoresistance. One important aim is to lower the depinning fields and to get reliable depinning behavior of the domain walls. This can be achieved by an improved quality of the ferromagnet by sputtering permalloy onto heated substrates [3]. Another important aspect is the reduction of the edge roughness of the permalloy nanowires, which play an important role in the depinning process. Different fabrication techniques like lift-off processing, substractive argon plasma-sputtering and wet-etching are used to prepare wires. They are contacted by coplanar waveguides and measured in a high-frequency setup. Results of the differently prepared samples are compared in terms of depinning fields and depinning efficiency. [1] S. S. P. Parkin et al., Science **320**, 190 (2008), [2] J. C. Slonczewski et al., J. Magn. Magn. Mat. **159** (1996), [3] G. Nahrwold et al., J. Appl. Phys. **105** , 07D511 (2009)

MA 33.63 Fri 11:00 Poster B1

Field-pulse exited precessional motion — •Stefan Buschhorn[1], Jie Li[2], Min-Sang Lee[2], Björn Redeker[2], and Thomas Eimüller[2,3] — [1]Institut für Experimentalphysik IV, Ruhr-Universität Bochum, 44780 Bochum — [2]Junior Research Group Mag-

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Recently we presented a high spatial and temporal resolution fs laser system using an all-optical approach to study magnetisation dynamics [1]. This setup has now been extended to enable magnetic field pulse excitation as well. These two methods give similar information, however as we are using one laser system, we may be able to separate the effect of heating from the effect resulting in a change of the instantaneous magnetic field direction. We will present the new part of our setup and our first results measured with a series of FeNi alloy samples, including Py.

[1] J. Li, M. Lee, *et. al.*, Rev. Sci. Instr. **80**, 073703 (2009)

MA 33.64 Fri 11:00 Poster B1

Inductive Detection of Magnetic Vortex Gyration in Permalloy Squares — •Hauke Hendrik Langner, Lars Bocklage, Toru Matsuyama, and Guido Meier — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstraße 11, 20355 Hamburg, Germany

In micrometer-sized thin permalloy squares with a Landau-domain pattern a vortex core points out of the plane with two possible polarizations. High frequency fields or currents applied to the permalloy square excite the vortex to gyrate around the center. We propose a procedure to detect the gyration frequency and phase in such permalloy squares. A rectangular induction loop is deposited above the permalloy square so that the changes of the stray field of the gyrating vortex induce a periodic voltage. We expect an alternating voltage close to the resonance frequency of the vortex.

The method provides the possibility to detect magnetization dynamics of single microstructures.

MA 33.65 Fri 11:00 Poster B1

A sensor layer to magnify the magnetic vortex core — •Edward Prabu Amaladass[1], Vitalij Sackmann[1], Manfred Fähnle[1], Markus Weigand[1], Michael Curcic[1], Hermann Stoll[1], Joachim Albrecht[2], Bartel Van Waeyenberge[3], Tolek Tyliszckak[4], Georg Woltersdorf[5], and Gisela Schütz[1] — [1]MPI für Metallforschung, Stuttgart, Germany — [2]Hochschule Aalen, Germany — [3]Ghent University, Belgium — [4]ALS, LBNL Berkeley, CA, USA — [5]Universität Regensburg, Germany

Vortex core switching could be achieved by dynamic in-plane Oersted fields or spin torque excitations. Since the dimension of the vortex core is only about 10 - 20 nm in diameter, reading out the magnetization direction of the vortex core has been a hurdle for technological applications. We have found that a GdFe layer can act as a sensor for vortex core switching by magnifying significantly the lateral size of the out-of-plane magnetization. A GdFe layer, showing perpendicular anisotropy and coercivity fields of the order of mT, was used in a Permalloy (PY) - Al - GdFe multilayer system. By magnetic X-ray microscopy and by taking advantage of the element specificity of XMCD, the switching of the out-of-plane magnetization is observed at the Ni L3 and Gd M5 absorption edges. It could be demonstrated that by application of a magnetic RF burst of adequate amplitude and length the vortex core polarization in the PY layer is reversed. Consequently, the magnetization of the whole GdFe cover layer is also switched by the stray field of the tiny PY vortex core. This enabled us to detect the vortex core polarization by magneto-optical Kerr microscopy for the first time.

MA 33.66 Fri 11:00 Poster B1

Spin-wave eigenmodes in small magnetic disks in the vortex state — •Björn Obry, Katrin Vogt, Helmut Schultheiss, Philipp Pirro, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern

We study the eigenmode spectrum of small magnetic permalloy disks with their magnetization in the vortex state. Brillouin light scattering microscopy experiments yield different spin-wave eigenmode spectra, depending on the excitation geometry and the disk size. By means of an oscillating out-of-plane magnetic field only radial standing spin-wave modes can be excited directly. Furthermore it is observed that mode coupling induces an indirect excitation of some azimuthal eigenmodes, the latter being expected for an in-plane excitation only.

Sample preparation by the Nano+Bio Center of the Technische Universität Kaiserslautern and financial support by the Graduiertenkolleg 792 is gratefully acknowledged.

MA 33.67 Fri 11:00 Poster B1

Proposal of a robust measurement scheme for the non-adiabatic spin torque using the displacement of magnetic vortices — •Benjamin Krüger[1], Massoud Najafi[2,3], Stellan Bohlens[1], Robert Frömter[3], Dietmar Möller[2], and Daniela Pfannkuche[1] — [1]I. Institut für Theoretische Physik, Universität Hamburg — [2]Arbeitsbereich Technische Informatik Systeme, Universität Hamburg — [3]Institut für Angewandte Physik, Universität Hamburg

A spin-polarized current flowing through a ferromagnetic sample exerts a spin-torque on the local magnetic moments. This interaction can be described by adding two current-dependent torque terms to the Landau-Lifshitz-Gilbert equation.[1] The strength of the non-adiabatic spin torque is under debate since measurements differ by one order of magnitude.

A vortex in a micro- or nanostructured magnetic thin-film element is a promising system for the investigation of the spin-torque effect. It is known that vortices are displaced from their equilibrium position when excited by spin-polarized electric currents. The spatial confinement of the vortex core within the film element yields an especially accessible system for measurements. Based on analytical calculations[2] it is possible to derive a robust scheme which allows to measure the contributions due to the adiabatic spin torque, the non-adiabatic spin torque, and the Oersted field separately.

[1] S. Zhang and Z. Li, Phys. Rev. Lett. 93, 127204 (2004)
[2] B. Krüger et al., Phys. Rev. B 76, 224426 (2007)

MA 33.68 Fri 11:00 Poster B1

Spin-transfer torque in MgO based tunnel junctions for different magnetic materials — •Christian Franz and Christian Heiliger — I. Physikalisches Institut, Justus Liebig University Giessen, D-35392, Germany

We use the non-equilibrium Keldysh formalism implemented in the Korringa-Kohn-Rostoker Green's function method [1] to calculate the spin-transfer torque in MgO based tunnel junctions. In particular, we discuss the bias voltage dependence of the torque for different magnetic materials. We investigate Fe, Co, and FeCo leads. For pure Fe leads our calculations of the spin-transfer torque [2] show excellent quantitative agreement with experimental observation. Furthermore, our results show the importance of the Δ_1 band gap in the ferromagnetic materials. There is a drastic change in the bias dependence of the spin-transfer torque if the applied bias voltage is larger than the Δ_1 band gap.

[1] C. Heiliger, M. Czerner, B. Yu. Yavorsky, I. Mertig, M. D. Stiles, J. Appl. Phys. 103, 07A709 (2008)
[2] C. Heiliger and M.D. Stiles, Phys. Rev. Lett. 100, 186805 (2008).

MA 33.69 Fri 11:00 Poster B1

Influence of band parameters on spin-transfer torque in tunnel junctions: model calculations — •Asma Heena Khalil and Christian Heiliger — . Physikalisches Institut, Justus Liebig University Giessen, D-35392, Germany

Investigations of the spin-transfer torque in magnetic tunnel junctions have come into focus of current research because these devices are a basis of magnetic random access memories (MRAM). In particular, one is interested in the bias voltage dependence of this torque. For a Fe/MgO/Fe system our ab initio calculations [1] are supported by experimental data [2] where the bias dependence seems to be linear. On the other hand results of simple-band model calculations show deviations from this behavior [3]. In this contribution we study the in-plane spin-transfer torque in magnetic tunnel junctions for different band fillings and exchange splittings. For parameters that reproduce the important features of the Fe band structure, the results are in agreement with experimental data as well as with ab initio calculations.

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MA 33.70 Fri 11:00 Poster B1

Temperature-Induced Magnetic Switching in Finite Chains — •David Bauer, Samir Lounis, Phivos Mavropoulos, and Stefan Blügel — Institut für Festkörperforschung and Institute for Advanced Simulation, Forschungszentrum Jülich, D-52425 Jülich, Germany

Understanding spin dynamics in magnetic nanostructures is important for applications in data storage. In particular the bistability of the magnetic state can lead to spontaneous switching and data loss at finite temperatures. For its investigation we adopt an approach on the basis of a classical spin model coupled to a heat bath. This requires the solution of the stochastic Landau-Lifschitz equations.

We apply this model to study the temperature-induced magnetic switching behavior of finite chains on surfaces. Different switching types are found, depending on the chain length, the exchange coupling constants and the magnetocrystalline anisotropy. A switch can occur either by coherent magnetization rotation, which is well described by an Arrhenius-Néel-law, or by a domain wall propagating through the chain after nucleation. We show that the domain-wall type of switching can be described by a combination of a random walk model and a modified Arrhenius-Néel-law. Furthermore, a possible strong increase of the anisotropy at the chain edges influences the switching time under certain contitions, related to the creation of an additional energy barrier acting against nucleation.

MA 33.71 Fri 11:00 Poster B1

Interaction of two magnon condensates — •Vitaliy I. Vasyuchka[1], Alexander A. Serga[1], Christian W. Sandweg[1], Andrii V. Chumak[1], Timo Neumann[1], Björn Obry[1], Helmut Schultheiss[1], Gennadiy A. Melkov[2], Andrei N. Slavin[3], and Burkard Hillebrands[1] — [1]FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany — [2]Department of Radiophysics, National Taras Shevchenko University of Kiev, Ukraine — [3]Department of Physics, Oakland University, Rochester, MI, USA

The interaction of two magnon condensates was studied by means of time-resolved Brillouin light scattering spectroscopy in a tangentially magnetized yttrium-iron-garnet film at room temperature. Both condensates were created using parametric microwave pumping. Firstly, the pump action results in the injection of phase correlated magnon pairs at half of the pumping frequency. Thus a condensate of photon coupled magnons arises. Secondly, a Bose-Einstein condensate (BEC) of magnons is formed at the lowest energy state [1]. We show that the interaction of these two condensates leads to distortion of the BEC of magnons due to scattering on the condensate of magnon pairs. Shortly after the pumping is switched off this distortion vanishes and the BEC signal increases drastically. Applying a second probing pump pulse during the pump-free evolution of the BEC of magnons results in the restoration of the condensate of magnon pairs and consequently in a sharp slump of the BEC signal. Financial support by the DFG (SFB/TRR 49). [1] S.O. Demokritov et al., Nature **443**, 430 (2006).

MA 33.72 Fri 11:00 Poster B1

Broadband spin-wave spectroscopy on permalloy plain films at low temperature — •Florian Brandl, Sebastian Neusser, Georg Dürr, and Dirk Grundler — Lehrstuhl für Physik funktionaler Schichtsysteme, Technische Universität München, Physik Department, James-Franck-Straße 1, D-85747 Garching b. München, Germany

We investigate spin wave propagation in $Ni_{80}Fe_{20}$ (permalloy) thin films. Using, both, the vector network analyzer ferromagnetic resonance (VNA-FMR) and propagating spin wave spectroscopy (PSWS) techniques we perform temperature dependent measurements on permalloy thin films. An external magnetic field of up to 2.5 T is applied along the growth direction of the thin films. We study resonance frequencies and damping of standing and propagating spin waves from helium to room temperature. We report data obtained in the time and frequency domain using PSWS and VNA-FMR, respectively. We acknowledge financial support through the German excellence cluster "Nanosystems Initiative Munich".

MA 33.73 Fri 11:00 Poster B1

Micro-stripline mediated emission and detection of spin wave propagation in permalloy thin films — •Klaus Thurner, Georg Dürr, Sebastian Neusser, and Dirk Grundler — Lehrstuhl für Physik funktionaler Schichtsysteme, Technische Universität München, Physik Department, James-Franck-Straße 1, D-85747 Garching b. München, Germany

We report spin-wave propagation experiments performed on ferromagnetic $Ni_{80}Fe_{20}$ (permalloy) thin films in the frequency domain. Spin waves are induced and detected by a pair of collinear coplanar waveguides (CPWs) connected to a broadband vector network analyzer. Tailored designs of both emitter and receiver CPWs for efficient and predefined spin-wave excitation are investigated. Electromagnetic impedance matching and wave vector matching to the spin-wave dispersion relation of permalloy are taken into account. The measurements are performed at room temperature with an in plane magnetic field applied in different directions. We acknowledge financial support through the German excellence cluster "Nanosystems Initiative Munich".

MA 33.74 Fri 11:00 Poster B1

Spin-wave quantization in a thermal well — •Sebastian Schäfer, Helmut Schultheiss, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

We report on micromagnetic simulations of two-dimensional spin-wave quantization caused by a local reduction of the saturation magnetization M_S, using the OOMMF code [1]. This reduction models the effect of a heat gradient in a 10 nm thin Permalloy film as could be caused by nanometer-sized point contacts with high current densities as well as a focused laser beam of high intensity. It is therefore called *thermal well*. We found high-intensity spin-wave excitations confined to the area of the *thermal well*. Those modes exhibit frequencies distinctively different from the spin-wave band of the thin Permalloy film. The quantization effects apparently are not – as in previous investigations [2] – governed by the geometrical confinement or demagnetization fields but only by the modified saturation magnetization. The nature of these modes as well as the dependence on the depth and width of the *thermal well* will be discussed.

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MA 33.75 Fri 11:00 Poster B1

Spin-wave excitation in magnetic nano hybrid structures — Christopher Rausch, Sebastian J. Hermsdörfer, Philipp Pirro, Helmut Schultheiss, •Britta Leven, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

We present a micromagnetic study of artificial spin-wave excitation in magnetic nano hybrid structures in order to identify reliable spin-wave sources for experimental application. A variety of magnetic hybrid structures have been investigated, either hybrid structures built of different materials or hybrid structures built of differently shaped elements of the same material. First we investigated NiFe nanowires combined with a periodic array of Cu lines crossing the magnetic layer. When we pass a DC current through this Cu/NiFe hybrid structure, propagating spin waves are excited due to the periodic modification of the internal magnetic field caused by the Cu lines. Second we studied the spin-wave emission of resonantly excited domain walls in cross-type and T-type NiFe wires. Applying an AC current to the structures, spin-wave excitation can be observed. The advantage of the T-type structure is that the spin waves propagate in the current free arm of the structure in contrast to the cross-type structure thus offering a more universal spin-wave source for further experiments. We acknowledge financial support by the DFG.

MA 33.76 Fri 11:00 Poster B1

Spin wave propagation in permalloy antidot lattices — •Georg Dürr, Sebastian Neusser, and Dirk Grundler — Lehrstuhl für Physik funktionaler Schichtsysteme, Technische Universität München, Physik Department, James-Franck-Straße 1, D-85747 Garching b. München, Germany

We present spin-wave spectroscopy data obtained on $Ni_{80}Fe_{20}$ (permalloy) thin films with periodic arrays of holes (antidot lattices). Samples are prepared using focused ion beam (FIB) etching and optical lithography. The periods of holes with a diameter of 100 nm vary between 400 nm and 800 nm. Spatially separated coplanar waveguides used for all-electrical emission and detection of spin waves are integrated into the samples. Propagating spin wave spectroscopy and pulsed inductive microwave magnetometry measurement techniques are used in frequency and time domain, respectively. Propagating spin wave modes are compared to both reflected spin wave modes and micromagnetic simulations. We focus on small in-plane magnetic fields where the propagating spin wave modes exhibit a complex angular dependence due to the inhomogeneity of both the demagnetization fields and domain configuration. The research leading to these results has

received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under Grant Agreement n°228673 and the German excellence cluster "Nanosystems Initiative Munich (NIM)".

MA 33.77 Fri 11:00 Poster B1

Ultrafast Magnetization Dynamics of Fe and Fe Alloys Investigated with Time-Resolved X-ray Spectroscopy — •Andrea Eschenlohr[1], Christian Stamm[1], Niko Pontius[1], Torsten Kachel[1], Ilie Radu[2], and Hermann A. Dürr[1] — [1]Helmholtz Zentrum Berlin für Materialien und Energie, Elektronenspeicherring BESSY II, Albert-Einstein-Str. 15, 12489 Berlin — [2]Radboud University Nijmegen, Heijendaalseweg 135, 6525 AJ Nijmegen, The Netherlands

The microscopic processes behind laser induced ultrafast demagnetization of ferromagnetic materials are still only partially understood [1, 2]. One particular issue is the femtosecond demagnetization of permalloy, which was shown to proceed much faster than that of pure Ni and Fe in all-optical experiments [2]. At the BESSY II Femtoslicing beamline, we measure x-ray magnetic circular dichroism with a time resolution of 100 fs, which enables us to study laser induced ultrafast demagnetization in an element specific way. Additional x-ray absorption measurements reveal transient, laser induced changes in the electronic structure, visible at the Fe L-edges. We discuss the results in context with previous work on Ni [3].

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MA 33.78 Fri 11:00 Poster B1

Ultrafast Demagnetization in Heisenberg Ferromagnets — •Marko Wietstruk[1], Torsten Kachel[1], Niko Pontius[1], Christian Stamm[1], Hermann A. Dürr[1], Wolfgang Eberhardt[1], Cornelius Gahl[2], Martin Weinelt[2,3], Alexey Melnikov[3], and Uwe Bovensiepen[4] — [1]Helmholtz-Zentrum Berlin, BESSYII — [2]Max-Born-Institut Berlin — [3]Freie Universität Berlin, FB Physik — [4]Universität Duisburg-Essen, FB Physik

Gd and Tb are typical Heisenberg ferromagnets, consisting of RKKY-coupled localized $4f$ moments and polarized $5d$ valence electrons. In our time-resolved x-ray magnetic circular dichroism (TR-XMCD) experiment we excite the valence electrons with a 50 fs laser pulse and probe the $4f$ moment using 100 fs x-ray pulses from the BESSY II femtoslicing source.

In Gd we found two distinct demagnetization processes. The first, occurring on a 1 ps timescale, coincides with the relaxation of hot electrons via electron-phonon scattering. This supports the theory of demagnetization via Elliott-Yafet type spin-flip scattering [1]. As the process persists much longer than the laser pulse, a demagnetization by coherent laser excitation is unlikely [2]. The second process with a time constant of 40 ps in Gd is attributed to spin-lattice relaxation [3]. In Tb we found a much faster time constant of <5 ps, as expected from theory [3].

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MA 33.79 Fri 11:00 Poster B1

Magnetization dynamics control of a single ferromagnetic nanoparticle subjected to ultra-short magnetic fields — •Alexander Sukhov and Jamal Berakdar — Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, Heinrich-Damerow-Str. 4, 06120 Halle/Saale

We consider theoretically the magnetization dynamics of a single ferromagnetic nanoparticle driven by ultra-short magnetic pulses. The macrospin approximation is employed based on a finite-temperature Landau-Lifshitz-Gilbert equation. For the case when the magnetic pulse duration is shorter than the field-free precessional period of the magnetization we utilize the local control theory [1] to obtain analytical expressions for the appropriate fields parameters that lead to swift magnetization switching or freezing [2]. The quality of this approximation and the reliability of the analytical expressions are endorsed by full numerical calculations that confirm our predictions. As an application we show how thermally assisted switching is realized by choosing the appropriate field parameters [3].

In the studies [2,3] the scheme was restricted to the case where the external fields were aligned in the plane perpendicular to the easy axis of the anisotropy. Recently we extended our study to the case where the field is applied at an arbitrary direction in space.

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MA 33.80 Fri 11:00 Poster B1

Optical detection of magnetoelastic interaction in a magnetic film — •Christian W. Sandweg, Benjamin Jungfleisch, Vitaliy I. Vasyuchka, Björn Obry, Helmut Schultheiss, Alexander A. Serga, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

The technique of parametric microwave pumping plays an important role for transferring energy to magnon systems. In the case of longitudinal pumping, when the microwave magnetic field is parallel to the bias magnetic field, a microwave photon splits into two magnons with half of the pumping frequency and opposite wave-vector. The exact spectral definition of the magnon groups created hereby is crucial for the deeper understanding of the energy transfer into a magnon gas and further applications. Here we report on the wave-vector sensitive detection of the magnons at half of the pumping frequency by means of Brillouin light scattering spectroscopy. We measured the wave number of these magnons from 0 to $1.75 \cdot 10^5$ cm^{-1} in a range of the bias magnetic field from 1560 to 1680 Oe. We present the experimental evidence of hybridization of parametrically pumped magnons with acoustic waves in Yttrium-Iron-Garnet films used in our experiment.

MA 33.81 Fri 11:00 Poster B1

Magnetotransmission of surface acoustic waves at the nickel / lithium niobate interface — •C. Heeg[1], M. Weiler[1], H. Söde[1], A. Brandlmaier[1], R. Huber[2], D. Grundler[2], M. S. Brandt[3], R. Gross[1], and S. T. B. Goennenwein[1] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany — [2]Physik Department, TU München, 85748 Garching, Germany — [3]Walter Schottky Institut, TU München, 85748 Garching, Germany

Surface Acoustic Waves (SAWs) have found vast scientific interest in the past decades, mainly due to their application as bandpass filters for e.g. mobile phones. SAWs at ferromagnetic/piezoelectric interfaces can be used to investigate the interaction between mechanical waves and magnetic degrees of freedom.

We generate SAWs at a center frequency of 170 MHz on $LiNbO_3$ substrates by lithographically defining a delay line of two identical, single-finger interdigital transducers spaced approximately 500 μm apart. An approximately 50 nm thick and 100 μm wide nickel Hall bar is then deposited in the SAW propagation path. In these samples we have investigated the correlation between the DC magnetoresistance $R(H)$ in the Hall bar and the high frequency SAW transmission as a function of an applied magnetic field. We find that the SAW damping and velocity $\mathbf{S}_{21}(H)$ is dependent on the magnetization in the ferromagnetic thin film as evidenced by coinciding switching fields in $\mathbf{S}_{21}(H)$ and $R(H)$.

This work is supported by the DFG via project GO 944/3.

MA 33.82 Fri 11:00 Poster B1

Construction of a SHG-FROG to characterize a laser amplifier system for higher harmonic generation (HHG) — •Nadine Keul, Patrik Grychtol, Roman Adam, and Claus M. Schneider — Institute of Solid State Research, IFF-9 "Electronic Properties", Research Center Juelich, D-52425 Juelich

Latest developments in nonlinear light sources are opening the door for employing ultra-short soft X-ray pulses in a laboratory environment and thus offering a compact tool for element-selective investigation of magnetic properties on a nanometer and femtosecond scale. To this end, ultrashort ($<$ 35 fs) laser pulses with peak-pulse energies exceeding 1 mJ are focused into a localized inert gas plasma generating higher harmonics (HHG) of the fundamental laser frequency. By this means ultrashort ($<$ 1 fs) coherent soft X-ray pulses with energies of up to 100 eV can be generated with moderate effort. The conversion efficiency depends on the special character (length, dispersion, amplitude, etc.) of the driving laser pulse. To characterize the pulse parameters of the amplifier system we assembled a SHG-FROG (Second Harmonic Generation - Frequency Resolved Optical Gating) set-up and investigated the HHG conversion efficiency depending on the shape of the laser pulse employing a X-ray CCD camera.

MA 33.83 Fri 11:00 Poster B1

Ab initio calculations of the electronic transport in MnAs nanoclusters — •Michael Czerner, André Simon, and Chris-

tian Heiliger — I. Physikalisches Institut, Justus Liebig University Giessen, D-35392, Germany

Magnetic MnAs nanoclusters can be grown on a GaAs substrate in a controlled manner [1]. Such structures can be used to construct planar magnetic devices for spintronic applications. We perform ab initio calculations by means of the non-equilibrium Keldysh formalism implemented in the Korringa-Kohn-Rostoker Green's function method [2]. We study the spin-dependent transport of MnAs in the hexagonal NiAs structure along different crystallographic directions. Furthermore we discuss in detail the transport through interfaces formed by two MnAs clusters with different magnetic domains. We found a very large magnetoresistance ratio above 200% while the spin polarization is low, which is originated by the different Fermi surface topologies of the two spin channels.

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MA 33.84 Fri 11:00 Poster B1

High frequency magnetotransport in ferromagnetic thin films — •M. Radlmeier, M. Weiler, H. Huebl, C. Heeg, A. Brandlmaier, R. Gross, and S. T. B. Goennenwein — Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, D-85748 Garching

DC magnetotransport is an established technique to determine static magnetic properties of ferromagnetic thin films and to electrically read out magnetization states in nanostructures. As modern devices for information technology are operated at frequencies in the GHz regime, it is important to compare DC and HF transport characteristics. To gather further information on the physical mechanisms involved in HF magnetotransport, one needs to investigate and compare the temperature dependence of DC and HF transport as well. We have prepared Hall bars of Co and Ni thin films by optical lithography and electron beam evaporation. These are bonded onto slotted CPW carriers and then mounted on a magnet cryostat dipstick equipped with HF leads. This allows to measure DC and HF magnetotransport with 2 K$\leq T \leq$ 300 K and $\mu_0 H \leq 7$ T. Furthermore, the sample can be rotated with respect to the magnetic field. A vector network analyzer is used to measure HF magnetotransport in a frequency range up to 8 GHz and the results are compared to DC magnetotransport measurements. While the DC magnetotransport provides information on static magnetic properties such as magnetization orientation and magnetic anisotropy, we discuss the features observed in HF magnetotransport in terms of giant magnetoimpedance and HF susceptibility.

This work is supported by the DFG via project GO 944/3.

MA 33.85 Fri 11:00 Poster B1

Spin transport in a thin crystalline graphite flake — •Jose Barzola-Quiquia and Pablo Esquinazi — Abteilung Supraleitung und Magnetism, Universität Leipzig, 04103 Leipzig

Due to the large electron mobility and mean free path, thin crystalline graphite samples are expected to have some advantages for certain devices in comparison with single graphene layers fixed on dielectric substrates. In this work we have tested the spin transport on a 30 nm thick and several micrometer long single crystalline graphite flake using a spin-valve configuration with four ferromagnetic Co electrodes of different widths and several μm separation. A 5 nm thin Pt layer has been introduced in between the ferromagnetic Co injector/detector and the graphite surface. In spite of the conductivity mismatch problem, efficient electrical spin injection and detection in graphite has been achieved. The magnetoresistance in the local and half-local electrodes shows clear maxima with symmetry around zero field. The spin transport can be detected up to 150 K, the maximum temperature used.

MA 33.86 Fri 11:00 Poster B1

On the spin polarization of Co-Mn-Sb thin films — •Jan Schmalhorst, Markus Meinert, and Günter Reiss — Universität Bielefeld, Fakultät für Physik, Dünne Schichten und Physik der Nanostrukturen, 33615 Bielefeld

Thin Co-Mn-Sb films of different compositions were investigated and utilized as electrodes in alumina based magnetic tunnel junctions with CoFe counter electrode. The preparation conditions were optimized with respect to magnetic and structural properties. The Co-Mn-Sb / Al-O interface was analyzed by X-ray absorption spectroscopy and magnetic circular dichroism with particular focus on the element-specific magnetic moments. Co-Mn-Sb crystallizes in different complex cubic structures depending on its composition. The magnetic moments of Co and Mn are ferromagnetically coupled in all cases. A tunnel magneto resistance ratio of up to 24% at 13K was found and indicates that Co-Mn-Sb is not a ferromagnetic half-metal. These results are compared to recent works on the structure and predictions of the electronic properties.

MA 33.87 Fri 11:00 Poster B1

Examination of spin currents in spin valve structures created by shadow lithography — •Andreas Lörincz[1], Jan Rhensius[1,2], Goran Mihajlović[3], Laura Heyderman[2], Axel Hoffmann[3], and Mathias Kläui[1] — [1]Universität Konstanz, 78462 Konstanz, Germany — [2]Paul Scherrer Institut, 5232 Villingen, Switzerland — [3]Argonne National Laboratory, Argonne, IL 60439-4806, USA

We investigate diffusive spin currents in copper conduits deposited on permalloy halfrings. The main focus on these investigations lies on the comparison with similar samples produced in a two-step lithography method. Structures created by the latter method experience surface oxidation due to exposure to air after the first deposition step, resulting in a contaminated interface. Standard characterizations for the magnetic and spin behaviour, such as GMR, nonlocal spin signal and Hanle measurements are presented in order to determine the differences between both deposition techniques. The effect of diffusive spin currents on magnetic domain walls due to strong surface torques on the magnetization of the affected material is discussed.

Considering the spin diffusion length, we compare these results with measurements on single- or multilayered graphene structures, which are a promising material as a spin conduit in future devices. To take advantage of the high spin diffusion length and the high electron mobility, the main challenge is to effectively inject spins into this two-dimensional conductor. A possible solution are tunnel barriers, which might lead to a larger injection efficiency.

MA 33.88 Fri 11:00 Poster B1

A variable-temperature ultra-high vacuum four-probe spin-polarized scanning tunnelling microscope — •Tobias Spitz, Shiro Yamazaki, Oswald Pietzsch, and Roland Wiesendanger — Institute of Applied Physics and Microstructure Advanced Research Center, University of Hamburg, Jungiusstraße 11, D-20355 Hamburg, Germany

A variable-temperature UHV four-probe spin-polarized scanning tunnelling microscope (SP-STM) is presented. The instrumental possibilities of a commercial system (Omicron's Nanoprobe) were substantially extended. Facilities for in-situ preparation of spin-polarized tips, as required for SP-STM and spin-resolved tunneling spectroscopy (SP-STS), were designed, built, and tested. An electron beam heating stage was constructed for removing surface oxides at the tip apex by flashing the tip to temperatures up to 2000K follwed by a subsequent magnetic thin film deposition process. It is a major challenge in transport experiments involving surface nanostructures to avoid leak currents through the underlying substrate. The necessary decoupling of the nanostructures and substrate can be achieved by a NaCl buffer layer as has been shown previously. The design of an appropriate home-built evaporator is presented.

MA 33.89 Fri 11:00 Poster B1

Transport properties of $La_{0.7}R_{0.3}MnO_3/SrTiO_3/La_{0.7}R_{0.3}MnO_3$ (R = Ca, Sr) magnetic tunnel junctions — •Patryk Nowik-Boltyk[1], Robert Werner[1], Lucero Alvarez[2], A. Yu. Petrov[2], Bruce A. Davidson[2], Reinhold Kleiner[1], and Dieter Koelle[1] — [1]Physikalisches Institut – Experimentalphysik II and Center for Collective Quantum Phenomena and their Applications, Universität Tübingen, Auf der Morgenstelle 14, D-72076, Germany — [2]INFM-TASC National Laboratory, Area Science Park, S.S. 14, Km 163.5, I-34012 Basovizza (TS), Italy

Half metals like the doped manganites $La_{0.7}Ca_{0.3}MnO_3$ (LCMO) and $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) are promising candidates for a very large tunneling magnetoresistance (TMR) effect due to their almost 100% spin-polarisation. However, weakening of the magnetic properties at the ferromagnet/insulator interfaces can cause a suppression of the TMR effect in magnetic tunnel junctions (MTJs) made of doped manganites. By introducing a doping profile in LRMO at the interface, the Mn valence can be controlled and the magnetization can be reinforced. We present results on the TMR in planar MTJs grown with different $SrTiO_3$ (STO) barrier thicknesses, as well as with different doping pro-

files within a few monolayers of LRMO at the interface. The LCMO trilayers were prepared using pusled laser deposition (PLD) while the LSMO trilayers were grown by molecular beam epitaxy (MBE). The MTJs where investigated in a temperature range $T = 4.2 - 300\,\mathrm{K}$ and characterized by differential conductance G vs voltage V and resistance R vs H measurements at different bias voltages.

MA 33.90 Fri 11:00 Poster B1

Measurements of the capacitance of magnetic tunnel junctions — •Ronald Lehndorff[1], Anna Gerken[1], Gerhard Jakob[2], Andreas Hütten[1], and Günter Reiss[1] — [1]Bielefeld University, D2 Physics, Bielefeld, Germany — [2]Mainz University, Institute of Physics, Mainz, Germany

Magnetic tunnel junctions (MTJ) based on CoFeB as ferromagnetic electrodes and MgO as insulating layer are important building blocks for current and future spintronics devices owing to their huge magnetoresistive effect. Electronically, they possess not only a resistive but also a capacitive component.

Here, we present a measurement setup build to evaluate the capacitance of MTJs in an external magnetic field using an ultra-precision capacitance bridge AH 2550 from Andeen-Hagerling, Inc. We show results measured on high-ohmic CoFeB/MgO MTJs with area resistances above 1 megaohm square micron and thoroughly discuss these and the precision of the measurements.

MA 33.91 Fri 11:00 Poster B1

Co/Pd multilayer based magnetic tunnel junctions with perpendicular magnetic anisotropy — •Zoë Kugler, Günter Reiss, and Andy Thomas — Bielefeld University, Department of Physics, Universitätsstr. 25, 33615 Bielefeld, Germany

Magnetic tunnel junctions with perpendicular magnetic anisotropy have recently attracted much attention due to their potential for higher storage densities and for reduced writing current densities in future magnetic memory applications. We present temperature dependent transport and magnetic measurements of MgO, Mg/MgO and Alumina based magnetic tunnel junctions with perpendicularly magnetized Co/Pd electrodes. The effect of annealing temperature, Co thickness in the lower and upper electrode and number of Co/Pd bilayers on the magnetoresistance were investigated. In order to characterize the electrodes we have calculated the volume and interface anisotropy from magnetic measurements with respect to the annealing temperature and the number of Co/Pd bilayers.

MA 33.92 Fri 11:00 Poster B1

Preparation and characterization of sputtered CoFeB/MgO/CoFeB-based TMR magnetic tunnel junctions (MTJs) — •Neda Sadrifar and Ulrich Herr — Institut für Mikro- und Nanomaterialien, Universität Ulm, 89081 Ulm

Magnetic tunnel junctions with crystalline (001)-oriented MgO tunnel barrier recently lead to achievement of extremely large tunneling magnetoresistance ratios (TMR) at room temperature. Arrays of such MTJ sensors are of great promise for the detection of magnetic or magnetically-labeled nanoparticles because of their high sensitivity and flexibility in resistance design. In this study, CoFeB/MgO/CoFeB-based MTJs were prepared by magnetron sputtering, standard photolithography and ion milling. First results show a TMR ratio of 32% at RT; which will be further improved. Characterization with respect to their microstructure and roughness was carried out by XRD, AFM, SEM and TEM. The goal is to build a detection system with high magnetic sensitivity which permits the detection and magnetic characterization of single magnetic nanoparticles.

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temperature dependence of transport properties of Co-Fe-B/MgO/Co-Fe-B magnetic tunnel junctions — •Ayaz Arif Khan, Jan Schmalhorst, and Günter Reiss — Thin films and physics of Nano structures, Department of Physics, Bielefeld university, P. O. Box 100131, 33501 Bielefeld germany.

We have performed a systematic analysis of the voltage and temperature dependence of the tunneling magnetoresistance (TMR) in Co-Fe-B/MgO/Co-Fe-B magnetic tunnel junctions (MTJs) with barrier thickness d_{MgO} between 1.8 and 4 nm. All the junctions show a comparable TMR of about 300 % at low temperature with low bias voltage. Both the junction resistance and magnetoresistance decreases with inceasing temperature or bias voltage. In the bias voltage range of ± 500 mV and temperature range of 13-330 K the strongest decrease of TMR with either increase in bias voltage (of about 98 %) or increase in temperature (of about 94 %) was observed for MTJ with 4.0 nm thick barrier. whereas for d_{MgO}= 1.8 nm the smallest drop of 51 % with increase in voltage and 43 % with rise of temperature was found. MTJs with 2.1 nm and 3.0 nm displayed an intermediate behaviour. This behaviour was analyzed in the framework of recently suggested models for the bias and temperature dependent transport. Especially, the influence of unpolarized and polarized hopping conductance will be discussed.

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Optimization of the tunnel magnetoresistance of CoFeB/MgO/ CoFeB - based magnetic tunnel junctions (MTJs) with e-beam evaporation barriers. — •Vladyslav Zbarskyy[1], Marvin Walter[1], Gerrit Eilers[1], Patrick Peretzki[2], Michael Seibt[2], and Markus Münzenberg[1] — [1]I. Physikalisches Institut, Georg-August-Universität Göttingen, 37077 Göttingen — [2]IV. Physikalisches Institut, Georg-August-Universität Göttingen, 37077 Göttingen

The investigation of MTJs with a high tunnel magnetoresistance (TMR) is very important for the production of MRAM devices. All our CoFeB layers are prepared via magnetron sputtering and MgO barriers via e-beam evaporation. We investigate the magnetic switching properties of CoFeB/MgO/CoFeB MTJs with measurements of hysteresis curves - using the magneto-optical Kerr effect - and TMR curves, optimizing the thickness of the CoFeB layers. Another parameter we change to optimize the ferromagnetic CoFeB electrodes is the annealing temperature. Both influence the solid state epitaxy leading to crystallization directly at the MgO/CoFeB interface. The optimization of MgO barrier properties is also necessary for the quality of our devices. In this context we study the TMR behaviour with the variation of the sample temperature during the e-beam evaporation of MgO barrier. We thank the DFG for funding the research through SFB602.

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Influence of roughness at interfaces on tunneling magnetoresistance in Fe/MgO/Fe — •Saeideh Edalati Boostan[1,2], Hosein Moradi[2], and Christian Heiliger[1] — [1]I. Physikalisches Institut, Justus Liebig University Giessen, D-35392, Germany — [2]Department of Physics, Faculty of Sciences, Ferdowsi University of Mashhad, Mashhad, Iran

We propose a theoretical model for magnetic tunnel junction devices with rough interfaces based on a single-band tight-binding approximation. The high tunneling magnetoresistance (TMR) for crystalline MgO barrier was observed at room temperature which is desirable for magnetic random access memory (MRAM) applications. In real junctions the Fe and MgO atoms are interdiffussed at interfaces and the numbers of diffused Fe and MgO atoms are not the same. The interface disorder is modeled by considering replacement of MgO sites by Fe atoms with a probability of n>0.5. The non-equilibrium Green's function formalism is used to calculate transport in Fe/MgO/Fe junctions. We investigate the voltage dependencies of TMR and current densities for parallel and anti-parallel configurations for majority and minority spins. The results show that the roughness decreases the TMR. The current density for the parallel (antiparallel) orientations of magnetizations decreases (increases) by including roughness at the interface.