DF 9: Poster I - Biomagnetism, FePt Nanoparticles, Magnetic Particles/Clusters, Magnetic Materials, Magnetic Semiconductors, Half-metals/Oxides, Multiferroics, Topological Insulators, Spin structures/Phase transitions, Electron theory/Computational micromagnetics, Magnetic coupling phenomena/Exchange bias, Spin-dependent transport, Spin injection/spin currents, Magnetization/Demagnetization dynamics, Magnetic measurement techniques

Time: Tuesday 12:15–15:15 Location: Poster A

DF 9.1 Tue 12:15 Poster A

Spin-resolved photoemission spectroscopy of $[\mathbf{Mn_6^{III}Cr^{III}}]^{3+}$ single-molecule magnets (SMM) deposited on surfaces and of Mn compounds as reference substances, cross comparison with XMCD — •Andreas Helmstedt[1], Aaron Gryzia[1], Niklas Dohmeier[1], Norbert Müller[1], Armin Brechling[1], Marc Sacher[1], Ulrich Heinzmann[1], Veronika Hoeke[2], Erich Krickemeyer[2], Thorsten Glaser[2], Mikhail Fonin[3], Samuel Bouvron[3], Philipp Leicht[3], Thomas Tietze[4], and Manfred Neumann[5] — [1]Faculty of Physics, Bielefeld University — [2]Faculty of Chemistry, Bielefeld University — [3]Department of Physics, University of Konstanz — [4]Max-Planck-Institut für Intelligente Systeme, Stuttgart — [5]Department of Physics, University of Osnabrueck

The properties of the Mn-based single-molecule magnet $[\mathbf{Mn_6^{III}Cr^{III}}]^{3+}$ deposited on surfaces are studied. This molecule exhibits a large spin ground state of S_T=21/2 and contains six Mn centres in two bowl-shaped Mn_3-triplesalen units linked by a hexacyanochromate. A preparation method for large-scale homogeneous samples needed for sample scanning to avoid radiation damage will be presented. The spin polarization of Auger electrons emitted from the manganese centres in $[\mathbf{Mn_6^{III}Cr^{III}}]^{3+}$ SMM after excitation with circularly polarized synchrotron radiation has been measured in the paramagnetic phase at selected excitation energies in the Mn-$L_{2,3}$ region. These results will be compared to XMCD data obtained at approx. 2K and 7T. Spin polarization data from Mn_2O_3 and Mn(II)acetate references after excitation at the Mn-$L_{2,3}$ edge are presented as well.

DF 9.2 Tue 12:15 Poster A

High-field ESR and magnetization of a Mn(III)-based single chain magnet — •Y. Krupskaya[1], Z. Tomkowicz[2], M. Rams[2], M. Balanda[3], S. Foro[4], Y. Skourski[5], J. Wosnitza[5], S.K. Nayak[6], J.V. Yakhmi[7], W. Haase[6], V. Kataev[1], and B. Büchner[1] — [1]IFW Dresden, Dresden, Germany — [2]Institute of Physics, Jagiellonian University, Kraków, Poland — [3]H. Niewodniczański Institute of Nuclear Physics PAN, Kraków, Poland — [4]Clemens-Schöpf-Institut für Organische Chemie und Biochemie, Technische Universität Darmstadt, Darmstadt, Germany — [5]Dresden High Magnetic Field Laboratory, Rossendorf, Germany — [6]Eduard-Zintl Institut für Anorganische und Physikalische Chemie, Technische Universität Darmstadt, Darmstadt, Germany — [7]Technical Physics and Prototype Engineering Division, Bhabha Atomic Research Centre, Mumbai, India

We present high-field magnetic study of a Mn(III)-based molecular chain. The compound shows a ferromagnetic hysteretic behavior of the magnetization at relatively high temperatures (up to 3 K). High-field/high-frequency ESR measurements were performed at the excitation frequencies between 332 and 528 GHz in magnetic fields up to 15 T. The frequency dependence of the ESR spectrum yields a g-factor of 1.8 and a negative effective magnetic anisotropy D of around −6.37 K. In addition, pulsed field (up to 60 T) magnetization measurements enabled determination of the effective spin value corresponding to the ground state of the chain. In conclusion, our experimental results indicate the single molecular chain magnet behavior of the studied compound.

DF 9.3 Tue 12:15 Poster A

EPR study of hyperfine interactions in Cu(II)- bis(oxamato) complexes — •A. Aliabadi[1], A. Petr[1], M. A. Abdulmalic[2], T. Rüffer[2], V. Kataev[1], and B. Büchner[1] — [1]IFW Dresden, Dresden, Germany — [2]Institute of Chemistry, Chemnitz University of Technology, Chemnitz, Germany

The hyperfine (HF) coupling of two Cu(II)-bis(oxamato) complexes containing four nitrogen ligands has been investigated using EPR spectroscopy at 10 GHz. The EPR spectra were modeled in order to determine the g-factor and the HF coupling values. First, measurements were performed on a liquid solution at room temperature to obtain isotropic g-factor and HF coupling constants for Cu and N. From the EPR measurements on powder samples we were able to extract the g-tensor and the Cu HF coupling tensor. In addition, the angular dependence of the EPR spectra was studied by rotation of a single crystal in three mutually perpendicular planes. From that the Cu HF coupling tensor was further refined and the N HF coupling tensor was determined. The results indicate that the difference between the determined parameters for two complexes is not significant. However, these parameters are smaller compared to a previous study of Cu(II)-bis(oxamato) complex containing two nitrogen ligands [1]. The results of this work should enable the determination of the spin density distribution between the central metal ion and the ligands in the studied molecules.

[1] B. Bräuer, T. Rüffer, R. Kirmse, J. Griebel, F. Weigend, G. Salvan, Polyhedron. 26 (2007) 1773.

DF 9.4 Tue 12:15 Poster A

Magnetic properties of a mixed valence Ni(II)-Ni(III)-complex as probed by the ESR spectroscopy and static magnetization measurements — •Jaena Park[1,3], Yulia Krupskaya[1], Vladislav Kataev[1], Bernd Büchner[1], Frederik Schleife[2], Berthold Kersting[2], and Rüdiger Klingeler[3] — [1]Leibniz Institute for Solid State and Materials Research IFW Dresden, Dresden, Germany — [2]Institute of Inorganic Chemistry, University of Leipzig, Leipzig, Germany — [3]Kirchhoff Institute for Physics, University of Heidelberg, Heidelberg, Germany

We investigated magnetic properties of a mixed valence Ni(II)-Ni(III)-complex by means of high-field electron spin resonance spectroscopy and static magnetization measurements. The metal core of the complex contains one Ni^{2+} ion ($S = 1$) and one Ni^{3+} ion ($S = 1/2$) coupled by three sulphur bridges. The magnetic field dependence of the magnetization at low temperatures and the temperature dependence of the static magnetic susceptibility reveal a ferromagnetic coupling between the Ni-spins. The high-field frequency tunable electron spin resonance measurements enable determination of the g-factor and magnetic anisotropy values for the studied complex. In addition, we compare the magnetic properties of the Ni(II)-N(III)-complex with those of the similar structure Ni(II)-N(II)-complex having both Ni ions in the 2+ oxidation state.

DF 9.5 Tue 12:15 Poster A

Electrical characterization of intermetallic FePt nanoparticles — •Ulrich Wiesenhütter[1], Darius Pohl[2], Bernd Rellinghaus[2], Jürgen Fassbender[1], and Artur Erbe[1] — [1]Helmholtz-Zentrum Dresden Rossendorf, D-01328 — [2]Leibniz-Institut für Festkörper- und Werkstoffforschung, D-01069

Magnetic nanoparticles have a large potential for applications such as medical diagnosis and therapy, (bio-)sensors or magnetic recording. Conventional techniques, e.g., MFM, electron holography or Lorentz microscopy are only suited to determine magnetical properties of macroscopic particle ensembles. In order to investigate the electrical and magnetic properties of a single, free-standing FePt nanoparticle two nano-sized Au electrodes that are fabricated by electron beam lithography, are used.The full characterization of the particle is carried out by electron microscopy and by recording current-voltage characteristics. As a result Coulomb-blockade effects have been observed at low temperatures. The capacitance of the nanoparticles is derived from the I/V characteristics.

DF 9.6 Tue 12:15 Poster A

Cobalt-Gold Core-Shell Nanoparticles as Probes for Quantitative MFM — •Tino Uhlig[1], Ulf Wiedwald[2], Denny Köhler[1], Paul Ziemann[2], and Lukas Eng[1] — [1]Institut für Angewandte Photophysik, TU Dresden — [2]Institut für Festkörperphysik, Universität Ulm

We present an easy, fast and reliable method for the preparation of magnetic force microscopy (MFM) probes based on single magnetic

nanoparticles. Due to their dipole like characteristics, these kind of magnetic probes open up possibilities for quantitative measurements of magnetizations on the nano-scale. Our fabrication method is based on the deposition of cobalt nanoparticles (diameter 30 nm) on a Si substrate and subsequent photochemical deposition of a gold layer on the particle surface. Single particles were attached to standard silicon AFM tips with the aid of a linker molecule (APTMS). The applicability of the fabricated probes was tested by imaging the magnetic domains of a hard disk drive sample. Furthermore a calibration method, using the deflection of the AFM cantilever in an external magnetic field, is presented.

DF 9.7 Tue 12:15 Poster A

Shift of the blocking temperature of Co nanoparticles by Cr capping — •Melanie Ewerlin[1], Derya Demirbas[1], Leonardo Agudo[2], Gunther Eggeler[2], and Oleg Petracic[1] — [1]Institut für Experimentalphysik / Festkörperphysik, Ruhr-Universität Bochum, 44780 Bochum, Germany — [2]Institute for Materials, Department of Material Science, Ruhr-Universität Bochum, 44780 Bochum, Germany

We have prepared Co nanoparticles (NPs) on Al_2O_3 buffer layers and studied the effect of capping with various amounts of Cr onto the magnetic properties. Structural and magnetometric characterization was performed using TEM and SQUID magnetometry, respectively. The uncapped Co NPs show superparamagnetic behavior with a blocking temperature of T_B=14K. The magnetic properties are strongly influenced by the Cr capping resulting in a decrease of T_B for nominal thicknesses of Cr up to 0.15nm. However, for larger values the blocking temperature increases again. XMCD measurements at the Cr edge indicate an anti-parallel alignment of the magnetic moments in the Cr layer with respect to the moments in the Co particle, which leads to a decrease of the effective magnetic volume and hence to a decrease of T_B. The second regime is governed by inter-particle coupling via Cr-bridges.

DF 9.8 Tue 12:15 Poster A

Interaction effects between self-assembled Co nanoparticles — •Astrid Ebbing[1], Leonardo Agudo[2], Gunther Eggeler[2], and Oleg Petracic[1] — [1]Institut für Experimentalphysik/Festkörperphysik, Ruhr-Universität Bochum, 44780 Bochum — [2]Institut für Werkstoffe, Ruhr-Universität Bochum, 44780 Bochum

In this work we present the influence of Pt on self-assembled Co nanoparticles (NPs). We show that capping the Co NPs with Pt results in strong changes in the magnetic properties. With increasing Pt capping we observe a transition from 'demagnetizing' (viz. dipolar) toward 'magnetizing' (e.g. polarization type) interactions between the NPs. We performed magnetization hysteresis, ZFC/FC vs. temperature and delta(M)-measurements using a superconducting quantum interference device magnetometer to investigate the nature of coupling between the NPs. The measurements show negative delta(M)-values for small amounts of Pt capping material and positive values for 0.53 nm Pt or more, which indicates a magnetizing interaction between the NPs via the Pt-bridges.

DF 9.9 Tue 12:15 Poster A

Characterization of superparamagnetic nanoparticles for bone tissue engineering — •M. Uhlarz[1], T. Herrmannsdörfer[1], R. De Santis[2], M. Sandri[3], A. Tampieri[3], E. Figallo[4], T. D'Alessandro[4], S. Keshari-Samal[5], G. Rischitor[6], and the MAGISTER collaboration[7] — [1]Hochfeld-Magnetlabor Dresden, HZ Dresden-Rossendorf — [2]IMCB-CNR, Napoli, Italia — [3]ISTEC-CNR, Faenza, Italia — [4]Fin-Ceramica SpA, Faenza, Italia — [5]ISMN-CNR, Bologna, Italia — [6]Western General Hospital, University of Edinburgh, UK — [7]Europäische Kommission, Bruxelles, Belgique

Currently, large bone or cartilage defects are stabilized by massively-invasive surgery. The permanent implants used for this purpose are either metallic prostheses, or body tissue taken elsewhere from the patient. In a novel tissue-engineering approach, autologous tissue regeneration is guided by implanted magnetic scaffolds under external magnetic field. These scaffolds attract superparamagnetic Fe_3O_4 (magnetite) nanoparticles tagged with Vascular Endothelial Growth Factor (VEGF) molecules. Release of the growth-factor molecules at the scaffold (optionally triggered by ac-field induced hyperthermia) attracts autologous chondrocytes and osteoblasts, which build up fresh bone and cartilage tissue. We report on the magnetic characterization of several biocompatible and biodegradable materials that might serve as scaffold materials.

This project is supported by the European Union's FP7-Cooperation Programme through the MAGISTER project (Magnetic Scaffolds for in-vivo Tissue Engineering), Large Collaborative Project FP7 - 21468.

DF 9.10 Tue 12:15 Poster A

Hall effect in nanodimensional multilayers based on island films of Pd and Fe — •Sergej A. Nepijko[1], Dmytro Kutnyakhov[1], Olena Tkach[2], Larysa Odnodvorets[2], Ivan Protsenko[2], and Gerd Schönhense[1] — [1]Institute of Physics, University of Mainz, 55099, Mainz, Germany — [2]Sumy State University, 40007, Sumy, Ukraine

Nanodimensional n-layers systems of $[Pd/Fe]_n/SiO_2/Si$, where $3 \leq n \leq 10$, were used to examine the Hall effect. Effective thickness of separate layers of Pd and Fe changed in the range from 0.4 to 1.4 nm (Pd) and from 0.6 to 0.9 nm (Fe). Electron microscopic studies indicate that the layers have island structure and their composition corresponds to fcc-Pd and bcc-Fe. Solid solutions of Pd-Fe with fct-lattice are formed only when the thickness of layers $\geq$ 3 nm and after annealing at $\geq$ 790 K. Measurement of Hall coefficient R_H indicate that its value monotonically decreases with increasing number of layers n. For example, for multilayer Pd(1.1 nm)/Fe(0.9 nm) R_H decreases from 5.5×10^{-9} m^3/C (n=2) to 3.97×10^{-9} m^3/C (n=10). A size dependence of R_H is observed also at fixed Fe layer thickness and variable thickness of Pd. For multilayer $[Pd(x)/Fe(0.6)]_{10}$ the Hall coefficient decreases from 4.80×10^{-9} m^3/C to 3.69×10^{-9} m^3/C while increasing the effective thickness of Pd from x= 0.4 to 1.4 nm.

DF 9.11 Tue 12:15 Poster A

Spin-fluctuation energies in 3*d* transition-metal clusters deposited on Pt (111) — •Sergej Riemer[1], Gustavo Pastor[2], Jesus Dorantes-Dávila[3], and Raul Garibay-Alonso[4] — [1]Universität Kassel, Germany — [2]Universität Kassel, Germany — [3]UASLP, San Luis Potosí, Mexico — [4]Universidad Autónoma de Coahuila, Mexico

A functional-integral theory of itinerant magnetism is applied to transition-metal clusters deposited on Pt (111). The low temperature limit of the local spin-fluctuation energies $\Delta F_l(\xi)$ at different atoms l is determined as a function of the exchange field ξ by using a real-space recursive expansion of the local Green's functions. The size, structural, and local-environment dependence of $\Delta F_l(\xi)$ is calculated for representative examples of Fe_N, Co_N and Ni_N with $N \leq 13$ atoms. The interplay between fluctuations of the module and of the relative orientation of the local magnetic moments is analyzed. Comparison between free and deposited clusters having the same structure and interatomic distances reveals remarkable changes in the spin-excitation spectrum of the clusters as a result of the hybridizations with the metallic support. For instance, in the case of small Fe clusters on Pt (111) one observes that the spin-flip energies are reduced by more than an order of magnitude as a consequence of deposition. A similar important reduction of the Curie temperature is expected. This contrasts with the results for the ground-state magnetic moments and magnetic order, which are essentially the same in the free and deposited configurations.

DF 9.12 Tue 12:15 Poster A

Coupling behavior in iron-oxide nanoparticle/Py thin film composite systems — •Caroline Fink[1], Philipp Szary[1], Giovanni Badini Confalonieri[1], Durgamadhab Mishra[1], Maria Benitez[1,2], Mathias Feyen[2], An-Hui Lu[2], Leonardo Agudo[3], Gunther Eggeler[3], and Oleg Petracic[1] — [1]Institut für Experimentalphysik/Festkörperphysik, Ruhr-Universität Bochum, D-44780 Bochum, Germany — [2]Max-Planck-Institut für Kohlenforschung, D-45470 Mülheim an der Ruhr, Germany — [3]Institut für Werkstoffe, Ruhr-Universität Bochum, D-44780 Bochum, Germany

We have investigated the magnetic and electrical transport properties of iron-oxide nanoparticle/Py thin film composite systems. Ultrathin films of Permalloy (Py) have been prepared by means of UHV ion beam sputtering and subsequently covered by one monolayer of iron-oxide nanoparticles. Post-annealing of the samples under controlled atmospheric conditions allows us to transform the particles into a mixed wüstite/magnetite (FexO/Fe3O4) phase showing intra-particle exchange bias. A slight variation of the NP type yields systems of different coupling behavior. Performing magnetometry and transport measurements we observe either a strong or weak coupling between the Py film and the NPs depending on the NP type. Moreover, a strongly decoupled behavior can be observed when adding a sapphire (Al2O3) layer separating the particles from the Py. Results have been compared with reference systems consisting of only NPs or only Py.

DF 9.13 Tue 12:15 Poster A

Magnetoresistance properties of Fe_3O_4 nanoparticles in a Cu matrix — •Sergej A. Nepijko[1], Dmytro Kutnyakhov[1], Maxym Demydenko[2], Serhiy Protsenko[2], Dmytro Kostyuk[2], and Gerd Schönhense[1] — [1]Institute of Physics, University of Mainz, 55099, Mainz, Germany — [2]Sumy State University, 40007, Sumy, Ukraine

The aim of the work was the manufacturing of ordered arrays of magnetic Fe_3O_4 nanoparticles, the investigation of their structural and phase state and magneto-resistance in a wide range of annealing temperatures. Nanoparticles were prepared by chemical synthesis and drop deposited onto a Si substrate. After deposition the ordered nanoparticle array was observed by TEM. Nanoparticle sizes changed from 6.0 nm (as deposited) to 11.6 nm (after annealing at 1200 K). The phase state of the nanoparticles was cubic (spinel type) with lattice parameter varying from 0.811 nm (as-deposited) to 0.840 nm (1200 K). The magnetoresistance was measured using nanostructured systems of Au(2nm)/Cu(20nm)/Fe_3O_4(nanoparticles)/SiO_2/Si with varying the angle between magnetic field direction and substrate plane from 0° to 90°. The resulted maximum value of magnetoresistance was about 2 %.

DF 9.14 Tue 12:15 Poster A

^{57}Fe Mössbauer spectroscopy on ferrite nanoparticles — •Mathias Kraken[1], Jochen Litterst[1], Ilka-Marina Grabs[2], Ingke-Christine Masthoff[2], Isabel Christina Souza Dinóla[3], Julian Andres Munevar Cagigas[3], Wiliam Trujillo Herrera[3], and Elisa Maria Baggio Saitovitch[3] — [1]Institut für Physik der kondensierten Materie | TU Braunschweig | Germany — [2]Institut für Partikeltechnik | TU Braunschweig | Germany — [3]Centro Brasileiro de Pesquisas Físicas | Rio de Janeiro | Brazil

Due to its specific timescale, Mössbauer spectroscopy is highly suitable to investigate the dynamic properties of magnetic nanoparticles. The hyperfine magnetic spectra between the blocking temperature and very low temperatures may exhibit a broad variety of different shapes. Accordingly, to describe this rich behaviour a whole range of different, controversially discussed models can be found in literature (1-3).
We performed ^{57}Fe Mössbauer measurements on $ZnFe_2O_4$ nanoparticles, prepared by a non-aqueous sol gel method and characterized by different techniques. The spectra were taken on strongly and weakly interacting particles and the fits to the spectra with the different models are compared in order to gain information about their suitability.

(1) D.H. Jones et al., J. Magn. Magn. Mater. 78, 320 (1989).

(2) S. Mørup et al., J. Magn. Magn. Mater. 40, 163 (1983).

(3) S. Bocquet et al., J. Magn. Magn. Mater. 109, 260 (1992).

DF 9.15 Tue 12:15 Poster A

Preparing of $La_{1/3}Sr_{2/3}FeO_3$ targets for sputtering of thin films — •Thomas Breuer, Thomas Brueckel, Joerg Voigt, and Joerg Persson — Peter Gruenberg Institut PGI and Juelich Centre for Neutron Science JCNS, JARA-FIT, Forschungszentrum Juelich GmbH, 52425 Juelich, Germany

$La_{1/3}Sr_{2/3}FeO_3$ is a transition metal oxide (TMO) with a perovskite structure. It exhibits strong electronic correlations, visible e.g. in a Verwey metal-insulator transition accompanying the antiferromagnetic phase transition at about $T_C = 200\,K$.
While the material has been investigated extensively in bulk form, the aim of the present study is to clarify its properties as thin epitaxial films. We have prepared ceramic sputter targets of $La_{1/3}Sr_{2/3}FeO_3$ in a solid state reaction and characterized them by means of chemical analysis, powder x-ray diffraction and magnetic measurements by a Vibrating Sample Magnetometer on PPMS. The material tends to lose oxygen during calcination and sintering at temperatures above 600 K which was detected by thermogravimetric analysis. Significant changes in structure and magnetic response are being observed for oxygen deficits as low as 2 %. Finally, the progress in the preparation and characterization of thin epitaxial films will be reported.

DF 9.16 Tue 12:15 Poster A

The first principle study of Cu-based hybrids — •Pegah Zolfaghari[1], Gilles A de Wijs[1], and Robert A de Groot[1,2] — [1]Electronic Structure of Materials, Institute for Molecules and Materials, Faculty of Science, Radboud University Nijmegen, Heyendaalseweg 135, 6525 AJ Nijmegen, The Netherlands — [2]Solid State Materials for Electronics, Zernike Institute for Advanced Materials, Rijksuniversiteit Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands

Hybrids, organic-inorganic materials, in the perovskite-type layer structures with the general formula $(C_nH_{2n+1}NH_3)_2MCl_4$ in which $n = 0, 1, 2, ...$, and M represents a divalent transition metal ion, have been extensively studied in recent years. Among these series of hybrids, the copper compounds are the most interesting ones. Firstly, the divalent metal Cu^{2+} is a strong Jahn-Teller ion, as a result different structual transitions in these materials occur. Secondly, the magnetic intra-layer interactions are ferromagnetic.

The density functional (DFT) calculations were applied to study the $(NH_4)_2CuCl_4$ and $(C_2H_5NH_3)_2CuCl_4$ compounds. The magnetic and electronic properties were investigated. The calculations reveal that the compounds have a stable, layered ferromagnetic ground state that is consistent with experimental results.

DF 9.17 Tue 12:15 Poster A

Synthesis and magnetic properties of cobalt ferrite nanoparticles — •Morad F. Etier[1], Vladimir V. Shvartsman[1], Frank Stromberg[2], Joachim Landers[2], Heiko Wende[2], Fábio G. Figueiras[3], and Doru C. Lupascu[1] — [1]Institute for Materials Science, University of Duisburg-Essen, Essen, Germany — [2]Faculty of physics and Center for Nanointegration (CeNIDE) Duisburg-Essen, University of Duisburg-Essen, Duisburg, Germany — [3]Department of Physics, CICECO, University of Aveiro, Aveiro, Portugal

Cobalt ferrite is one of the most widely used materials in magnetic recording devices due to its high coercivity (about 5400 Oe), moderate magnetization (84 emu/g), and good chemical stability. Below Tc = 820 K cobalt ferrite is in a ferrimagnetic state. The magnetic properties of cobalt iron oxide nanoparticles mainly depend on the annealing temperature and particle size.

Nanoparticles of cobalt ferrite were successfully fabricated by the co-precipitation method. The crystal structure was confirmed by X-ray diffraction, the composition by energy dispersive spectroscopy, and phase changes by thermogravimetric differential thermal analysis. The particle morphology was analyzed by scanning electron microscopy. Magnetic properties were investigated by magnetometry and Mössbauer spectroscopy. Particle size is in the range of 24 to 44 nm. Both the particle size and agglomeration level are controlled by the amount of sodium hydroxide used. Dependence of remnant magnetization and coercive field on particle size is analyzed.

DF 9.18 Tue 12:15 Poster A

Magnetic and Electronic properties of Mn-stabilized Zirconia (MnSZ) — •Jan Zippel[1], Michael Lorenz[1], Anette Setzer[1], Holger Hochmuth[1], Pablo Esquinazi[1], Nikolai Sobolev[2], Alexandre Jacquot[3], and Marius Grundmann[1] — [1]Universität Leipzig, Fakultät für Physik und Geowissenschaften, Institut für Experimentlaphysik II, Linnéstrasse 5, 04103 Leipzig, Germany — [2]Universidade de Aveiro, Departamento de Fisica, Campus de Santiago, 3810-193 Aveiro, Portugal — [3]Fraunhofer Institut für Physikalische Messtechnik, Heidenhofstrasse 8, D-79110 Freiburg, Germany

The possibility to combine both, the electron spin as a new degree of freedom and the electron charge offers opportunities for a new generation of devices. As recently predicted [1], MnSZ is proposed as a ferromagnetic semiconductor with a Curie temperature T_C above room temperature. As recently shown, a Mn related ferromagnetism has not been observed yet [2]. By applying an annealing step in oxygen deffficient ambient at about $T_{\rm ann} \approx 700°$ C to the MnSZ thin films grown by pulsed-laser deposition (PLD), we observe a ferromagnetic behavior in superconducting quantum interference device (SQUID) measurements at about $T = 60$ K. In addition, electron paramagnetic resonance (EPR) suggests a change of the Mn oxidation state from an EPR silent Mn^{3+} to Mn^{2+}. Seebeck-effect measurements verify a transition from p–type conductivity to n–type conductivity around 500 K. [1] S. Ostanin et *al.*, Phys. Rev. Lett. **98**, 016101 (2007). [2] J. Zippel et *al.*, Phys. Rev. B **82**, 125209 (2010).

DF 9.19 Tue 12:15 Poster A

The magneto-impedance of iron whiskers at low temperature — •Matthäus Langosch, Haibin Gao, and Uwe Hartmann — Institute of Experimental Physics, Saarland University, P. O. Box 151150, D-66041, Saarbrücken, Germany

In order to understand all aspects of the AC transport behavior of a ferromagnetic material in an external magnetic field at low temperature, iron single crystals (iron whiskers) were grown as specific samples to investigate the magneto-impedance (MI) effect at 4.2 K. The MI measurements were performed as a function of the magnitude of the driving current and its frequency. The chosen frequencies were up to

100 kHz, where domain wall motion takes place and contributes to the MI effect. The measured low temperature impedance changes are on the order of hundreds of percent and are much higher than that at room temperature. This behavior can mainly be attributed to a large mean free electronic path on the one hand and the skin effect on the other hand.

DF 9.20 Tue 12:15 Poster A

Structural and magnetic analysis of Vanadates — •Christine Tölzer[1], Johanna Brand[1], Masahiko Isobe[2], Karsten Binder[1], Timo Taetz[3], María Teresa Fernández-Díaz[5], Angela Möller[3,4], Yutaka Ueda[2], and Markus Braden[1] — [1]II. Institute of Physics, University of Cologne — [2]Institute for Solid State Physics, University of Tokyo — [3]Institute of Inorganic Chemistry, University of Cologne — [4]Department of Chemistry and Texas Center for Superconductivity, University of Houston — [5]Institute Laue-Langevin, Grenoble

We present the analysis of three different Vanadates: $InCu_{2/3}V_{1/3}O_3$, $Rb_2V_8O_{16}$ and ZnV_2O_4. The layered compound $InCu_{2/3}V_{1/3}O_3$ is a representative of the quasi two-dimensional S=1/2 honeycomb lattice due to the ordering of Cu and V. A Néel-temperature near 38 K was deduced from anomalies in the magnetic susceptibility. We have studied the magnetic structure in $InCu_{2/3}V_{1/3}O_3$ by neutron diffraction on the high-flux powder diffractometer D20. A rise in scattering upon cooling indicates magnetic ordering to set in near the anomaly observed in the susceptibility. Furthermore, we discuss the charge and orbital ordering in $Rb_2V_8O_{16}$ and in ZnV_2O_4, as analysed by single-crystal x-ray diffraction as function of temperature.

DF 9.21 Tue 12:15 Poster A

Normal and anomalous Hall effect in $NbFe_2$ — •Sven Friedemann[1], Manuel Brando[2], William J Duncan[3], Andreas Neubauer[4], Christian Pfleiderer[4], and Malte Grosche[1] — [1]University of Cambridge, Cavendish Laboratory, JJ Thomson Avenue, CB3 0HE Cambridge, United Kingdom — [2]Max Planck Institute for Chemical Physics of Solids, Nöthnitzer Strasse 40, 01187 Dresden, Germany — [3]Department of Physics, Royal Holloway, University of London, Egham TW20 0EX, United Kingdom — [4]Physik Department E21, Technische Universität München, James-Franck-Strasse, D-85748 Garching, Germany

The intermetallic system $NbFe_2$ exhibits ferromagnetic and antiferromagnetic order, which can be suppressed by slight changes to the composition within the $Nb_{1-y}Fe_{2+y}$ homogeneity range. A quantum critical point (QCP) arises at slight Nb excess of about $y = 0.015$. In proximity to its QCP $NbFe_2$ exhibits non-Fermi-liquid behaviour, which makes this material the first clear candidate for a three dimensional ferromagnetic QCP in a clean transition metal compound at ambient pressure. We present Hall effect measurements on several single crystals chosen from the $Nb_{1-y}Fe_{2+y}$ solution series. The data are analysed in terms of anomalous and normal contributions to the Hall voltage. We find anomalous contributions arising from both Side Jump and Skew Scattering with distinct changes in their relative strength as a function of Nb content. The normal contribution reflects the electronic structure.

DF 9.22 Tue 12:15 Poster A

First principles studies of complex magnetism in Mn nanostructures on Fe(001) surface — •ricardo noboru igarashi[1], angela burlamaqui klautau[2], and helena maria petrilli[1] — [1]Instituto de Física, Universidade de São Paulo, CP 66318, 05315-970, São Paulo, SP, Brazil — [2]Faculdade de Física, Universidade Federal do Pará, Belém, PA, Brazil

The magnetic properties of Mn nanostructures on Fe(001) surface have been studied using the noncollinear first-principles RS-LMTO-ASA (Real-Space Linear Muffin Tin Orbital Atomic Sphere Approximation) [1] method within density functional theory. We have considered a variety of nanostructures such adsorbed wires, pyramids, flat and intermixed clusters of sizes varying from two and nine atoms. Our calculations of interatomic exchange interactions reveal the long range nature of exchange interactions between Mn-Mn and Mn-Fe atoms. We have found that the strong dependence of these interactions of the local environment and the effect of spin-orbit coupling lead to the possibility of realizing complex magnetic structures such as helical and half skyrmion.

[1] S. Frota-Pessôa, Phys. Rev. B 69, 104401 (2004); Phys. Rev. B 46, 14570 (1992); P. R. Peduto, S. Frota-Pessôa and M. S. Methfessel, Phys. Rev. B 44, 13 283 (1991).

DF 9.23 Tue 12:15 Poster A

Incorporation of N codopants in Co:ZnO investigated by X-ray absorption spectroscopy — •Daniel Schauries[1], Andreas Ney[1], Verena Ney[1], Fabrice Wilhelm[2], Andre Rogalev[2], and Flora Yakhou[2] — [1]Fakultät für Physik, Universität Duisburg-Essen, Lotharstr. 1, D-47057 Duisburg, Germany — [2]European Synchrotron Facility, 6 Rue Jules Horowitz, BP 220, 38043 Grenoble Cedex, France

p-doping of ZnO in general remains a grand challenge for material science. In particular p-type ZnO is of interest to investigate the perspectives for obtaining RT-ferromagnetism in p-type Co:ZnO.

We have grown Co:ZnO:N(0001) on sapphire substrates using reactive magnetron sputtering from Co/Zn targets at Co concentrations of 10, 15 and 20% and different Ar : O_2 : N_2 sputter gas compositions.

The structure was studied by synchrotron-based element specific X-ray absorption spectroscopy. All edges were measured with the electric field of the X-rays perpendicular and parallel to the c-axis to obtain X-ray Linear Dichroism (XLD). Subsequently all spectra for the Zn, Co, O and N-K-edge were simulated with FDMNES[1] to determinate the positions of the species. While Co only occupies Zn-sites, the situation turned out to be more complex for N — for low N_2-concentration in the sputter gas probably incorporated N_2 was formed, high N_2-levels also led to the formation of substitutional N atoms on O-sites.

The resulting magnetic properties of Co:ZnO:N will be discussed as well. We greatfully acknowledge financial support from the DFG through the Heisenberg Programme.

[1] Y. Joly, Phys. Rev. B **63**, 125120-125129 (2001).

DF 9.24 Tue 12:15 Poster A

Polarized Neutron Reflectometry of Rare-Earth Nitride Thin Films — •Sebastian Brück[1,2], David Cortie[2], Josh Brown[3], Thomas Saerbeck[2], Clemens Ulrich[1], Frank Klose[2], and James Downes[3] — [1]School of Physics, University of New South Wales, Sydney, Australia — [2]Australian Nuclear Science and Technology Organization, Lucas Heights, Australia — [3]Department of Physics, Macquarie University, Australia

Rare-earth monopnictides like HoN, DyN, or ErN are semiconductors with typical band gaps between 0.73 and 1.3eV. The fact that they exhibit ferromagnetic ordering at low temperatures makes them possible candidates for an intrinsically ferromagnetic semiconductor. Thin, polycrystalline rare-earth nitride films of 15 to 40nm thickness were grown onto c-plane sapphire substrates using low-energy ion assisted deposition. A temperature- and field-dependent polarized neutron reflectometry study in combination with SQUID magnetometry was carried out to characterize the magnetic properties of these films in a depth resolved way. The investigated samples show a homogeneous distribution of the magnetic moment throughout the film with ferromagnetic ordering temperatures comparable to the bulk materials. ErN and HoN films do not show an opening of the magnetic hysteresis loop even for the lowest measured temperature of T=2K. DyN on the other hand clearly shows a coercive field and remnant magnetization at 5K.

DF 9.25 Tue 12:15 Poster A

ZnO Metal Semiconductor Field Effect Transistor with magnetic channel — •Tim Kaspar, Danilo Bürger, Ilona Skorupa, Vicki Kühn, Artur Erbe, Manfred Helm, and Heidemarie Schmidt — Helmholtz-Zentrum Dresden-Rossendorf, P.O. Box 510119, 01314 Dresden, Germany

We focus on the development of transparent semiconductor spintronics devices. Our work is motivated by the observation of s-d exchange inducted spin polarization in magnetic ZnO:(Co, Mn) thin films below 50 K and related magnetoresistance effect [1]. Our aim is to control the conductance in ZnO Metal Semiconductor Field Effect Transistors (MESFET) with magnetic channel by external electrical AND magnetic fields. The magnetic ZnO:(Co, Mn) channel layers have been deposited by pulsed laser deposition on c-plane sapphire substrates. Gate, source, and drain contacts have been structured by optical lithography. The gate contact has been fabricated by reactive sputtering of Ag/Au [2]. Source and drain contacts have been fabricated from high conducting transparent ZnO. The characteristics of the ZnO-based MESFETs with magnetic channel in external perpendicular magnetic fields ranged from -1.8T to +1.8T are presented.

[1] Qingyu Xu, *et al.*, Phys. Rev. Lett. **101**, 076601 (2008)

[2] H.Frenzel *et al.*, Appl. Phy. Lett. **92**, 192108 (2008

DF 9.26 Tue 12:15 Poster A

Anomalous hysteretic Hall effect in a ferromagnetic, Mn-

rich, amorphous Ge:Mn nano-network — •Danilo Bürger, Shengqiang Zhou, Marcel Höwler, Xin Ou, György Kovacs, Helfried Reuther, Arndt Mücklich, Wolfgang Skorupa, Manfred Helm, and Heidemarie Schmidt — Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, P.O. Box 510119, 01314 Dresden, Germany

The read out of the magnetization state in magnetic semiconductors by electrical Hall resistance measurements makes it possible to use ferromagnetic semiconductors in nonvolatile memories. In a previous work [1], we fabricated ferromagnetic Ge:Mn by Mn ion implantation and pulsed laser annealing (PLA) and observed hysteretic Hall resistance below 10 K. By applying different PLA conditions we fabricated a percolating, Mn-rich, amorphous Ge:Mn nano-network with hysteretic Hall resistance up to 30K. This nano-network is embedded in crystalline Ge:Mn between 5 nm and 40 nm under the sample surface. We applied chemical and physical etching to confirm the contribution of the nano-network to the magnetic properties. The nano-network has a significant influence on the correlation between magnetism and anomalous Hall resistance. In the future such nano-networks may be used to spin-polarize free charge carriers in semiconductors at room temperature. [1] S. Zhou *et al.*, Phys. Rev. B **81**, 165204 (2010)

DF 9.27 Tue 12:15 Poster A

Optical and Magneto-optical Properties of ZnO(0001) Single Crystals Implanted with Fe and Co Ions — •Scarlat Camelia[1], Zhou Shengqiang[1], Gordan Ovidiu[2], Fronk Michael[2], Zahn R. T. Dietrich[2], Helm Manfred[1], Schmidt Heidemarie[1], and Salvan Georgeta[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Germany — [2]Semiconductor Physics, Chemnitz University of Technology, Germany

ZnO is a transparent wide-band-gap semiconductor which has been intensively investigated in the view of (magneto-) and (opto-)electronic applications. In this work the (magneto-)optical properties of unimplanted ZnO(0001) single crystals and single crystals implanted with ^{57}Fe and Co ions were investigated at room temperature by means of Raman spectroscopy, spectroscopic ellipsometry, and magneto-optical Kerr effect (MOKE) spectroscopy. The ZnO (0001) single crystals were coimplanted with ^{57}Fe and Co ions at 623 K with same fluence respectively. After implantation the samples were annealed in a high-vacuum furnace at 1073 K for different annealing time. The Raman spectra measured in resonance with an excitation energy of 3.82 eV exhibit higher order scattering by LO phonons. The increase in the ratio between the second and the first order phonon peak intensities for long annealing time can be correlated with a reduction in the number of defects and with improved crystallinity. The implanted ZnO crystals exhibit magneto-optical activity in two broad spectral ranges centered around 3 eV and around 4.3 eV, the strength of which also varies significantly with the annealing time.

DF 9.28 Tue 12:15 Poster A

Bipolar resistive switching at manganite/manganite interfaces — •Christin Kalkert, Jon-Olaf Krisponeit, Vasily Moshnyaga, Bernd Damaschke, and Konrad Samwer — I. Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Bipolar resistive switching stands for remanent switching of resistivity by application of electric fields reversible by opposite polarities. This phenomenon is observed in a wide variety of perovskite materials and holds the potential of creating new resistive random access memory devices. $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) manganite films were prepared by using the metalorganic aerosol deposition technique. On Al_2O_3 substrates the manganite films show nanocolumnar growth with different growth orientations as determined by x-ray diffraction and TEM analysis. The films were structured by electron beam lithography into LSMO paths/bridges between larger LSMO contact areas; after a second lithography step Au/Cr films were deposited onto the contact areas. These structures show bipolar resistive switching, which can also be induced and probed by means of conductive AFM. The C-AFM measurements show that the switching takes place at the manganite/manganite interfaces, i.e. at the boundaries of the nanocolumns. The resistive switching of the structures and the C-AFM measurements are discussed in terms of a local structural transformation at the manganite/manganite interfaces. (APL 99, 132512, (2011))

Financial support by DFG via SFB 602, TPA2 and the Leibniz Program is ackowledged.

DF 9.29 Tue 12:15 Poster A

Ultrafast Spin-Lattice Coupling in Transition Metal Oxides — •Lena Maerten, André Bojahr, Marc Herzog, Daniel Schick, and Matias Bargheer — Insitut für Physik und Astronomie, Universität Potsdam, Germany

Understanding the interplay of the electronic, lattice and spin degrees of freedom in solids is essential for devising future nanoelectronic applications. Nanostructured transition metal oxides provide an ideal test ground for studying the interaction of the contributing subsystems on an ultrafast time scale.

We use femtosecond optical and infrared pump probe spectroscopy and time resolved x-ray diffraction techniques to investigate the electronic and lattice dynamics in $SrRuO_3/SrTiO_3$ and $(LaSr)MnO_3/SrTiO_3$ superlattices. Sub-picosecond buildup of magnetostrictive stress has been found in a $SrRuO_3/SrTiO_3$ nanolayer [1]. We show additional temperature- and fluence-dependent reflectivity data revealing further insight into the demagnetization process and discuss the coupling of the magnetic and structural degrees of freedom for the different materials by means of x-ray diffraction results.

[1]C. v. Korff Schmising et al., PRB 78, 060404 (2008)

DF 9.30 Tue 12:15 Poster A

Colossal Magnetoelastic Effects at the Phase Transition of (La, Pr, Ca)MnO_3 — •Markus Michelmann, Christoph Meyer, Vasily Moshnyaga, and Konrad Samwer — I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37707 Göttingen

A strong coupling of charge, spin and lattice degrees of freedom in perovskite manganites, i.e. (La, Pr, Ca)MnO_3, results from the competition between the ferromagnetic double exchange and charge/orbital ordering, promoted by the electron-phonon interaction. Therefore, the paramagnetic-ferromagnetic (PM-FM) phase transition is clearly reflected in the behavior of the elastic constants. Here, we report ultrasound velocity and attenuation in polycrystalline $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$ bulk samples (y = 0, 0.4, 0.5, 1) as a function of temperature, $T = 10 - 300$ K, and magnetic field, $B = 0 - 7$ T, with special focus on the hysteresis effects and metamagnetism at the 1st order PM-FM transition. Close to the Curie point modest magnetic fields, $B = 1 - 5$ T, induce a large increase of shear stiffness and a strong softening of bulk modulus by about 10%. A minimum in bulk modulus and a peak in longitudinal sound attenuation were observed at the phase transition and attributed to a coupling between the lattice and spin fluctuations. The magnitude of this softening is maximized at a certain temperature and magnetic field, indicating a critical end point of the magnetic transition. Support by Deutsche Forschungsgemeinschaft via SFB 602, TP A2 is acknowledged.

DF 9.31 Tue 12:15 Poster A

Magneto-optical Studies on Transition Metal doped Zinc Oxid — •Stephanie Jankowski[1], Sebastian Geburt[2], Carsten Ronning[2], and Wolfram Heimbrodt[1] — [1]Department of Physics and Material Science Center, Philipps- University Marburg, Renthof 5, D-35032 Marburg, Germany — [2]Physikalisch-Astronomische Fakultät, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, D-07743 Jena, Germany

We present the results of magneto photoluminescence on ZnO-bulk doped with the magnetic ions Co and Mn. The measurements have been performed in magnetic fields up to 7 Tesla in a temperature range 1.8-300 K. Zeeman spectroscopic in the excitonic region have been used to determine the g-factors of the samples. Normally the g-factor of II-VI diluted magnetic semiconductor is very high because of the Giant Zeeman effect. Even in case of transition metal doped ZnO surprisingly small Zeeman-splitting has been found. In comparison to other Mn- and Co-doped II-VI semiconductors the optical 3d intra-ionic transitions are very weak. The physical reasons for these phenomena will be discussed.

DF 9.32 Tue 12:15 Poster A

Microscopic and macroscopic studies on the magnetoelectric coupling in chiral multiferroics — Max Baum[1], •Jonas Stein[1], Simon Holbein[1], Thomas Finger[1], Navid Qureshi[1], Jeannis Leist[3], Joachim Hemberger[1], Petra Becker-Bohatý[2], Ladislav Bohatý[2], Götz Eckold[3], and Markus Braden[1] — [1]II. Physikalisches Institut, Universität zu Köln — [2]Institut für Kristallographie, Universität zu Köln — [3]Institut für Physikalische Chemie, Universität Göttingen

In the chiral magnets $MnWO_4$ and $TbMnO_3$ ferroelectric polarisation is directly induced by the non-collinear magnetic structure. We present

microscopic neutron scattering studies and macroscopic measurements of the ferroelectric polarisation and of the magnetic structure in these materials. Using a stroboscopic method the control of the chiral magnetism by an external electric field is analysed with polarised neutrons finding unexpectedly large relaxation times. Measurements of the pyrocurrent on $MnWO_4$ confirm these long time scales. In addition we discuss the magnetic excitations at the incommensurate zone centre of $MnWO_4$, a low energy mode should posses electromagnon character. The magnetic structure of $NaFe(WO_4)_2$ was studied by neutron diffraction. At zero magnetic field we find an incommensurate structure which transforms to commensurate order upon the application of moderate fields.

DF 9.33 Tue 12:15 Poster A

On the ferroelectric phase transition of boracites — •Michael Fechner and Nicola Spaldin — ETH Zurich, Department for Material Theory,CH-8093 Zurich, Switzerland

We present results of first-principles electronic structure calculations for the Cl and I boracites. The boracites[1] are a class of ferroelectric minerals with formula $Me_2B_7O_{12}X$, where Me is a bivalent metal (Fe, Co, Zn) and X a halogen (Cl, Br or I). All boracites are cubic at high temperature, and undergo a phase transition on cooling first to an orthorhombic phase and in some cases subsequently to a triclinic phase. Boracites with magnetic ions further develop magnetic ordering and become multiferroic. Here we investigate the mechanism for the ferroelectric phase transition from the cubic high symmetry phase to the orthorhombic ferroelectric intermediate and triclinic low temperature phase. Finally we found a dominant unstable phonon mode at the Γ point which drives the phase transition. However this mode couples with modes at the zone boundary making the boracites improper ferroelectrics.

[1] Nelmes, R., 1974. Structural Studies of Boracites - Review of Properties of Boracites. Journal Of Physics C-Solid State Physics, 7(21), pp.3840-3854.

DF 9.34 Tue 12:15 Poster A

XAS and XMCD of ultrathin Fe layers on $BaTiO_3$(001): Experiment and Theory — •Stephan Borek[1], Angelika Chassé[1], Guntram Fischer[1], Wolfram Hergert[1], Remya Kunjuvettil Govind[1], Karl-Michael Schindler[1], Vasili Hari Babu[2], Joachim Gräfe[2], Martin Welke[2], and Reinhard Denecke[2] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg — [2]Wilhelm-Ostwald-Institut für Physikalische und Theoretische Chemie, Universität Leipzig

Promising candidates for switching the magnetization using voltages are multiferroic systems. As a model system we studied ultrathin Fe layers on $BaTiO_3$(001). Using x-ray absorption spectroscopy as a powerful method to investigate structural, electronic and magnetic properties simultaneously, the circular dichroism in x-ray absorption (XMCD) and x-ray absorption as such were used to determine the remanent magnetization as a function of film thickness. The onset of ferromagnetism at a temperature of 150 K was found for 5±1 layers. Using a Heisenberg-model in the framework of Monte-Carlo-Simulations shows that up to 3 monolayers the critical temperature is around 170 K. In addition the contribution of each layer could be separated using a fully relativistic multiple scattering formalism. Different magnetic structures and their impact on the spectroscopic properties, as well as the anisotropic behaviour of the multiferrroic systems have been investigated theoretically. The spin and orbital moments as obtained from the XMCD experiments and DMFT calculations will be compared.

DF 9.35 Tue 12:15 Poster A

Ferroelectricity and Magnetic Structure of Mn Moments in Multiferroic $GdMnO_3$ — •Enrico Schierle[1], Victor Soltwisch[1], Christoph Trabant[1,2], Alex Frano[1,3], Detlef Schmitz[1], Fabiano Yokaichiya[1,6], Andrej Maljuk[1,4], Dimitri Argyriou[1,5], and Eugen Weschke[1] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie, Germany — [2]II. Physikalisches Institut, Universität zu Köln, Germany — [3]MPI-FKF Stuttgart, Germany — [4]IFW, Dresden, Germany — [5]European Spallation Source, Lund, Sweden — [6]Laboratrio Nacional de Luz Sincrotron, Campinas-SP, Brasil

Orthorhombic $REMnO_3$ oxides can show strongly coupled ferroelectric (FE) and magnetic order, with FE polarization P induced by magnetic cycloids of the Mn spins[1,2]. However, from recent X-ray diffraction studies, there is growing evidence for a decisive role of ordering of the RE-4f moments as well and it seems that a large part of P can be explained by ionic displacements not necessarily connected with cycloidal magnetic order of Mn moments[3,4,5]. We employed Resonant Soft X-Ray Scattering at the Mn-$L_{2,3}$ resonance to prove the existence of a ferroelectric phase at the surface of $GdMnO_3$ even in zero external magnetic field and to examine its connection to the magnetic structure of the Mn moments in an element specific way.

[1] Kimura et al., Nature **426**, 55-58 (2003) [2] Kenzelmann et al., PRL **95**, 087206 (2005) [3] Schierle et al., PRL **105**, 167207 (2010) [4] Feyerherm et al., Journal of Physics: Conference Series **200**, 012032 (2010) [5] Walker et al., Science **333**, 1273 (2011)

DF 9.36 Tue 12:15 Poster A

Electronic and magnetic properties of $LuFe_2O_4$ — •Christine Derks[1], Karsten Kuepper[2], Manfred Neumann[1], Dharmalingam Prabhakaran[3], Stephen J. Blundell[3], Andrei Rogalev[4], and Fabrice Wilhelm[4] — [1]Fachbereich Physik, Universität Osnabrück, Germany — [2]Institut für Festkörperphysik, Universität Ulm, Germany — [3]Department of Physics, University of Oxford, United Kingdom — [4]ESRF, Grenoble, France

$LuFe_2O_4$ is a compound showing fascinating magneto electric coupling via charge ordering. Electronic and magnetic properties of the charge ordered phase of LuFe2O4 have been investigated by means of x-ray spectroscopic and theoretical electronic structure approaches [1]. Using hard x-ray radiation of the ESRF ID12 circular polarisation beamline, Fe K-edge and Lu L-edge spectra have been detected. The Fe K-edge spectra will be discussed in comparison to the former Fe L-edge spectra. The Lu L-edge spectra show very interesting XMCD signals from which a small magnetic moment could be deduced.

[1]Kuepper et al. Phys. Rev. B, Vol. 80, 22, 220409

DF 9.37 Tue 12:15 Poster A

Influence of the strength of the magnetoelectric coupling on the electric field induced magnetization reversal in a composite multiferroic chain — Paul P. Horley[1], Alexander Sukhov[2], Chenglong Jia[2], Eduardo Martinez[1], and •Jamal Berakdar[2] — [1]Centro de Investigacion en Materiales Avanzados (CIMAV S.C.), Chihuahua/Monterrey, 31109 Chihuahua, Mexico — [2]Institut für Physik, Martin-Luther Universität Halle-Wittenberg, 06120 Halle/Saale, Germany

A theoretical study of the multiferroic dynamics in a composite one-dimensional system consisting of unstrained $BaTiO_3$ multiferroically coupled to an iron chain is presented. The method [1] is based on the thermodynamical treatment of the magnetization and the polarization quantitatively described via the Landau-Lifshits-Gilbert and the Landau-Khalatnikov equations (both at T=0 K) coupled via an additional term in the total free energy. The coupling originates from the screening charge induced in the ferromagnet by the ferroelectric polarization in a very narrow interfacial layer. For real parameters corresponding to the rhombohedral phase of $BaTiO_3$ and for bcc iron and for a wide range of strengths of this coupling we predict the possibility of obtaining a well-developed hysteresis in the ferromagnetic part of the system induced by an external electric field. We also inspect the dependence of the reversal modes on the electric field frequency and predict a considerable stability of the magnetization reversal for frequencies in the range of 0.5÷12[GHz]. [1] A. Sukhov *et al.,* J. Phys.: Cond. Matter **22**, 352201 (2010); Ferroelectrics (at press).

DF 9.38 Tue 12:15 Poster A

Electric field controlled manipulation of the magnetization in $BaTiO_3$ based ferroelectric/ferromagnetic hybrid structures — •Stephan Geprägs, Matthias Opel, Sebastian T. B. Goennenwein, and Rudolf Gross — Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching

Multiferroic materials, which simultaneously possess at least two long-range ordering phenomena in the same phase, have attracted widespread interest over the last years. In particular, the coexistence and cross-coupling of ferroelectric and ferromagnetic ordering in magnetoelectric multiferroics could offer the possibility to electrically read and write the magnetic state in future non-volatile memory cells. Unfortunately, these materials are scarce in nature. Attractive alternatives are composite material systems, in which ferromagnetic and ferroelectric compounds are combined. Such extrinsic multiferroic structures enable large and robust magnetoelectric effects at room temperature due to the elastic coupling between the ferroic constituents.

Here, we report on the electric field control of the magnetization in ferromagnetic/ferroelectric hybrid structures based on $BaTiO_3$ single crystals, using different materials as ferromagnetic layer, such as polycrystalline Ni and $Fe_{50}Co_{50}$ as well as epitaxial Fe_3O_4 and

Sr_2CrReO_6 thin films. In these hybrid structures, reversible and irreversible changes of the magnetization as a function of the applied electric field were found, which are discussed in the framework of a theoretical model based on molecular dynamics simulations.

DF 9.39 Tue 12:15 Poster A

Interfacial effects on $[(SrMnO_3)_j/(LaMnO_3)_k]_N$ multilayers — •Markus Waschk, Paul Zakalek, Alexander Weber, and Thomas Brückel — Jülich Centre for Neutron Science JCNS-2 and Peter Grünberg Institut PGI-4, Forschungszentrum Jülich GmbH, D-52425 Jülich

On the search for new storage devices, the combination of ferroelectric and ferromagnetic properties in metal-oxide layers opens a wide field of new non-volatile memory devices, which show low energy consumption. Here we combine $LaMnO_3$ (LMO) and $SrMnO_3$ (SMO), which both are antiferromagnetic bulk insulators, while a multilayer stack behaves as ferromagnetic conductor for very small bilayer thicknesses. The ferromagnetism of the lower LMO layer is induced by the interface to the upper SMO layer. The influence is strongly dependent on the roughness of the interface, and was not yet observed in the opposite boundary. Our multilayers are grown epitaxially on $SrTiO_3$ (STO) (100) single crystals by an oxygen-assisted Molecular Beam Epitaxy System and alternatively, to compare both preparation methods, by a high pressure oxide sputtering system. Within our very smooth layers with interfacial roughness of the order of a unit cell we study the influence of the interface quality on the magnetic behaviour. We present the preparation method from first steps to a complex multilayer and the results of our in-house characterisation methods. Further we show our first results of a polarized neutron reflectometry study at D-17 of the ILL in Grenoble which show depth resolved the magnetic properties of the single layers and interfaces.

DF 9.40 Tue 12:15 Poster A

Fe-Cr cation ordering in PLD grown thin-films of multiferroic double perovskite Bi_2FeCrO_6 — •Vikas Shabadi, Philipp Komissinskiy, Mehran VafaeeKhanjani, Aldin Radetinac, and Lambert Alff — Institut für Materialwissenschaft, Technische Universität Darmstadt, Petersenstraße 23, 64287 Darmstadt, Germany

Co-existence of magnetism and ferroelectricity was theoretically predicted in the ordered double perovskite Bi_2FeCrO_6 [1]. We report epitaxial BFCO thin-films grown by pulsed laser deposition from a 20 % Bi-rich ceramic target on single crystal $SrTiO_3$(100) substrates. The degree of the Fe-Cr cation ordering in the BFCO films was comparatively calculated based on the X-ray diffraction patterns. The magnetic moments of the BFCO films were measured with a SQUID magnetometer and analyzed as a function of the Fe-Cr ordering. We believe that the discrepancies in the previously reported values of the magnetic moment of BFCO are connected to the varying degree of Fe-Cr cation ordering [2,3]. Further motivation has been derived from a recent experiment that achieved more than 90 % spontaneous B-site ordering in a similar Fe-Cr based double perovskite system [4].

[1] P. Baettig and N. A. Spaldin. Appl. Phys. Lett. 86, 012505 (2005)
[2] D. H. Kim et al. Appl. Phys. Lett. 89, 102902 (2006)
[3] R. Nechache, et al. J. Appl. Phys. 105, 061621 (2009)
[4] S. Chakraverty, M. Kawasaki et al. Phys. Rev. B 84, 064436 (2011)
The authors would like to acknowledge the support from DAAD.

DF 9.41 Tue 12:15 Poster A

Chemical solution deposition of multiferroic La0.7Sr0.3MnO3, BaTiO3 thin films prepared by ink plotting — •Anke Kirchner[1], Melis Arin[2], Petra Lommens[2], Xavier Granados[3], Susagna Ricart[3], Bernhard Holzapfel[1], and Isabel van Driessche[2] — [1]IFW Dresden, Institute for Metallic Materials, Helmholtzstr. 20, 01069 Dresden, Germany — [2]SCRiPTs, Department of Inorganic and Physical Chemistry, Ghent University, Krijgslaan 281 (S3), 9000 Ghent, Belgium — [3]Materials Science Institute of Barcelona, CSIC-ICMAB, Campus Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain

Ferroelectric BaTiO3 (BTO) as well as ferromagnetic La0.7SrMnO (LSMO) thin films were prepared by chemical solution deposition (CSD). Based on these, a multiferroic architecture stack of La0.7Sr0.3MnO3 / BaTiO3 layers was developed. Aqueous, environmentally friendly precursor solutions were formulated for both materials. These are used for ink plotting on SrTiO3 (100) substrates. Films were subjected to a subsequent thermal treatment at the corresponding crystallization temperature. The structural as well as the magnetic and electric properties are presented. The Curie temperature of the ferromagnetic LSMO layer with a film thickness of only 60 nm was determined to 360 K. The magnetization curve indicates a hysteresis loop with a saturation magnetization above 400 emu/cm3. The ferroelectric character of the BTO films was demonstrated by polarization curves.

DF 9.42 Tue 12:15 Poster A

Diffraction Anomalous Fine Structure of Ho_2PdSi_3 and $YMn_{2-\xi}Fe_\xi O_5$ — •Melanie Nentwich[1], Matthias Zschornak[1], Carsten Richter[1,2], and Dirk C. Meyer[1] — [1]TU Bergakademie Freiberg, Institut für Experimentelle Physik, Leipziger Straße 23, 09596 Freiberg — [2]Hamburger Synchrotronstrahlungslabor HASYLAB at DESY

Diffraction Anomalous Fine Structure (DAFS) is a site-selective method for studying local electronic structures. As an advantage over X–ray Absorption Fine Structure (XAFS) it is possible to differentiate between atoms of the same kind but different Wyckoff positions which is especially useful for site–ordered mixed valence systems. Here, this method was applied to study the substitution of Mn atoms with Fe on the octahedral and pyramidal sites in $YMn_{2-\xi}Fe_\xi O_5$ [2]. Further, the *c*–ordering of Pd substitutes on Si sites according to a super structure proposal from F. Tang et al. [1] was investigated for the intermetallic compound Ho_2PdSi_3. Theoretical modelling was performed using the FDMNES code [3]. The measurements of the experimental data have been carried out at beamline E2 of DESY/HASYLAB Hamburg.
[1] F. Tang et al., Phys. Rev. B 84, 104105 (2011).
[2] F. Wunderlich et al., Phys. Rev. B 82, 014409 (2010).
[3] Y. Joly, Phys. Rev. B 63, 125120-125129 (2001).

DF 9.43 Tue 12:15 Poster A

Synthesis and characterisation of $BaTiO_3$ nanopowders and $CoFe_2O_4/BaTiO_3$ nanocomposites — •Yanling Gao, Morad Etier, and Doru C. Lupascu — Institute for Materials Science, University Duisburg-Essen, Universitätsstrasse 15, 45141 Essen, Germany

Multiferroic materials have drawn much attention, because they display the coexistence of ferroelectric and magnetic properties. In this study, we have succeeded in the synthesis and characterization of the $BaTiO_3$ nanocrystals by the low cost and straightforward autocombustion process of amorphous organic precursor. In the following, $CoFe_2O_4/BaTiO_3$ nanocomposites with core/shell structures were also obtained by using this process. The particles are systematically characterized by powder X-ray diffraction (XRD), scanning electron microscopy (SEM), thermogravimetric, differential thermal analyses (TGA/DTA), and infrared spectroscopy (IR). The XRD results confirm the presence of both the spinel and the perovskite phases. The SEM-EDX and the atomic force microscopy (AFM) micrographs of $CoFe_2O_4/BaTiO_3$ show two-phase composite nanostructures of a cobalt ferrite core coated with a $BaTiO_3$ shell. The weight fraction of $CoFe_2O_4$ and the size of nanocomposites are the keys to the dielectric and magnetic properties of $CoFe_2O_4/BaTiO_3$ nanocomposites.

DF 9.44 Tue 12:15 Poster A

Topology of spin polarization of the 5d states on W(110) and Al/W(110) surfaces — •Artem G. Rybkin[1], E. E. Krasovskii[2,3,4], D. Marchenko[5], E. V. Chulkov[2,4,6], A. Varykhalov[5], O. Rader[5], and A. M. Shikin[1] — [1]St. Petersburg State University — [2]University of the Basque Country, San Sebastián — [3]IKERBASQUE Bilbao — [4]Donostia International Physics Center — [5]Helmholtz-Zentrum Berlin — [6]Materials Physics Center, CSIC-UPV/EHU, San Sebastián

The spin polarization of W(110) and Al/W(110) surfaces is studied by spin- and angle-resolved photoemission. On both surfaces distinct $E(\mathbf{k}_\parallel)$ dispersions are identified with an unusual topology: a single spectral branch is spin polarized antisymmetrically relative to the $\bar{\Gamma}$ point, and two spin-polarized branches cross at $\bar{\Gamma}$. Based on *ab initio* theory coupled with one-step photoemission calculations, we show that the measured spin polarization is a property of the ground state and identify the effect as the counterpart of the recently discovered Rashba-polarized bulk states but with a distinct non-Rashba topology. We address also the question of topological protection.

DF 9.45 Tue 12:15 Poster A

STM studies on the ternary topological insulator $PbBi_4Te_7$ —

•Andreas Eich, Alexander Ako Khajetoorians, Julian Hagemeister, Oswald Pietzsch, Jens Wiebe, and Roland Wiesendanger — Institute of Applied Physics, University of Hamburg, Jungiusstrasse 11, D-20355 Hamburg, Germany

Topological insulators are a new class of materials with a bulk band gap like an ordinary insulator but exhibit a gapless surface state where the spin and momentum are locked. This topological surface state which results from a combination of spin-orbit interactions and time-reversal symmetry exhibits exotic spin-dependent transport phenomena at the surface. Nevertheless, the electronic properties of these surface states can be influenced by adsorbates. By adding a third component to a binary topological insulator it is also possible to influence both the energetic position of the Dirac cone and the surface state localization. Here we show STM measurements of the structure of a ternary topological insulator, namely $PbBi_4Te_7$. It has a hexagonal unit cell and contains five-layer (5L) and seven-layer (7L)-blocks with the atomic layer sequence, Te-Bi-Te-Bi-Te (5L) and Te-Bi-Te-Pb-Te-Bi-Te (7L). Theory predicts that not only the position of the Dirac cone relative to the Fermi energy is changed but that the surface states are localized in the 7L-block, leading to buried surface-states in the case of a 5L-terminated surface. We review the growth properties of this crystal and comment on the topological properties of these layers.

DF 9.46 Tue 12:15 Poster A

Bose-Hubbard model on two-dimensional line graphs — •Johannes Motruk and Andreas Mielke — Institut für Theoretische Physik, Ruprecht-Karls-Universität Heidelberg, Philosophenweg 19, D-69120 Heidelberg

We investigate the positive hopping bosonic Hubbard Model on line graphs of finite 2-connected planar bipartite graphs. The model on these lattice geometries exhibits flat bands and the single- as well as many-particle ground states are highly degenerate. Using notions from graph theory, we are able to give a basis for the space of many-particle ground states. The particles in these states are localized on vertices of the line graph which are edges of the original graph belonging to edge-disjoint cycles. This construction works up to a certain critical filling factor at which the cycles are close-packed. We rigorously show the linear independence of these states and prove that they span the space of many-particle ground states.

Furthermore, we establish that the entropy per lattice site in the ground state with constant (except critical) filling factor remains finite in the thermodynamic limit. Some of our findings can be applied to spin models of quantum antiferromagnets at high fields on the considered lattices.

DF 9.47 Tue 12:15 Poster A

Growth, Annealing and Characterization of $Sr_3Fe_2O_{7-\delta}$ — •Darren Peets[1], Junghwa Kim[1], Andrey Maljuk[1,2], Chengtian Lin[1], and Bernhard Keimer[1] — [1]MPI-FKF, Heisenbergstr. 1, D-70569 Stuttgart — [2]IFW Dresden, Helmholtzstr. 20, D-01069 Dresden

Iron(IV)- and ruthenium(IV)-containing perovskite-related phases have proven rich in novel physics. $SrFeO_{3-x}$ exhibits a wide variety of unusual magnetic phases, from five distinct types of helical magnetism at $x = 0$ [1] to a phase with frustrated, disordered Fe^{4+} moments at $x = 0.25$ [2]. The Ru-based intergrowth phase $Sr_3Ru_2O_7$ exhibits metamagnetic quantum critical points in field. However, the magnetic phase diagram of its Fe^{4+} analogue $Sr_3Fe_2O_{7-\delta}$ remains largely unexplored. We report the crystal growth, oxygen annealing, and characterization of large single-crystalline samples of $Sr_3Fe_2O_{7-\delta}$ suitable for neutron diffraction experiments. This work lays the foundation for comprehensive doping-dependent studies of $Sr_3Fe_2O_{7-\delta}$'s magnetic phase diagram and magnetic excitations.

[1] S. Ishiwata *et al.*, Phys. Rev. B **84**, 054427 (2011)
[2] M. Schmidt *et al.*, J. Phys.: Condens. Matter **15**, 8691 (2003)
[3] R.A. Borzi *et al.*, Science **315**, 214 (2007)

DF 9.48 Tue 12:15 Poster A

Finite-temperature density-functional theory of the Hubbard model — •Tobias Müller and Gustavo Pastor — Universität Kassel, Heinrich-Plett-Str. 40, 34132 Kassel

The finite temperature properties of the Hubbard model are investigated in the framework of lattice density-functional theory (LDFT). The single-particle density matrix γ_{ij} with respect to the lattice sites is considered as the basic variable of the many-body problem. Following Mermin's theorem the free energy $F = E - TS = K + W - TS$ at temperature T is regarded as a functional of γ, where $K[\gamma]$, $W[\gamma]$ and $S[\gamma]$ stand for the kinetic-energy, Coulomb-energy and entropy functionals, respectively. A finite-temperature extension of Levy's constraint search approach is formulated. In this framework exact numerical results for W and S are obtained as a function of the nearest-neighbor γ_{ij} and T for different system sizes at half-band filling. The properties of these functionals are discussed in some detail. On the basis of this analysis we propose a simple explicit approximation to $W[\gamma]$ and $S[\gamma]$ which is relevant to arbitrary lattices. The method is finally applied to one-dimensional systems and the accuracy of the derived equilibrium properties is discussed

DF 9.49 Tue 12:15 Poster A

Green function of the single-site full-potential scattering problem including scalar-relativistic and spin-orbit effects — •David Bauer, Phivos Mavropoulos, Rudolf Zeller, and Stefan Blügel — Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, D-52425 Jülich

We present a method for the solution of the scalar-relativistic equation for a finite-range non-spherical potential and with the option of including spin-orbit coupling. Our scope is to determine the Green function for the single-site scattering problem, which is used in the multiple-scattering Korringa-Kohn-Rostoker Green function method for electronic structure calculations of impurity atoms embedded in a crystalline host.

The Green function can be written in a semi-separable form where the regular and irregular radial solutions of the scalar-relativistic operator are used. Also the right- and left-hand-side solutions are needed, which are not necessarily identical and can differ for example when including spin-orbit coupling as a pertubative term. The radial functions are calculated by a direct solution of a generalized Lippmann-Schwinger (LS) integral equation by employing a Chebyshev expansion. To save computational time, we proceed in a two step approach. First a LS equation is solved for the spherically symmetric case. The result is used to determine the Green function of the spherical problem, which in a second step is used in a new LS equation that includes non-spherical and spin-orbit terms. The latter has a special structure which allows a reduction of the computational time.

DF 9.50 Tue 12:15 Poster A

Micromagnetic Simulations of Spin Dynamics in Magnetic Nanodots — •Robert Rückriem[1], Philipp Krone[1], Thomas Schrefl[2], and Manfred Albrecht[1] — [1]Institute of Physics, Chemnitz University of Technology, Chemnitz, Germany — [2]St. Pölten University of Applied Science, St. Pölten, Austria

Micromagnetic simulations were performed to investigate the spin dynamics in a single magnetic nanodot varying diameter ($50-150$ nm), thickness ($5-20$ nm), saturation magnetization ($0.5-2.0$ T) and uniaxial anisotropy ($0-250$ kJ/m^3). Using a finite element based three step simulation technique, the spatial distribution of excited spin waves as well as their frequency spectra was obtained. The occurring spin wave modes were identified as edge modes which are strongly influenced by demagnetizing field effects [1] and center modes which oscillate in the whole nanodot. By changing the magnetic and geometric parameters of the nanostructure, the precession frequency can be tuned which is important for magnetic engineering for instance in the field of microwave assisted magnetic recording [2].

[1] J. Jorzick, S. O. Demokritov, B. Hillebrands, M. Bailleul, C. Fermon, K. Y. Guslienko, A. N. Slavin, D. V. Berkov and N. L. Gorn, Phys. Rev. Lett. 88, 047204 (2002)
[2] J.-G. Zhu, X. Zhu, Y. Tang, IEEE Trans. Magn. 44, 125 (2008)

DF 9.51 Tue 12:15 Poster A

Pairs of diverging-converging spin vortices in biquadratically interlayer exchange coupled elements — •Sebastian Wintz[1], Christopher Bunce[1], Anja Banholzer[1], Thomas Strache[1], Michael Körner[1], Sibylle Gemming[1], Artur Erbe[1], Jeffrey McCord[2], Jörg Raabe[3], Christoph Quitmann[3], and Jürgen Fassbender[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Christian-Albrechts-Universität zu Kiel, Kiel, Germany — [3]Swiss Light Source, Paul Scherrer Institut, Villigen, Switzerland

Spin structures have been a relevant topic of magnetism research for many years. In particular, magnetic vortices have attracted much attention, due to their non-trivial topology and the various dynamic modes they exhibit [1]. A magnetic vortex consists of a planar, flux-closing magnetization curl that turns out of the plane in the central nanoscopic core. For a single layer structure, the curl's radial components typically cancel each other out. Recent investigations show that

this holds also true for multilayer vortex systems comprising bilinear interlayer exchange coupling (IEC) [2]. In this contribution we report on pairs of diverging-converging spin vortices occurring in biquadratically coupled systems. Using magnetic x-ray microscopy we directly observe that the individual vortices of such pairs possess a residual radial magnetization component. From this $\nabla \mathbf{M}_{xy} \neq 0$, an additional perpendicular magnetization divergence $\nabla \mathbf{M}_z$ is analytically deduced. We compare our continuous model with discrete micromagnetic simulations. [1] S.-B. Choe et al., Science 304, 420 (2004). [2] S. Wintz et al., Appl. Phys. Lett. 98, 232511 (2011).

DF 9.52 Tue 12:15 Poster A

Structural, electronic, and magnetic properties of CoO/Ni interfaces — •Udo Schwingenschlögl, Sergiy Grytsyuk, and Fabrizio Cossu — KAUST, PSE Division, 23955-6900 Thuwal, Kingdom of Saudi Arabia

We study the CoO/Ni interface. Since the lattice mismatch of Ni with respect to CoO is about 21% we use a large supercell for our first-principles calculations, which reduces the lattice mismatch to 0.8%. We investigate the structural, electronic, and magnetic properties of two CoO/Ni interfaces: (1) An O layer mediates the coupling between Ni and Co and (2) direct Ni-Co contact. Our results indicate that the magnetization is reduced by 19% in the first case, while in the second case it increases by 106% as compared to bulk Ni. The magnetic moments of the Ni atoms are larger if the exchange coupling is mediated by O atoms, while for direct contact with the Co atoms they become smaller than in the bulk. The Co 3d local density of states of the second interface shows surprisingly small deviations from the corresponding bulk results, although the first coordination sphere is no longer octahedral.

DF 9.53 Tue 12:15 Poster A

Exchange-bias effects in Co/$YMnO_3$ bilayer: Magnetization and magneto-transport measurements — •J. Barzola-Quiquia, A. Lessig, C. Zandalazini, G. Bridoux, and P. Esquinazi — Division of Superconductivity and Magnetism, University of Leipzig, D-04103 Leipzig, Germany

The exchange bias effects in a bilayer composed by the antiferromagnetic o-$YMnO_3$ and ferromagnetic Co thin films have been investigated through SQUID magnetometry and magneto-transport measurements. Magnetization hysteresis loops and magneto-transport properties show pronounced asymmetries in the field and magnetization axis. Both exchange bias parameters, the exchange bias field $H_E(T)$ and the magnetization shift $M_E(T)$, vanish around the Néel temperature $T_N \simeq 45$ K. The magnetization shift is also measured by a shift in the longitudinal and Hall resistances showing a similar temperature dependence as the one obtained from magnetization measurements. Because the o-$YMnO_3$ film is highly insulating, our results demonstrate that the M_E shift is related to the pinned moments within the ferromagnetic Co layer at the interface.

DF 9.54 Tue 12:15 Poster A

Perpendicular exchange bias in ferrimagnetic spin valves — •Radu Abrudan[1], Ilie Radu[2], Detlef Schmitz[3], Hartmut Zabel[1], and Florin Radu[3] — [1]Institut für Experimentalphysik/Festkörperphysik, Ruhr-Universität Bochum, D-44780 Bochum, Germany — [2]Radboud University Nijmegen, Institute for Molecules and Materials, Heyendaalseweg 135, 6525 AJ Nijmegen,The Netherlands — [3]Helmholtz-Zentrum Berlin für Materialien und Energie, Albert-Einstein-Strasse 15, 12489 Berlin, Germany

Exchange bias effect refers to the shift of the hysteresis loop of a ferromagnet which is in direct contact to an antiferromagnet. For applications in spintronics a robust and tunable EB effect is required. We present experimental evidence for perpendicular EB in ferrimagnetic spin valves in a $DyCo_5$/Ta/$Fe_{76}Gd_{24}$ prototype trilayer, where the $DyCo_5$ alloy plays the role of a hard ferrimagnet and the $Fe_{76}Gd_{24}$ is a soft ferrimagnet. Taking advantage of the tunability of the exchange coupling between the ferrimagnetic layers by means of thickness variation of an interlayer spacer, we show that perpendicular exchange bias can be induced with desirable absolute values at room temperature with no field cooling procedure. Moreover, the shift of the hysteresis loop can be reversed with relatively low magnetic fields of several hundred Oersteds. This flexibility in controlling a robust perpendicular EB at room temperature may be of crucial importance for applications.

DF 9.55 Tue 12:15 Poster A

Renormalization of exchange coupling parameters in systems with coexisting strong and induced magnetic moments — •Phivos Mavropoulos, Marjana Ležaić, Gustav Bihlmayer, and Stefan Blügel — Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, D-52425 Jülich

In magnetic systems with coexisting strong and induced (weak) magnetic moments, it is often the case that the magnetic excitations change the direction and magnitude of the weak moments but only the direction of the strong moments. It is also often the case that the energy landscape can be parametrised by a quadratic dependence on the weak-moments magnitude in addition to a Heisenberg expression for the strong-moments direction. We show that under these conditions the weak moments can be completely eliminated as degrees of freedom in favour of renormalized exchange coupling parameters among the strong moments. We further show that this renormalization is also valid at elevated temperatures. The thermodynamic properties (including all correlation functions) of the full system, where the strong and weak moments are independent degrees of freedom, can be derived from the correlation functions of the renormalized system, where only the strong moments are accounted for as degrees of freedom. A prerequisite for the latter theorem is a quadratic measure in the phase space of the weak moments. The theorem justifies certain schemes for the derivation of exchange parameters and can also be of practical use for reducing the numerical load in calculations.

DF 9.56 Tue 12:15 Poster A

Coupling Single Molecule Magnets to Ferromagnetic Substrates — Alberto Lodi Rizzini[1], Cornelius Krull[1], •Timofey Balashov[1], Jerald Kavich[1], Aitor Mugarza[1], Piter Miedema[2], Pardeep Thakur[3], Violetta Sessi[3], Svetlana Klyatskaya[4], Mario Ruben[4], Sebastian Stepanow[5], and Pietro Gambardella[1] — [1]ICN, Barcelona, Spain — [2]Utrecht University, Utrecht, The Netherlands — [3]ESRF, Grenoble, France — [4]Institute of Nanotechnology, KIT, Germany — [5]Max-Planck-Institut für Festkörperforschung, Stuttgart, Germany

We investigate the interaction of $TbPc_2$ single molecule magnets (SMMs) with ferromagnetic Ni substrates. Using element-resolved x-ray magnetic circular dichroism, we show that $TbPc_2$ couples antiferromagnetically to Ni films through ligand-mediated superexchange. This coupling is strongly anisotropic and can be manipulated by doping the interface with electron acceptor or donor atoms. We observe that the relative orientation of the substrate and molecule anisotropy axes critically affects the SMM magnetic behavior. $TbPc_2$ complexes deposited on perpendicularly magnetized Ni films exhibit enhanced magnetic remanence compared to SMMs in the bulk. Contrary to paramagnetic molecules pinned to a ferromagnetic support layer, we find that $TbPc_2$ can be magnetized parallel or antiparallel to the substrate, opening the possibility to exploit SMMs in spin valve devices.

DF 9.57 Tue 12:15 Poster A

Zero bias anomalies and magnon excitation in tunnel junctions with magnetic and nonmagnetic electrodes — •Volker Drewello, Zoë Kugler, Günter Reiss, and Andy Thomas — Universität Bielefeld, Fakultät für Physik, Dünne Schichten und Physik von Nanostrukturen, Universitätsstr. 25, 33615 Bielefeld

In order to understand the tunneling spectra of magnetic tunnel junctions, tunnel junctions are fabricated in which one or both ferromagnetic electrodes were replaced by non-magnetic metal (tungsten). The bias dependence of these junctions is investigated with high accuracy by inelastic electron tunneling spectroscopy. Both types of junctions exhibit a zero bias anomaly that is different in size and sign compared to those of magnetic tunnel junctions, that is, junctions with two ferromagnetic electrodes. A pronounced difference is also found depending on the material that the electrons tunnel into, which is attributed to the excitation of magnons.

DF 9.58 Tue 12:15 Poster A

Electrical characterization of nanoscaled CoFeB|MgO|CoFeB-based magnetic tunneljunctions (MTJs) for thermal spin-transfer-torque (TST) — •Johannes Christian Leutenantsmeyer[1], Marvin Walter[1], Vladyslav Zbarsky[1], Patrick Peretzki[2], Henning Schuhmann[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

MTJs are of general interest because of their quantum mechanical properties such as the tunnel-magnetoresistance (TMR), spin-transfer-

torque and the recently measured magneto Seebeck effect.

Here we present the studies about our nanoscaled MTJs. The junctions are grown in UHV at base pressures around 5×10^{-10} mbar. The thin films are deposited by magnetron sputtering (Ta, CoFeB) and E-Beam evaporation (MgO, Ru). After annealing, the samples are patterned with bondpads via optical lithography, which enable us to contact sub-micron-scaled junctions. The MTJ itself is written by e-beam lithography and etched by argon-ion milling. With a high resolution e-beam resist, we reach a junction size of approximately 50 nm. The smaller junctions require the transition to thinner barriers (down to 3 monolayers), which we develop for the observation of new phenomena, like the theoretically predicted TST. Characterization shows TMR of up to 230% and large magneto Seebeck effect.

We gratefully acknowledge the funding of Deutsche Forschungsgemeinschaft through SFB 602 and SPP SpinCaT.

DF 9.59 Tue 12:15 Poster A

Spin transport and tunnel magnetoresistance of MgO-based magnetic tunnel junctions with different CoFeB compositions — •Vladyslav Zbarsky[1], Marvin Walter[1], Gerrit Eilers[1], Markus Münzenberg[1], Patrick Peretzki[2], Michael Seibt[2], and Johannes Leutenantsmeyer[1] — [1]I. Phys. Inst., Universität Göttingen, Germany — [2]IV. Phys. Inst., Universität Göttingen, Germany

The optimization of MTJs is necessary for increasing the TMR and therefore is very important for the production of MRAM devices. The quality of the tunnel barrier of our CoFeB/MgO/CoFeB MTJs is essential for getting high TMR. For this reason we minimized the roughness of MgO layer on the TMR. Another important parameter which we could optimize is the choice and preparation of the buffer layer. For example we compared two sorts of Ta buffer layers: prepared via magnetron sputtering and via e-beam evaporation. Already by optimizing these two parameters we could increase the TMR from 80% to above 220%. The next important step is further optimization of annealing parameters, because annealing influences the crystallisation behaviour of our MTJs. In this case, we investigate the influence of the annealing temperatures and annealing duration on the TMR. For the magneto-Seebeck effect a strong dependence on the choice of CoFeB composition is theoretically predicted. A change in the composition is of strong interest since the Fe to Co ratio gradually tunes the Fermi level by electron doping. In this context, we investigate the behaviour of TMR and spin transport for different CoFeB alloys.

DF 9.60 Tue 12:15 Poster A

Domain wall dependent magnetoresistance at zero field in electromigrated ferromagnetic nanocontacts. — •Mohamad-Assaad Mawass[1,5], Robert M. Reeve[1], Jakoba Heidler[2], Jan Rhensius[2,3], Laura J. Heyderman[2], Regina Hoffmann[4], André Bisig[2,3], and Mathias Kläui[1,2,3] — [1]Johannes Gutenberg-Universität Mainz, Mainz, Germany — [2]Paul Scherrer Institut, Villigen, Switzerland — [3]Universität Konstanz, Konstanz, Germany — [4]Physikalisches Institut and DFG-Center for Functional Nanostructures, Karlsruhe Institute of Technology, Karlsrue, Germany — [5]Max-Planck-Institut für Intelligente Systeme, Stuttgart, Germany

Magnetotransport measurements of magnetic nanocontacts have been studied with the aim to understand the interactions between spin-polarized charge carriers and magnetization on the nanoscale. Here, we study the evolution of magnetoresistance (MR) in electromigrated ferromagnetic break junctions obtained in clean ultra-high vacuum (UHV) conditions. While previously permalloy (Ni80Fe20) nanocontacts with variable constriction width have been investigated [A. Patra et al., PRB 82, 134447 (2010)], the question of the influence of the alloy nature on the observed MR effects remains. The in-situ controlled electromigration of notched half ring structures under UHV conditions for pure Ni and Fe contacts was investigated and similarly large effects could be observed. In particular, large MR effects at remanence are found in contacts that approach the atomic limit. Additionally, our measurements show a sign-change of the MR at low conductance levels and this is compared to recent theoretical predictions.

DF 9.61 Tue 12:15 Poster A

Anomalous Hall effect as a Fermi surface property — •Alexander Mook[1], Falko Pientka[1,2], Ingrid Mertig[1,3], and Peter Zahn[1] — [1]Institut für Physik, Martin-Luther-Universität, Von-Seckendorff-Platz 1, D-06120 Halle — [2]Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, D-06120 Halle — [3]Fachbereich Physik, Freie Universität, D-14195 Berlin

Already Haldane has shown in a seminal paper that the intrinsic anomalous Hall conductivity can be expressed as an integral over the Fermi surface as expected for a Fermi liquid property [1].

The anomalous Hall conductivity can be expressed either by a volume integral of the occupied states in the Brillouin zone or a Fermi surface integral with a thorough treatment of the Brillouin zone boundaries. We implemented both methods and applied them to a tight-binding Hamiltonian including exchange splitting and spin-orbit coupling.

Our investigations show that both results agree well. Details of the integration procedure have to be optimized to obtain a satisfying agreement for cases where avoided band crossings occur close to the Fermi level. The surface integration replaces the time consuming volume integration over the Fermi sea [2]. The method is applicable to advanced ab initio electronic structure schemes which provide besides the band energies also the Berry curvature.

[1] F. D. M. Haldane, *Phys. Rev. Lett.* **93**, 206602 (2004). [2] M. Gradhand, D. V. Fedorov, F. Pientka, P. Zahn, I. Mertig, and B. L. Göyrffy, *Phys. Rev. B* **84**, 075113 (2011).

DF 9.62 Tue 12:15 Poster A

Structural, electronic and transport properties of platinum-based chains: an ab initio study — •Ilia Sivkov, Kun Tao, and Valeri Stepanyuk — Max-Planck-Institut für Mikrostrukturphysik Weinberg 2, D-06120 Halle, Germany

We have investigated the structural, electronic and magnetic properties of platinum-based chains. Both pure platinum chains and chains with 3d impurities have been considered. The calculations of these properties were performed using methods based on the density functional theory.We show that the magnetic anisotropy energy of such chains strongly depends both on their shape, and on the impurities involved. Furthermore, transport calculations based on the non-equilibrium Green's function formalism have been performed.

DF 9.63 Tue 12:15 Poster A

Magnetic and transport properties of a series of dinuclear Nickel(II) complexes — •Claudia Loose[1], Torsten Hahn[1], Jens Kortus[1], Jochen Lach[2], and Berthold Kersting[2] — [1]TU Bergakademie Freiberg, Fakultät für Chemie und Physik — [2]TU Leipzig, Fakultät für Chemie und Mineralogie

Using first-principle density functional theory (DFT) we examined four different dinucklear Nickel(II) complexes [1] in order to obtain the electronic and magnetic structure with a special focus on spin-dependent transport through these molecules.

We compare results from different exchange correlation functionals (PBE/B3LYP) as implemented in two different packages (NRLMOL/ORCA). Furthermore we investigate the transport properties of those complexes using methods of the non equilibrium Green's function formalism (NEGF).

[1] Coord. Chem. Rev. 253 (2009) 2244 - 2260

DF 9.64 Tue 12:15 Poster A

Optimization of spin-valve structures for spin-pumping experiments — •Christian Swoboda, Nils Kuhlmann, Andreas Vogel, Toru Matsuyama, and Guido Meier — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstrasse 11, 20355 Hamburg, Germany

In recent years, high-frequency phenomena of magnetic nanostructures have been studied intensively since they are expected to provide new technological applications as well as fundamental understanding of spin dynamics. Currently, the combination of magnetization dynamics and spin transport, the spin-pumping effect [1, 2], is of great interest. First experimental results including the detection of pure spin currents have been presented [3]. The aim of our work is to build an all-metal lateral spin-valve [4], where the spins are injected into an adjacent normal-metal via a ferromagnet with precessing magnetization at ferromagnetic resonance (spin-pumping). The lateral spin-valve device enables to detect and to quantify the pure spin current via a second ferromagnet. Besides the basic concept of a lateral spin-valve device operated by spin-pumping, we present a detailed study of the magnetization dynamics of the ferromagnetic electrodes. We optimized geometry and center-to-center distance of the electrodes in order to enhance the spin-pumping efficiency.

[1] Y. Tserkovnyak et. al., PRL 88, 117601 (2002); [2] A. Brataas et. al., PRB 66, 060404 (2002); [3] M.V. Costache et. al., PRB 78, 064423 (2008); [4] A. Vogel et. al., APL 94, 122510 (2009)

DF 9.65 Tue 12:15 Poster A

Spin density distribution and Hanle lineshapes of injected spins into n-GaAs — •Bernhard Endres, Mariusz Ciorga, Robert Wagner, Sebastian Ringer, Martin Utz, Dominique Bougeard, Dieter Weiss, Christian H. Back, and Günther Bayreuther — Universität Regensburg

Spin extraction into a ferromagnetic GaMnAs contact from an n-GaAs channel across an Esaki diode structure was measured by cross-sectional imaging of the spin polarization in GaAs [1,2]. The resulting spin density distribution in the 1 μm thick GaAs channel shows a strong bias dependence with the maximum polarization at the contact edge opposite to the maximum charge current. This behavior cannot be described by a frequently used one-dimensional model whereas two-dimensional numerical simulations of the electron drift and spin diffusion reproduce the observed distribution quite well. Even at the nominally field-free contact edge electron drift must be taken into account because of the inhomogeneous current density. As a consequence, if Hanle measurements are fitted with a one-dimensional drift-diffusion function as usually done they yield spin lifetimes which may strongly depend on the distance to the contact and the applied bias voltage. In contrast, a two-dimensional fit including the nonuniform current density provides spin lifetimes nearly independent of bias and contact distance. The remaining variations can be explained by electric fields around the contact area. [1] P. Kotissek et al., Nature Phys. 3, 872 (2007) [2] B. Endres et al., J. Appl. Phys. 109, 07C505 (2011)

DF 9.66 Tue 12:15 Poster A

Fe_3O_4/ZnO: A high-quality magnetic oxide-semiconductor heterostructure by reactive deposition — •Ozan Kirilmaz[1], Sebastian Brück[1,2], Markus Paul[1], Andreas Müller[1], Eberhard Goering[3], Jo Verbeeck[4], He Tian[4], Michael Sing[1], and Ralph Claessen[1] — [1]Experimentelle Physik 4, Universität Würzburg, D-97074 Würzburg, Germany — [2]University of New South Wales, School of Physics, Sydney NSW 2052, Australia — [3]Max Planck Institute for Intelligent Systems, D-70569 Stuttgart, Germany — [4]Electron Microscopy for Materials Science, University of Antwerp, 2020 Antwerp, Belgium

Magnetite (Fe_3O_4) is ranked among the most promising materials to be used as a spin injector into a semiconducting host. We demonstrate epitaxial growth of Fe_3O_4 films on ZnO which presents a further step for polarized spin injection into semiconductors. Regarding volume properties of the films, X-ray photoelectron spectroscopy evidences that the iron-oxide is phase-pure and stoichiometric magnetite. Diffraction measurements indicate highly oriented epitaxy and complete structural relaxation. The magnetic behavior shows a slow approach to saturation at high fields in comparison with bulk crystals. The typical (111) surface structure of Fe_3O_4 is observed already at the early growth stage. Due to island growth, domain boundaries form upon coalescence of the islands. The island growth enables partial relaxation of the misfit strain. X-ray resonant magnetic reflectometry reveals that only the very first monolayers of Fe_3O_4 at the interface exhibit a reduced magnetization, presumably related to the presence of the ZnO substrate.

DF 9.67 Tue 12:15 Poster A

Spin Injection and Spin Transport in Zinc Oxide — •Matthias Althammer, Eva-Maria Karrer-Müller, Sebastian T. B. Goennenwein, Matthias Opel, and Rudolf Gross — Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching

The wide bandgap semiconductor zinc oxide is interesting for semiconductor spintronics because of its small spin-orbit coupling implying a large spin coherence length. We investigate the injection, transport, and detection of spin-polarized charge carriers in ZnO utilizing all-electrical, vertical spin valve devices with ferromagnetic electrodes. Using pulsed laser deposition and electron-beam evaporation, we fabricated epitaxial multilayers of TiN/Co/ZnO/Ni/Au on (0001)-oriented Al_2O_3 substrates with different thicknesses of the ZnO spacer layer ranging from 5 nm to 100 nm. The multilayers were patterned into vertical mesa structures with junction areas between 100 μm^2 and 400 μm^2. Magnetotransport measurements show a clear spin valve behavior. The switching fields correspond to the coercive fields of the ferromagnetic layers as determined by SQUID magnetometry. For a ZnO thickness of 15 nm, the magnetoresistance (MR) increases from 0.8% at 200 K to 8.5% at 1.8 K. We analyze the maximum MR at low temperatures as a function of the ZnO thickness in the framework of a two spin channel model with a spin-dependent interface resistance and obtain a spin drift length for ZnO of 14.3 nm.

This work was supported by the Deutsche Forschungsgemeinschaft via SPP 1285 (project no. GR 1132/14).

DF 9.68 Tue 12:15 Poster A

Spindynamics of microstructured permalloy systems — •Sven Stienen[1], Ralf Meckenstock[1], Jürgen Lindner[1], Nathalie Reckers[1], Kai Wagner[1], Florian Römer[1], Zheng Duan[2], and Michael Farle[1] — [1]Universität Duisburg-Essen, Fakultät für Physik and CeNIDE, Lotharstraße 1, 47057 Duisburg — [2]University of California, Department of Physics and Astronomy, Irvine, USA

We model a ferromagnetic resonance (FMR) measurement by micromagnetic simulations using the 3D Object Orientated Micromagnetic Framework (OOMMF) code to investigate spinwave modes in permalloy (Py) microstripes. Dispersion relations (3-12GHz) were calculated with different directions (0°/90°) of the external magnetic field (0-400mT) applied in the sample plane. The major magnetic anisotropy in the Py-stripe is the demagnetisation field. The simulations allow the visualization and identification of the excitations in the time and space domain. Quasi uniform, edge and not-aligned modes are observed. The simulations were compared with the FMR results obtained by anisotropic magneto resistance[1]. The position and shape of all modes can be explained by specific aspects of the demagnetisation field and are in qualitativly good agreement with simulations. This work has been supported by the Deutsche Forschungsgemeinschaft (DFG) via SFB 491.

[1]A. Banholzer et al, Nanotechnology, 22,(2011) 295713

DF 9.69 Tue 12:15 Poster A

Imaging of magnetisation dynamics of coupled vortices in trilayer systems — •Anja Banholzer[1], Sebastian Wintz[1], Christopher Bunce[1], Thomas Strache[1], Michael Körner[1], Arthur Erbe[1], Aleksandr Puzic[2], Jörg Raabe[2], Christoph Quitmann[2], Kilian Lenz[1], and Jürgen Fassbender[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01314 Dresden, Germany — [2]Paul Scherrer Institut, 5232 Villigen, Switzerland

Magnetic vortices recently gained interest as potential storage media. Different control methods are used to manipulate the vortex states. We now use scanning transmission x-ray microscopy (STXM) to image the magnetic configurations within the different layers of a Co/Cu/NiFe trilayer system. The dominant coupling mechanisms here are the magneto-dipolar interaction and interlayer exchange coupling. The corresponding magnetization configurations under a static magnetic field, as well as ac magnetic fields are investigated. The emerging motion of the core is tunable by the amplitude and frequency of the field. The interactions of the two cores and their individual resonance frequencies are studied. This implies a corresponding resistance change of different configurations at different magnetic fields and currents as well as the displacement of the core.

DF 9.70 Tue 12:15 Poster A

Oersted field contribution on the magnetic vortex core dynamics probed by homodyne detection — •June-Seo Kim[1,5], Martin Stärk[1], Mathias Kläui[1,5], Florian Kronast[2], Roland Mattheis[3], Christian Ulysse[4], and Giancarlo Faini[4] — [1]Fachbereich Physik, Universität Konstanz, Universitätsstr. 10, D-78457 Konstanz, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, Germany — [3]Institut für Photonische Technologien e.V., Jena, Germany — [4]Phynano Team, Laboratoire de Photonique et de Nanostructures, CNRS, Marcoussis, France — [5]Institut für Physik, Johanes Gutenberg-Universität Mainz, D-55099, Mainz, Germany

When injecting spin-polarized currents into magnetic discs, both spin torque and Oersted fields can manipulate magnetic vortex structures. The Oersted field contribution due to the inhomogeneous current distribution in the magnetic vortex core structure is experimentally determined by using a homodyne detection scheme. We find that the amplitude of the vortex core gyration increases for vortices located close to the current injection contacts due to the enhancement of the Oersted field contribution. From systematic phase measurements as a function of microwave frequency, two remarkable phenomena are observed: (i) the trajectory of the vortex core gyration is distorted by the interaction with the disc edge leading to non-linear oscillations (ii) the interplay between spin torque and Oersted field depends sensitively on the exact vortex core position.

DF 9.71 Tue 12:15 Poster A

Ultrafast, layer-selective dynamics of interlayer exchange-coupled Fe-Ru-Ni-trilayers — •Dennis Rudolf[1], Patrik

Grychtol[1], Roman Adam[1], Bastian Heller[1], Moritz Plötzing[1], Christian Weier[1], Claus M. Schneider[1], Chan La-O-Vorakiat[2], Emrah Turgut[2], Henry C. Kapteyn[2], Margaret M. Murnane[2], Stefan Mathias[3], Martin Aeschlimann[3], Justin M. Shaw[4], Hans Nembach[4], and Thomas J. Silva[4] — [1]Peter Grünberg Institut, PGI-6, Research Center Jülich, 52425, Jülich, Germany — [2]Department of Physics and JILA, University of Colorado, Boulder, Colorado 80309-0440, USA — [3]University of Kaiserslautern and Research Center OPTIMAS, 66606, Kaiserslautern, Germany — [4]Electromagnetics Division, National Institute of Standards and Technology, Boulder, Colorado, 80305-3328, USA

Using ultrafast light pulses of laser-generated high harmonics between 20 eV and 70 eV, we investigated static and dynamic properties of interlayer exchange-coupled thin Fe-Ru-Ni-trilayers with varying Ru thickness. In the static case we observed layer-selective switching of Fe- and Ni-layers. We studied the magnetization dynamics on the fs-timescale using a pump-probe technique with 1,5 eV-pump and high harmonics-probe and observed layer-selective dynamics of Fe- and Ni-layers at the M absorpion edges (54 eV for Fe and 66 eV for Ni). A comparison of the demagnetization times for parallel and antiparallel magnetization alignment of the Fe- and Ni-layers provides insight into the role of exchange interaction and spin transport in femtomagnetism.

DF 9.72 Tue 12:15 Poster A

Element-resolved Ultrafast Spin Dynamics in Multi-component Ferromagnets and Ferrimagnets — •Andrea Eschenlohr[1], Ilie Radu[1,2], Christian Stamm[1], Kadir Vahaplar[2], Torsten Kachel[1], Niko Pontius[1], Rolf Mitzner[1], Karsten Holldack[1], Alexander Föhlisch[1], Florin Radu[1], Richard F. L. Evans[3], Thomas A. Ostler[3], Johan Mentink[2], Roy W. Chantrell[3], Arata Tsukamoto[4,5], Akiyoshi Itoh[4], Andrei Kirilyuk[2], Alexey V. Kimel[2], and Theo Rasing[2] — [1]Helmholtz Zentrum Berlin für Materialien und Energie GmbH, Germany — [2]Radboud University Nijmegen, The Netherlands — [3]University of York, UK — [4]Nihon University, Chiba, Japan — [5]Japan Science and Technology Agency, Saitama, Japan

With 100 fs soft x-ray pulses generated by the Femtoslicing facility at the BESSY II storage ring we measure element-resolved transient x-ray magnetic circular dichroism in ferromagnetic NiFe alloys, as well as ferrimagnetic GdFeCo alloy after laser excitation. We find time constants of demagnetization that are not only different for each magnetic sublattice in our alloy samples, but also different from the time constants found for respective pure element samples. Supported by phenomenological considerations and atomistic simulations we conclude that sub-picosecond magnetization dynamics is sensitive to both the magnetic moment and exchange interaction between the sublattices in multi-component magnets.

DF 9.73 Tue 12:15 Poster A

Gyration of magnetic vortices in anharmonic potentials — •Christian Adolff, Michael Martens, Thomas Kamionka, Ulrich Merkt, and Guido Meier — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiustr. 11, 20355 Hamburg, Germany

Magnetic vortices inherently form in soft ferromagnetic thin-film elements. They can be described as quasiparticles in confining potentials with eigenfrequencies in the sub-gigahertz range [1, 2]. We investigate the excitation of magnetic vortices in permalloy squares with side lengths of up to five micrometers. Strongly excited vortex cores move near to the edges of the squares where significant deviations from a parabolic potential occur. Analyzing the eigenfrequency of the vortex for different geometries, i.e. side lengths and thicknesses, gives insight into isotropic and anisotropic terms of the potential. These are studied by means of ferromagnetic resonance spectroscopy, micromagnetic simulations and analytical calculations.

[1] A. Thiele, J. Appl. Phys. 45, 377 (1974)
[2] B. Krüger et al., Phys. Rev. B 76, 224426 (2007)

DF 9.74 Tue 12:15 Poster A

Magnetization dynamics in Ni on the picosecond timescale — •Martin Lüttich[1], Jakob Walowski[1], Andreas Mann[1], Markus Münzenberg[1], Unai Atxitia[2], and Oksana Chubykalo-Fesenko[2] — [1]I. Physikalisches Institut, Universität Göttingen — [2]Instituto de Ciencia de Materiales de Madrid

Magnetization dynamics of polycrystalline nickel films are measured using the all-optical pump-probe technique for various pump pulse fluences. The parallel treatment of photons, electrons, phonons and magnetic correlations of the system amounts a challenge to the microscopic theoretical description. At the same time different length and time scales are involved.

We investigate the influence of hot electrons on the relative demagnetization. Performing the experiment for different pump fluences, we measure a higher relative demagnetization at higher fluences. These results are compared to simulations with the Landau-Lifshitz-Bloch equation, which is based on a thermal model, and featured by the consideration of two electron temperature dependent relaxation times $\tau_\perp$ and $\tau_{||}$. The electron temperature needed as input for the simulations is extracted from experiments.

DF 9.75 Tue 12:15 Poster A

Ultrafast Demagnetization Dynamics in $Ni_{1-x}Pd_x$ alloys — •Moritz Plötzing[1], Patrik Grychtol[1], Roman Adam[1], Claus M. Schneider[1], Hans Nembach[2], Justin Shaw[2], Tom Silva[2], Oliver Schmitt[3], Daniel Steil[3], Mirko Cinchetti[3], and Martin Aeschlimann[3] — [1]Peter Grünberg Institut, PGI-6, Research Center Jülich, 52425, Jülich, Germany — [2]Electromagnetics Division, National Institute of Standards and Technology, Boulder, Colorado 80305-3328, USA — [3]University of Kaiserslautern and Research Center OPTIMAS, 67663, Kaiserslautern, Germany

In the presented work, we investigated alloys of Ni and Pd with varying mixing ratios focusing on the magnetization dynamics on different timescales. For this purpose, we characterized the samples using a vibrating sample magnetometer and ferromagnetic resonance in order to determine the Curie temperature T_C and the picosecond dynamics, respectively. The latter is described by the Gilbert damping parameter α. Both quantities depend strongly on the stoichiometry and can be tuned very precisely over a wide range by changing the Pd concentration. Additionally, we carried out a thorough investigation of the laser-induced demagnetization time τ_M on the femtosecond timescale employing a time-resolved MOKE setup. According to the theoretical model published in [1], the dynamics on both timescales is related and the proportionality is mainly defined by T_C. Using the measured values for α and τ_M, we study the applicability of the theory for a ferromagnetic d-alloy and consequently the underlying fundamental processes.

[1] Koopmans et al., Phys. Rev. Lett. 95, 267207 (2005)

DF 9.76 Tue 12:15 Poster A

Ultrafast magnetization dynamics of FePt:Cu — •Daniel Steil[1], Sabine Alebrand[1], Oliver Schmitt[1], Mirko Cinchetti[1], Martin Aeschlimann[1], Fabian Ganss[2], Christoph Brombacher[2], and Manfred Albrecht[2] — [1]Department of Physics and Research Center OPTIMAS, University of Kaiserslautern, 67663 Kaiserslautern, Germany — [2]Institute of Physics, Chemnitz University of Chemnitz, 09107 Chemnitz, Germany

$L1_0$ ordered FePt compounds with out of plane anisotropy are one future candidate as a storage layer for the next generation of hard disc drives, due to their very high anisotropy energy. As these compounds typically have very high coercivity, they are best used in combination with heat assisted recording (HAMR) [1]. We have studied the demagnetization dynamics in the alloy system FePt:Cu following impulsive laser excitation. In particular we also investigated the helicity dependence of the magnetization dynamics. By adding copper to FePt it is possible to tune anisotropy and Curie temperature, which allows to study the influence of both parameters on magnetization dynamics. We find a fast and strong demagnetization for all sample compositions, leading to a long lasting multidomain state for high enough excitation fluences in remanence. Additionally we observe a small influence of light helicity on the magnetization dynamics for at least one of the samples, whose origin will be discussed.

Funding by the EU within the FP7 project UltraMagnetron is kindly acknowledged.

[1] D. Weller et al., Annu. Rev. Mater. Sci. 30, 611-644 (2000)

DF 9.77 Tue 12:15 Poster A

Angular and Temperature dependent Ferromagnetic Resonance (FMR) measurements on FeRh thin films — •Eduardo Mancini, Federico Pressacco, Markus Härtinger, Georg Woltersdorf, and Christian Back — Institut für Experimentelle und Angewandte Physik, Universität Regensburg, Regensburg, Deutschland

We report the results of FMR investigations performed on $Fe_{0.5}Rh_{0.5}$(30 nm)/MgO below and above the critical temperature

(around 400 K) at which the magnetic order changes from the antiferromagnetic- to the ferromagnetic phase. From these measurements we extract the amplitude, the position and the linewidth of the resonance line. For the amplitude the heating and cooling branches display the hysterestic behavior which is expected for this material with a difference in their critical temperatures of about 10 K. In the ferromagnetic phase (T=450 K), we observe an easy plane anisotropy for the magnetization from the analysis of the resonance position as a function of the external field orientation. From the linewidth of the resonance we extract the damping of the magnetization and discuss its temperature dependence in the neighborhood of the critical temperature.

DF 9.78 Tue 12:15 Poster A

Time-resolved Scanning-Kerr-Microscope on Rolled-Up-Ferromagnetic-Microstructures — •Daniel Mellem, Sebastian Mansfeld, Jan-Niklas Toedt, Felix Balhorn, Lennard Moldenhauer, Wolfgang Hansen, Detlef Heitmann, and Stefan Mendach — Institut für Angewandte Physik, Jungiusstr. 11, D-20355 Hamburg

Our time-resolved Scanning-Kerr-Microscope (TR-SKM) [1] is used to directly image propagating spin waves. We introduce the working principle of our Microscope and present first measurements of spin waves in rolled-up ferromagnetic structures, which were recently introduced as a novel type of flexible spin wave resonator by our group [2].

We gratefully acknowledge support by the DFG via SFB668 and GrK 1286.

[1] S. Mansfeld et al., Physical Review Letters, in press (2011)
[2] F. Balhorn et al. PRL 104, 037205, 2010

DF 9.79 Tue 12:15 Poster A

Spin-Wave Confinement in Rolled-Up Permalloy Nano-Stripes in Various Magnetization Configurations — •Lennart Moldenhauer, Felix Balhorn, Daniel Mellem, Sebastian Mansfeld, Wolfgang Hansen, Detlef Heitmann, and Stefan Mendach — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiustr. 11, 20355 Hamburg, Germany

A variety of planar systems consisting of magnetic nano- and microstripes have recently been investigated in terms of their magnetodynamic behavior [1]. Using the concept of self-rolling strained layers [2] we realized rolled-up Permalloy (Py) stripes.

We studied the spin-wave behavior in these three dimensional self-organized structures in different magnetic configurations and for varying geometrical stripe parameters via broadband microwave absorption spectroscopy. We discuss our measurements in terms of azimuthal and axial spin-wave confinement. We compare our results to previous experiments on planar stripes and rolled-up films [3].

[1] J. Topp et al., PRB **78**, 024431 (2008); [2] V. Y. Prinz et al., Physica E **6**, 828-831 (2000); [3] F. Balhorn et al., PRL **104**, 037205 (2010)

DF 9.80 Tue 12:15 Poster A

Ultrafast magnetic dynamics in EuTe thin films — •Niko Pontius[1], Christoph Trabant[1,2], Enrico Schierle[1], Eugen Weschke[1], Torsten Kachel[1], Christian Schüßler-Langeheine[1], Rolf Mitzner[1], Günther Springholz[3], and Karsten Holldack[1] — [1]Helmholtz-Zentrum Berlin — [2]II. Physikalisches Institut, Universität zu Köln — [3]Institut für Halbleiterphysik, Johannes Kepler Universität, Linz, Austria

Ultrafast control of magnetic materials and structures are a key prerequisite for developing advanced magnetic storage devices with increased speed and decreased dimensions. To this end, investigations of confined magnetic structures behaviour apart from equilibrium with sufficient spatial and temporal resolution under as defined conditions as possible are essential.

Here we investigate the fs temporal non-equilibrium evolution of the antiferromagnetic (AFM) order in EuTe thin films through resonant soft x-ray diffraction after laser excitation. Momentum resolved scans across the Bragg reflection provide information on the thin film magnetic profile evolution during the ultrafast quenching and recovery of the AFM order. They reveal that the magnetic profile is modified in a completely different way than for elevated temperatures in thermal equilibrium. Since the AFM structure of EuTe sensitively depends on the ionic distances, this study also provides new information on the interplay between structural and magnetic degrees of freedom. The measurements were performed at the FemtoSPEX facility at the HZB.

DF 9.81 Tue 12:15 Poster A

Temperature dependence of the magnon dispersion relation in low-dimensional transition-metal systems: A first-principles investigation — •Waldemar Töws and Gustavo M. Pastor — Universität Kassel, Heinrich-Plett-Str. 40, 34132 Kassel

The influence of Stoner excitations on the spin-wave spectrum of one- and two-dimensional 3d transition metals has been investigated. The physical situations represented by the Stoner excitations correspond to extreme nonequilibrium states, which can be induced by strong ultrashort laser pulses. In this work we quantify to what extent an important increase of the electronic temperature T_e describing Stoner excitations affects the stability of magnetism within the metal. For this purpose, we perform numerical calculations in the framework of *ab initio* density-functional theory with a generalized gradient approximation to the exchange and correlation energy. The free energy of frozen-magnon states as a function of spin-wave vector q and T_e have been systematically studied for V, Fe, Co and Ni wires and monolayers with various nearest-neighbor distances. First of all, we demonstrate that the local magnetic moments are extremely stable even at temperatures T_e much larger than the Curie temperature T_C. The T_e-dependence of the magnetic couplings between the local moments is quantified by fitting the effective exchange couplings J_{ij} to the free-energy dispersion relation in the framework of a classical spin model. One actually finds that electronic temperatures T_e well above T_C are needed to change the nature of the magnetic order within the metal. The consequences for the theory of laser-induced magnetization dynamics are discussed.

DF 9.82 Tue 12:15 Poster A

Time Resolved Scanning Kerr Microscopy of Structures in thin ferromagnetic Films — •Jan-Niklas Toedt, Sebastian Mansfeld, Jesco Topp, Kim Martens, Daniel Mellem, Wolfgang Hansen, Detlef Heitman, and Stefan Mendach — Institute of Applied Physics, University of Hamburg

We study the behavior of planar Damon-Eshbach spin-waves in thin structured ferromagnetic films utilizing time resolved scanning Kerr microscopy (TR-SKM) [1]. We have investigated spin waves incident on a range of structures including gratings, double slits and modulated films. We show that the underlying physics can be explained by the anisotropy of the dispersion relation leading, e.g., to sub wavelength imaging [2, 3].

We gratefully acknowledge support by the DFG via SFB 668, SFB 508, GrK 1286, and by the City of Hamburg via the Cluster of Excellence Nano-Spintronics.

[1] Freeman et al., Journal of Applied Physics **79**, 5898 (1996); [2] Liu et al., Science **315**, 1686 (2007); [3] Mansfeld et al., Physical Review Letters, in press (2011) - arXiv:1108.5883v1

DF 9.83 Tue 12:15 Poster A

Field-induced magnetization dynamics in dot patterned CoB/Pt multilayer structures — •F. Büttner[1,2,3,4], C. Moutafis[2,3], A. Bisig[1,2,3,6], C.M. Günter[4], J. Geilhufe[5], M. Schneider[4], C. v. Korff Schmiesing[4], M. Hantschmann[4], M. Riemeier[4], J. Mohanty[4], S. Schaffert[4], J. Franken[7], R. Lavrijsen[7], H. J. M. Swagten[7], H. Stoll[8], M. Weigand[5,8], M. Kläui[1,2,3,6], and S. Eisebitt[4,5] — [1]Uni Mainz, 55128 Mainz, Germany — [2]PSI, 5232 Villigen, Switzerland — [3]EPF Lausanne, 1015 Lausanne, Switzerland — [4]TU Berlin, 10623 Berlin, Germany — [5]HZB, 12489 Berlin, Germany — [6]Uni Konstanz, 78457 Konstanz, Germany — [7]TU Eindhoven, 5612 AZ Eindhoven, Netherlands — [8]MPI für Metallforschung, 70569 Stuttgart, Germany

The controlled movement of nanometer sized magnetic domains on the (sub-) nanosecond time scale is of key importance for the development of new magnetic devices in storage and computing technology. While magnetization dynamics in in-plane magnetized materials has been intensely studied, domain sizes are too large for most state-of-the-art applications. In out-of-plane materials, however, we find narrow domains and domain walls, but these are much more sensitive to local pinning, thus making controlled displacements extremely challenging. We present here high resolution magnetic images of low pinning CoB/Pt multilayer structures and demonstrate the suitability of this material for controlled and reproducible field-induced dynamics of the magnetic domains on the nanosecond time scale.

DF 9.84 Tue 12:15 Poster A

Spin-wave tunneling through a mechanical gap in microstructured $Ni_{81}Fe_{19}$-stripes — •Thomas Langner[1], Björn

Obry[1], Philipp Pirro[1], Thomas Brächer[1,2], Katrin Vogt[1,2], Britta Leven[1], and Burkard Hillebrands[1] — [1]TU Kaiserslautern, Fachbereich Physik and Forschungszentrum OPTIMAS, Erwin-Schrödinger-Str. 56, 67663 Kaiserslautern — [2]Graduate School Materials Science in Mainz, Gottlieb-Daimler-Straße 47, 67663 Kaiserslautern

The manipulation of the propagation properties of spin waves is of high importance to develop systems that can transport information using the spin wave as information carrier. One way to manipulate these properties is the use of magnetic tunnel barriers. We investigated the tunneling of spin waves through a mechanical gap in microstructured stripes made of $Ni_{81}Fe_{19}$. The focus of this work is on the investigation of the transmission of spin waves with varying wavelengths through a tunnel barrier with respect to the position of the gap. It is shown that quantization effects play an important role in the transmission behavior of tunneling spin waves in microscaled systems. The region between the excitation antenna and the gap acts as a spin-wave resonator. It has a large influence not only on the excitation properties but also on the transmission characteristics. We present Brillouin light scattering microscopy measurements revealing a strong influence of pinning effects of standing spin-wave modes inside this resonator on the tunneling efficiency.

DF 9.85 Tue 12:15 Poster A

Spin-wave logic elements based on ferromagnetic microstructures — •Jan Westermann[1], Philipp Pirro[1], Thomas Brächer[1,2], Björn Obry[1], Katrin Vogt[1,2], Roland Neb[1], Britta Leven[1], and Burkard Hillebrands[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany — [2]Graduate School Material Science in Mainz, 67663 Kaiserslautern, Germany

The investigation of propagating spin waves in micron-sized metallic ferromagnetic structures is subject of different experimental studies due to their potential application in spin-wave logic devices. Using the amplitude and the phase of the spin waves, these devices may provide outstanding performance, especially when operated with multiple frequencies.

We present micro-magnetic simulations focused on the feasibility of micro-structured spin-wave logic elements as well as an experimental investigation of short wavelength spin waves. The controlled excitation and the propagation of those spin waves is essential for efficiently working spin-wave logic elements. To analyze the excitation spectrum we use phase resolved Brillouin Light Scattering Microscopy to observe the spin waves in single micro-structures. For these experiments, we excite spin waves using different kinds of microwave antennas which show geometry dependent excitation spectra. Our experimental and numeric investigations show that magnetic micro-structures are promising candidates for wave-logic based elements. Financial support by Carl-Zeiss-Foundation, MAINZ and DFG is gratefully acknowledged.

DF 9.86 Tue 12:15 Poster A

Quantitative modeling of elastically driven ferromagnetic resonance — •Matthias Pernpeintner[1], Mathias Weiler[1], Lukas Dreher[2], Hans Huebl[1], Christian Heeg[1], Rudolf Gross[1], Martin S. Brandt[2], and Sebastian T. B. Goennenwein[1] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany — [2]Walter Schottky Institut, Technische Universität München, 85748 Garching, Germany

In conventional ferromagnetic resonance (FMR) experiments, an external radio frequency magnetic field drives the magnetization precession. Recently, it has been shown that FMR can be excited all elastically by means of coherent phonons [1]. In this acoustically driven FMR, the magnetoelastic coupling of surface acoustic waves (SAW) in the GHz frequency range with a thin ferromagnetic film is exploited.

Here we show that acoustically driven FMR can be phenomenologically modeled using a modified Landau-Lifshitz-Gilbert approach in which the SAW induces an internal, virtual magnetic driving field. In a quantitative analysis, the magnetization dynamics are calculated as a function of external magnetic field magnitude and orientation. Full quantitative agreement of this simulation and SAW transmission experiments performed in a $Ni/LiNbO_3$ hybrid device is shown, using a set of parameters consistent with literature data.

This opens the path for further experimental studies of resonant magnon-phonon coupling and acoustic spin current generation using elastically driven magnetization dynamics.

[1] M. Weiler *et al.*, Phys. Rev. Lett. **106**, 117601 (2011).

DF 9.87 Tue 12:15 Poster A

Microscopic magnetic structuring of spin-wave wave- guides by ion implantation in a $Ni_{81}Fe_{19}$ layer — •Thomas Meyer[1], Björn Obry[1], Philipp Pirro[1], Thomas Brächer[1,2], Roland Neb[1], Julia Osten[3], Thomas Strache[3], Jürgen Fassbender[3], and Burkard Hillebrands[1] — [1]FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany — [2]Graduate School Materials Science in Mainz, 67663 Kaiserslautern, Germany — [3]Institut für Ionenstrahlphysik und Materialforschung, Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany

Ion implantation of ferromagnetic films has proven to be a promising tool for the fabrication of fully planar samples with a microscopic magnetic substructure. A waveguide-like propagation of spin waves in a $Ni_{81}Fe_{19}$ film which was locally patterned by ion implatation could be observed. The investigations have been performed using Brillouin light scattering microscopy on samples patterned with varying ion fluences. Further investigations on the coupling behaviour of two parallel stripes in this fully planar structures have been performed. The presented fabrication technique of spin-wave waveguides provides much lower stray fields and better heat conduction. Especially the latter is a matter of interest when the objects are exposed to intense microwave fields (excitation of spin waves) or investigated by laser spectroscopy like Brillouin light scattering. Financial support by the DFG (GRK 792) is gratefully acknowledged.

DF 9.88 Tue 12:15 Poster A

Thermally modulated ferromagnetic resonance in planar microresonator — •Puchong Kijamnajsuk[1,2], Christian Schöppner[1], Sven Stienen[1], Detlef Spoddig[1], Ralf Meckenstock[1], and Josef Pelzl[2] — [1]Universität Duisburg-Essen, Standort Duisburg, Institut für Physik und CeNIDE, AG Farle, Lotharstr. 1, 47048 Duisburg — [2]Institute of Experimental Physics, Ruhr University Bochum

A novel approach based on the combination of two scanning thermal near field techniques: the thermally modulated ferromagnetic resonance (FMR) by the probe of a scanning thermal wave microscope and the 3ω-signal from the same thermal probe. The simultaneous detection of the thermally modulated microwave absorption and of the 3ω-response of the nano-probe offers a means to control the thermal contact between probe and sample. To enhance the sensitivity of the FMR detection for the single 30nm x 30nm x 30nm ferromagnetic Heusler alloy $Ni_{45}Mn_{37}In_{13}Co_5$, we have designed a microresonator setup. The constant amplitude microwave field is generated inside the resonator at the position of the sample at a fixed frequency 14GHz. To observe the FMR we apply the fixed external magnetic field and modulate the sample temperature by joule heating from the probe. With the microresonator we demonstrate the detection of FMR of a single nano-sized cube.

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Broadband Electron Spin Resonance Experiments using superconducting Coplanar Waveguides — •Conrad Clauss[1], Daniel Bothner[2], Lapo Bogani[1], Marc Scheffler[1], Dieter Koelle[2], Reinhold Kleiner[2], and Martin Dressel[1] — [1]1. Physikalisches Institut, Universität Stuttgart, D-70550 Stuttgart, Germany — [2]Physikalisches Institut - Experimentalphysik II and Center for Collective Quantum Phenomena in LISA+, Universität Tübingen, D-72076 Tübingen, Germany

In recent years superconducting coplanar devices operating at microwave/GHz frequencies are employed in more and more experimental studies.

Here, we present electron spin resonance (ESR) experiments using a superconducting coplanar waveguide to provide the RF field to drive the spin flips. In contrast to conventional ESR studies this allows broadband frequency as well as magnetic field swept observation of the spin resonance.

We show experimental data of the spin resonance of the organic radical NitPhoMe (2-(4'-methoxyphenyl)-4,4,5,5-tetra-methylimidazoline-1-oxyl-3-oxide) for frequencies in the range of 1 GHz to 40 GHz and corresponding magnetic fields up to 1.4 T (for g=2). In addition we show the temperature dependence of the ESR signals for temperatures up to 30 K, which is well above the critical temperature of the niobium superconductor.

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Studying magnetic nanostructures and the local magnetic

induction of bulk samples by micro-Hall magnetometry — •Merlin Pohlit[1], Pintu Das[1], Adham Amyan[1], Yuzo Ohno[2], Hideo Ohno[2], and Jens Müller[1] — [1]Physikalisches Institut, Goethe-Universität, Frankfurt (M), Germany — [2]Laboratory for Nanoelectronics and Spintronics, Tohoku University, Sendai, Japan

Hall magnetometers based on high-mobility two-dimensional-electron systems in GaAs/AlGaAs heterostructures are powerful tools for studying individual magnetic structures on the micro- and nanoscale [1]. In particular, the devices can be used in a wide temperature and magnetic field range. Besides the possibility to position magnetic structures directly on top of the lithographically defined Hall crosses, bulk magnetic and superconducting samples may be placed on the magnetometers for local magnetic induction measurements. Here, a series of adjacent Hall crosses allows for spatially-resolved measurements with micron-size resolution. The versatility of the devices can be demonstrated by different measuring techniques including eight-terminal Hall gradiometry, magnetic flux noise measurements and the use as susceptometers. We discuss various examples for these methods, e.g. on the ferromagnetic semimetal EuB_6, where two consecutive transitions occur at 15.5K and 12.6K.These are related to electronic and magnetic phase separation and bulk magnetic ordering, but the details are not yet fully understood. We perform stray field calculations in order to simulate our results and find good agreement with the experimental data. [1] P. Das et al., APL 97, 042507 (2010)