MA 64: Poster 1

Time: Friday 9:30–13:00 Location: P2-EG

MA 64.1 Fri 9:30 P2-EG

Emergent Momentum-Space Skyrmion Texture on the Surface of Topological Insulators — Narayan Mohanta[1], Arno P. Kampf[2], and •Thilo Kopp[3] — [1]Center for Electronic Correlations and Magnetism, Theoretical Physics III, Institute of Physics, University of Augsburg, 86135 Augsburg, Germany — [2]Center for Electronic Correlations and Magnetism, Experimental Physics VI, Institute of Physics, University of Augsburg, 86135 Augsburg, Germany — [3]Center for Electronic Correlations and Magnetism, Theoretical Physics III, Institute of Physics, University of Augsburg, 86135 Augsburg, Germany

The quantum anomalous Hall effect has been theoretically predicted and experimentally verified in magnetic topological insulators. In addition, the surface states of these materials exhibit a hedgehog-like "spin" texture in momentum space. Here, we apply the previously formulated low-energy model for Bi_2Se_3, a parent compound for magnetic topological insulators, to a slab geometry in which an exchange field acts only within one of the surface layers. In this sample set up, the hedgehog transforms into a skyrmion texture beyond a critical exchange field. This critical field marks a transition between two topologically distinct phases. The topological phase transition takes place without energy gap closing at the Fermi level and leaves the transverse Hall conductance unchanged and quantized to $e^2/2h$. The momentum-space skyrmion texture persists in a finite field range. It may find its realization in hybrid heterostructures with an interface between a three-dimensional topological insulator and a ferromagnetic insulator.

MA 64.2 Fri 9:30 P2-EG

The Influence of the Dzyaloshinskii-Moriya (DM) interactions on the magnon spectrum in Cu_2OSeO_3 — •Y. Onykiienko[1], Y. Tymoshenko[1], D. Inosov[1], P. Portnichenko[1], A. Schneidewind[2], P. Cermak[2], A. Henschel[3], and M. Schmidt[3] — [1]Institute of Solid State Physics, TU Dresden, D-01069 Dresden, Germany — [2]Jülich Center for Neutron Science (JCNS), Garching, Germany — [3]Max Planck Institute for Chemical Physics of Solids, Dresden, German

Cu_2OSeO_3 is an insulating helimagnetic multiferroic material which hosts a skyrmion phase. It has non-centrosymmetric space group ($P2_13$) similar to the B20 skyrmion compounds (e.g. MnSi, FeGe), but with a much more complex structure. Recent studies reveal good agreement between TOF neutron scattering data and theoretical predictions that suggest a spin model with up to 5 nearest-neighbor Heisenberg exchange interactions neglecting antisymmetric DM terms responsible for the helical ground state. Taking them into account leads to corrections that are smaller than the resolutions of most available instruments. However a significant deviation has been found in the spin-wave spectrum, presumably, caused by the DM interactions.

By means of the cold neutron TAS we observed the gap of about 1.6 meV in the magnetic spectrum which is absent in the previously reported spin-wave model. In addition we established magnon branch splitting at high symmetry points of the reciprocal space. Both observations can be explained in the frame of the linear spin-wave theory by taking into account theoretically predicted DM interactions.

MA 64.3 Fri 9:30 P2-EG

Dzyaloshinskii-Moriya Interaction in FeGe samples: Ferromagnetic resonance and micromagnetic simulations — •Thomas Feggeler[1], Ralf Meckenstock[1], Zi-An Li[1], Detlef Spoddig[1], Iliya Radulov[2], Konstantin Skokov[2], Oliver Gutfleisch[2], and Michael Farle[1,3] — [1]Fakultät für Physik, Universität Duisburg-Essen, 47057 Duisburg, Germany — [2]Institut für Materialwissenschaft, TU Darmstadt, Alarich-Weiss-Str. 16, 64287 Darmstadt, Germany — [3]Immanuel Kant Baltic Federal University, 236041 Kaliningrad, Russian Federation

We perform temperature and angular dependent Ferromagnetic Resonance (FMR) measurements (X-band) on bulk FeGe and FeGe in confined geometries. Results of a polycrystalline bulk B20-FeGe sample (diameter 3.78 mm, thickness 0.78 mm), manufactured by high pressure high temperature synthesis, show Dyson-shaped resonances with an angular dependent resonance field between 345 mT and 322 mT at 294 K. Cooling the sample to 152 K reveals several additional resonances in good agreement to [1]. An angular dependence of the resonances could not be detected below 280 K. FMR-Measurements of FeGe samples in confined geometries (6 μm x 200 nm x 20 nm) show several resonances in a small angular range between 270 K and 280 K, indicating a complex standing wave pattern as discussed in [2]. Additionally, we will show the results of supplementary static and dynamic micromagnetic simulations of the bulk and confined geometry FeGe. [1] Haraldson, S., et al. JMR, 1972. 8(3): p. 271-273. [2] Zingsem, B.W., et al., arXiv:1609.03417, 2016: p. 1-26.

MA 64.4 Fri 9:30 P2-EG

Thickness dependence of the appearance of the skyrmion phase in FeGe: A TEM study — •Sebastian Schneider[1,2], Darius Pohl[1], Ulrich K. Rössler[3], Marcus Schmidt[4], Axel Lubk[5], Thomas Gemming[6], Kornelius Nielsch[1,7], Sebastian T. B. Goennenwein[2], and Bernd Rellinghaus[1] — [1]IFW Dresden, Institute for Metallic Materials, Dresden — [2]TU Dresden, Institute of Solid State Physics, Dresden — [3]IFW Dresden, Institute for Theoretical Solid State Physics, Dresden — [4]Max-Planck Institute for Chemical Physics of Solids, Research Field Chemical Metals Science, Dresden — [5]IFW Dresden, Institute for Solid State Research, Dresden — [6]IFW Dresden, Institute for Complex Materials, Dresden — [7]TU Dresden, Institute of Materials Science, Dresden

Novel nanoscale magnetic phenomena such as skyrmions cause a steadily increasing demand for ultra-high resolution quantitative magnetic characterization. Here, transmission electron microscopy (TEM) provides the possibility to locally correlate the magnetic properties of the sample with its structure and chemical composition thereby providing for a more complete picture of the underlying physics. We investigate the skyrmion phase of a thin lamella of a FeGe single crystal in Lorentz-TEM (LTEM). Corresponding thickness measurements of sample areas under investigation reveal a breakdown of the skyrmion phase below film thicknesses of 40 nm. We furthermore report on the lateral components of the magnetization in skyrmions by applying the transport of intensity equation to focal series of LTEM images.

MA 64.5 Fri 9:30 P2-EG

Investigation of the Influence of the Skyrmion Radius on Real-Time Skyrmion Trajectories and the Skyrmion Hall Effect — •P. Bassirian[1], K. Litzius[1,2], I. Lemesh[3], B. Krüger[1], L. Caretta[3], K. Richter[1], F. Büttner[3], J. Förster[2], R. M. Reeve[1], M. Weigand[2], I. Bykova[2], H. Stoll[2], G. Schütz[2], G. S. D. Beach[3], and M. Kläui[1] — [1]Institute of Physics, Johannes Gutenberg-University Mainz, 55099 Mainz, Germany — [2]Max Planck Institute for Intelligent Systems, 70569 Stuttgart, Germany — [3]Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA

Magnetic skyrmions are promising candidates for new data storage and information processing devices, due to their topologically stabilized spin structure and their recently demonstrated efficient spin orbit torque driven dynamics. Recent experimental studies have shown a deviation of the skyrmion trajectories with respect to the direction of the current flow [1,2]. This deviation angle between motion direction and current direction is quantified as the skyrmion Hall angle (SHA). We have observed a dependence of the SHA on the size of the skyrmion [2,3], which allows us to manipulate the skyrmion trajectory by engineering the skyrmion size. We investigate the response of the skyrmion radius on an external magnetic field to obtain the influence of materials properties and skyrmion size on the skyrmion Hall effect.

[1] Jiang, W. et al. Nat. Phys. (online) DOI:10.1038/nphys3883 (2016). [2] Litzius, K. et al., Nature Physics (in press 2016), arxiv:1608.07216. [3] Woo, S. et al. Nat. Mater. 15, 501-506 (2016).

MA 64.6 Fri 9:30 P2-EG

Antiferromagnetic domain wall motion in the presence of spin-polarized current and temperature gradient — •Olena Gomonay, Kei Yamamoto, and Jairo Sinova — Institut für Physik, Johannes Gutenberg Universität Mainz, D-55099 Mainz, Germany

Antiferromagnets (AF) are promising materials for spintronic applications because they show fast magnetic dynamics and low susceptibility with respect to magnetic fields. Application of AF as information storage devices implies fast and reliable switching between different states.

In this presentation we focus on the domain wall motion as a main mechanism of the switching. We consider combined effects of the temperature gradient and spin current on the AF domain wall motion. We demonstrate that spin current splits the effective temperatures of the magnon gas in different domains and thus induces the magnon current equivalent to the thermal one. This mechanism can add to or compete with the entropic mechanism, that results from the temperature gradient. We show that tailoring of the device geometry can enhance or suppress the effective force that sets the AF domain wall into motion. This effect opens a way to manipulate a domain wall position in the presence of temperature gradient.

MA 64.7 Fri 9:30 P2-EG

Co-sputtered PtMnSb thin films and Pt/PtMnSb bilayers for spin-orbit torque investigations — •Jan Krieft[1], Johannes Mendil[2], Myriam H. Aguirre[3], Can O. Avci[4], Christoph Klewe[5], Karsten Rott[1], Jan-Michael Schmalhorst[1], Günter Reiss[1], Pietro Gambardella[2], and Timo Kuschel[1,6] — [1]CSMD, Bielefeld University, Germany — [2]Department of Materials, ETH Zürich, Switzerland — [3]Universidad de Zaragoza, Spain — [4]MIT, Boston, USA — [5]ALS, Berkeley, USA — [6]University of Groningen, The Netherlands

The manipulation of magnetization by the use of spin-orbit torques (SOTs) has recently been extensively studied.[1,2] Particular attention is paid to non-centrosymmetric systems with space inversion asymmetry, where SOTs emerge even in single-layer materials.[3,4] Here, we report on the growth and epitaxial properties of the SOT material PtMnSb thin films and PtMnSb/Pt bilayers deposited on MgO(001) substrates by dc magnetron co-sputtering at high temperature in ultra-high vacuum. The film properties were investigated by x-ray diffraction, x-ray reflectivity, atomic force microscopy, and electron microscopy, in order to provide information on the film structure, stoichiometry, and surface topography.

[1] I. M. Miron et al., Nature 476, 189 (2011).
[2] L. Neumann et al., Appl. Phys. Lett. 109, 142405 (2016).
[3] T. Jungwirth et al., Nat. Nanotechn. 11, 231 (2016).
[4] P. Wadley et al., Science 351, 587 (2016).

MA 64.8 Fri 9:30 P2-EG

Investigating the skyrmion breathing mode using conjugate variables — •Benjamin F. McKeever[1], Artem G. Abanov[2], and Karin Everschor-Sitte[1] — [1]Johannes Gutenberg-Universität, Mainz, Germany — [2]Texas A&M University, College Station, Texas, USA

The understanding and subsequent manipulation of properties of magnetic skyrmions is an important challenge for their use in future energy-efficient devices. Different excitations of single skyrmions have been observed and here we consider the so called "breathing mode" in which the core region of the skyrmion periodically grows and shrinks. We analyse the breathing mode in analogy to how it has been studied in quantum Hall systems, namely by using a phenomenological theory of conjugate variables.

MA 64.9 Fri 9:30 P2-EG

GMR films with crossed anisotropies for perpendicular field measurements — •Fabian Ganss[1,3], Wolfgang Raberg[2], Sebastian Luber[2], Sri Sai Phani Kanth Arekapudi[3], Olav Hellwig[3,4], and Manfred Albrecht[1] — [1]Institute of Physics, Augsburg University, Augsburg — [2]Infineon Technologies AG, Neubiberg — [3]Institute of Physics, Chemnitz University of Technology, Chemnitz — [4]Institute for Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Dresden

As 3-dimensional field sensors require one part being susceptible to perpendicular fields, thin film GMR stacks with a linear and reversible response to such fields are of interest for the development of monolithic sensor devices. Stacks with such a behavior can be achieved by combining a *pinning layer* with perpendicular *easy axis* and a *free layer* with perpendicular *hard axis*. Furthermore, the stray field of the pinning layer can be minimized and its coercivity enhanced if a ferrimagnet (or antiferromagnet) is used. For the present study, $\mathrm{Tb_xCo_{100-x}}$ alloys have been chosen as the pinning layer material and $\mathrm{Ni_{81}Fe_{19}}$ for the free layer. The single layers have been characterized by SQUID-VSM measurements, the complete layer stack by magneto-resistance measurements. Initial films confirm the expected behavior and exhibit a change in resistivity of 5% in a field range of 10 kOe. Further films will be optimized regarding their magnetic and electric properties. They shall be micro-structured then and equipped with bottom contacts through the substrate.

MA 64.10 Fri 9:30 P2-EG

Magnetic susceptibility and phase transitions in the B20 helical magnet $\mathbf{Mn_{1-x}Co_xGe}$ — •Patrick Strauss[1], Evgeny Altynbaev[2], Sven-Arne Siegfried[3], Evgeny Moskvin[2], André Heinemann[3], Ludmila Fomicheva[4], Anatoly Tsvyashchenko[4], Sergey Grigoriev[2], and Dirk Menzel[1] — [1]IPKM, TU Braunschweig, Germany — [2]PNPI, Gatchina and Saint-Petersburg State University, Russia — [3]Helmholtz-Zentrum Geesthacht, Germany — [4]IHPP, Troitsk, Russia

The non-centrosymmetric transition metal silicides and germanides crystallizing in the cubic B20 structure are well-known for the competing Heisenberg and Dzyaloshinskii-Moriya (DM) interactions leading to incommensurate helical spin structures. The germanides stand out for their relatively high ordering temperatures (278 K for FeGe, e.g.) and complex magnetic phase diagrams. We present a distinct magnetic characterization of the solid solution $\mathrm{Mn_{1-x}Co_xGe}$ measured by SQUID magnetometry. The ordering temperature decreases from $T = 200$ K for MnGe to $T = 25$ K for $\mathrm{Mn_{0.05}Co_{0.95}Ge}$. Small-angle neutron scattering (SANS) measurements imply that the helical spin structure is driven by RKKY exchange for $x < 0.45$. In this regime, hysteresis measurements show low anisotropy. In contrast, the exchange is dominated by DM interaction for $x > 0.45$, which can be supported by an enhanced magnetic anisotropy derived from the magnetization curves. In the high-field regime magnetic transitions are observed which are discussed in the context of the results of the SANS measurements.

MA 64.11 Fri 9:30 P2-EG

Thermodynamics of the Kagome lattice with arbitrary spin $S \geq 1/2$ — •Patrick Müller, Andreas Zander, and Johannes Richter — Institut für Theoretische Physik, Universität Magdeburg - 39016 Magdeburg, Germany

One of the most prominent and at the same time frequently discussed model with a frustration induced highly degenerated classical ground-state (GS) manifold is the Heisenberg antiferromagnet (HAFM) on the Kagome lattice. The geometry of the lattice, which consists of corner-sharing triangles, suppresses a conventional ordering of the spins at absolute zero. Although it is clear that for $S = 1/2$ there is no magnetic long-range order, the precise nature of the quantum spin-liquid is still under debate. We use the spin-rotation invariant Green's function method (RGM) with an additional input (ground-state energy data of the Coupled-Cluster-Method (CCM)[1]) to study the temperature dependence of the magnetic structure factor $S_{\mathbf{Q}}$, the susceptiblity χ_0, the specific heat C_V, the correlation length $\xi_{\mathbf{Q}}$ and the correlation functions $\langle S_0 S_{\mathbf{R}} \rangle$ for $S \geq 1/2$. Moreover, we compare the RGM data with the corresponding high-temperature expansion (HTE) data [2]. [1] O. Götze, D. J. J. Farnell, R. F. Bishop, P. H. Y. Li, and J. Richter, Phys. Rev. B **84**, 224428, (2011). [2] A. Lohmann, H.-J. Schmidt, and J. Richter, Phys. Rev. B **89**, 014415, (2014). [3] B. H. Bernhard, B. Canals, and C. Lacroix, Phys. Rev. B **66**, 104424, (2002). [4] D. Schmalfuss, J. Richter, and D. Ihle, Phys. Rev. B **70**, 184412, (2004).

MA 64.12 Fri 9:30 P2-EG

Study of hysteresis phenomena in spin crossover systems — •Raluca-Maria Stan, Roxana Gaina, and Cristian Enachescu — Faculty of Physics, Alexandru Ioan Cuza University of Iasi, Iasi, Romania

Spin transition molecular magnets are inorganic compounds, commutable between two states in thermodynamic competition: the low spin state (LS) and the high spin state (HS). When the intermolecular interactions are larger than a threshold, the commutation is accompanied by various hysteresis, such as thermal, light induced or pressure hysteresis, property at the base of applications for information storage and numerical display. Here we shall study the thermal hysteresis (TH) and light induced thermal hysteresis (LITH) in the case of $\mathrm{Fe(bbtr)_3(ClO_4)_2}$ spin crossover compound. While the TH obtained at higher temperature (above 100K) is rate-independent, the LITH, obtained at low temperatures while irradiating the compound with a laser beam, shows a strong rate dependence (kinetic effects). Using the First Order Reversal Curves (FORC) method, which is well known for its capacity to provide information about the intrinsic properties of compounds showing hysteresis, we have qualitatively analyzed the kinetic effects. Then, in order to obtain a further quantitative analysis of the phenomena, the Mean Field model was used to simulate the observed behavior and an algorithm to disentangle between the static and dynamical effects in LITH was proposed.

MA 64.13 Fri 9:30 P2-EG

Phase diagram of $La_{1-x}Sr_xMnO_3/SrTiO_3$ epitaxial thin films — •Danny Schwarzbach[1], Markus Jungbauer[2], and Vasily Moshnyaga[2] — [1]Institut für Materialphysik, Georg-August-Universität Göttingen — [2]Erstes Physikalisches Institut, Georg-August-Universität Göttingen

Charge, spin and orbital interface reconstructions in $LaMnO_3/SrMnO_3$ superlattices (SLs) result in a novel interfacial high-temperature ferromagnetism. We present a complex study of parent mixed-valence $La_{1-x}Sr_xMnO_3$ (LSMO(x), $x = 0 - 1$) film system, which enables us to model and quantify magnetic coupling between FM and AFM phases in SLs. The LSMO(x) films ($d = 40\,\mathrm{nm}$) were epitaxially grown by metalorganic aerosol deposition technique on STO substrates with (001) and (111) orientations. The LSMO(x)/STO(001) films with $x \leq 0.6$ were found to be fully strained, whereas those of LSMO(x)/STO(111) start to relax for $x > 0.4$. The tensile strain in the (001)-plane favors an AFM ordering of the A-type due to orbital polarization of $(x^2 - y^2)$ orbitals of Mn ions. Therefore, the FM/AFM crossover is shifted to higher values of Sr-doping, x, for the films grown on STO(111) as compared to those on STO(001) substrate. Using in-situ optical ellipsometry we were able to monitor and control substrate temperature, film thickness and growth mode itself. Moreover, the acquired phase shift between p- and s-polarized reflected waves was found to depend on the charge density (Mn^{3+}/Mn^{4+} ratio), helping us to quantify the FM/AFM crossover.

Financial support from DFG (SFB1073, TP B04) is acknowledged.

MA 64.14 Fri 9:30 P2-EG

Optically detected magnetic resonances for different magnetic phases in CuB_2O_4 — •Henning Moldenhauer[1], Vitalii Yu. Ivanov[2], Jörg Debus[1], Dennis Kudlacik[1], Roman Pisarev[3], Dmitri R. Yakovlev[1,3], and Manfred Bayer[1,3] — [1]Experimentelle Physik 2, Technische Universität Dortmund, Dortmund, Germany — [2]Institute of Physics, Polish Academy of Sciences, Warsaw, Poland — [3]Ioffe Institute, Russian Academy of Sciences, St. Petersburg, Russia

A recent study has shown a direction dependent photoluminescense (PL) of up to 70% in CuB_2O_4, that means an asymmetry between the opposite directions of the PL emission from the crystal. Moreover, the non-centrosymmetric tetragonal CuB_2O_4 consists of two sublattices with different magnetic ordering; magnetic phase transitions occur at about 9 K and 21 K. We investigate the magnetic phase transitions and the spatial PL emission asymmetry using the optically detected magnet resonance technique with 60 GHz microwave radiation. We demonstrate strong dependences on the magnetic field direction and microwave radiation power for the spectrally selected PL transitions of the antiferromagnetically ordered sublattice. In that way, we aim at enhancing the understanding of the energy and spin level structure of the sublattices in CuB_2O_4 at different temperature ranges thus underlying its highly interesting optical and magnetic properties.

MA 64.15 Fri 9:30 P2-EG

Measuring the spin-spin interaction on few doubly labeled proteins using NV-centers in diamonds — •Bastian Kern[1], Lukas Schlipf[1], Kebiao Xu[1,2,3], Amit Finkler[3], Markus Ternes[1], Jörg Wrachtrup[1,3], and Klaus Kern[1,4] — [1]MPI for Solid State Research, D-70569 Stuttgart, Germany — [2]CAS Key Laboratory of Microscale Magnetic Resonance, USTC, 230026 Hefei, China — [3]3. Physikalisches Institut, Universität Stuttgart, D-70569 Stuttgart, Germany — [4]Institut de Physique de la Matière Condensée, EPFL, CH-1015 Lausanne, Switzerland

Electron Paramagnetic Resonance (EPR) measurements of proteins labeled with two nitroxide spins have enabled the structural analysis of these proteins with sub-nm spatial resolution [1], with the main drawback of of large numbers of spins required for the experiment ($\sim 10^{10}$ spins). Using an atomic scale sensor can lower this limit significantly. A system perfectly suited for this task are single nitrogen vacancy (NV) centers in diamonds [2]. For the first we time measure the interaction between nitroxide spin labels on doubly labeled proteins while only probing few (~1-100) molecules with a triple electron resonance scheme at cryogenic temperatures: The dipolar interaction between the two spins on the protein, which is related to their distance, is detected using a nearby third electron spin of an NV center. These results show the capability of NV spin spectrometry in determining the distance between spin labels, using only few molecules.

[1] O. Duss et al, Nat. Comm. 5, 3669 (2014); [2] F. Jelezko, J. Wrachtrup, Phys. Stat. Sol. 203, 13, 3207-3225 (2006)

MA 64.16 Fri 9:30 P2-EG

Magnetoelectric properties in oxidized-graphenic nanoplatelets and thin films obtained from bamboo — •Katherine Gross[1], Jhon Jairo Prias-Barragán[2,3], Luc Lajaunie[4], Raul Arenal[4], Hernando Ariza-Calderón[2], and Pedro Prieto[1] — [1]CENM, Universidad del Valle, Colombia — [2]IIS, Universidad del Quindio, Colombia — [3]EITP, Universidad del Quindio, Colombia — [4]LMA, INA, Universidad de Zaragoza, Zaragoza, Spain

We employed a novel and cost-effective pyrolytic method to synthetize oxidized-graphenic nanoplatelets (OGNP) and thin films using bamboo, which is a cheap and highly renewable natural source. We have studied the magnetic response by systematically varying the crystal structure and topological defects. The crystal structure and the surface topography is modified by increasing the carbonization temperature in a range of 473K to 973K. At 973K OGNP present a higher ordered crystalline graphite structure and a sp2 fraction of 87 percent. OGNP show ferromagnetic order and low coercivity at room temperature. Magnetic properties are correlated with the presence of topological defects due to a natural formation of islands during the carbonization process. Magnetic force microscopy gives direct evidence for local ferromagnetic order at the topological defects. Temperature dependence on conductivity of the thin films showed typical semiconductor behavior, which could be described by the Mott 3D variable-range hopping mechanism. Hysteretic negative magnetoresistance (MR) was found in thin films, which confirms the intrinsic nature of the observed ferromagnetism. At 300 K the maximum MR is about 2 percent.

MA 64.17 Fri 9:30 P2-EG

PLY-Cu for organic MTJs — •Christian Denker[1], Pavan K. Vardhanapu[2], Bikash Das Mohapatra[4], Ulrike Martens[1], Heba Mohammad[1], Mykola Medvidov[3], Christiane Helm[1], Swadhin Mandal[2], and Markus Münzenberg[1] — [1]Institut für Physik, Universität Greifswald, Germany — [2]IISER, Kolkata, India — [3]ZIK HIKE, Universität Greifswald, Germany. — [4]NISER, Bhubaneshwar, India

Phenalenyl (PLY) based molecules are promising candidates for spintronics application. Attempts to use open shell PLY molecules have been unsuccessful due to their instability. Mandal and coworkers took a new route for PLY-based molecules with a closed shell ground state. For example, zinc methyl phenaleny (ZMP) shows a magnetoresistance of 20% even near room temperature [Nature 493 509 (2013)].

Motivated by these results, we are investigating a new closed shell molecule, PLY with Cu complex, for its spintronics suitablity. Thin film are deposited by thermal evaporation maintaining its chemical properties as shown by Fourier transform infrared spectroscopy (FTIR). Ferromagnet/PLY-Cu/ferromagnet heterostructure devices are fabricated by deposition through an in-situ mask under different angles. These devices are characterized by atomic-force microscopy (AFM), scanning electron microscopy (SEM) and magneto-resistance measurements.

MA 64.18 Fri 9:30 P2-EG

Spin transport across antiferromagnetic IrMn thin films — •Joel Cramer[1,2], Bowen Dong[1,2], Samridh Jaiswal[1,3], Felix Fuhrmann[1], Gerhard Jakob[1], and Mathias Kläui[1,2] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz, 55128 Mainz, Germany — [2]Graduate School of Excellence Materials Science in Mainz, 55128 Mainz, Germany — [3]Singulus Technologies AG, Hanauer Landstraße 103, 63796 Kahl am Main, Germany

Recently, the investigation of magnonic spin currents in antiferromagnetic materials has gained interest. We present measurements on the spin transmission of metallic, antiferromagnetic iridium manganese (IrMn) thin films in yttrium iron garnet (YIG)/IrMn/Pt tri-layers. For this purpose, spin Seebeck (SSE) as well as spin Hall magnetoresistance (SMR) measurements have been performed. When measured as a function of temperature, a signal maximum appears in the temperature profile of the SSE amplitude with the temperature of the maximum depending on the IrMn thickness. Below this temperature, the signal decreases rapidly and is eventually suppressed at temperatures, at which YIG/Pt reference samples still show a clearly measurable SSE voltage. The same trend is observed in the temperature dependent SMR measurements. In insulating AFMs spin transmission has been studied[1,2] and is explained by the AFM layer undergoing the phase transition from the paramagnetic into the antiferromagnetic state. To check for this possibility, temperature dependent SQUID magnetometry measurements are performed. [1] Qiu et al., Nat. Comm. 7, 12670 (2016) [2] Prakash et al., Phys. Rev. B 94, 014427 (2016)

MA 64.19 Fri 9:30 P2-EG

Thermoelectrical characterization of MnSi nanowires — •Alexander Fernández Scarioni[1], David Schroeter[2], Xiukun Hu[1], Sibylle Sievers[1], Dirk Menzel[2], Stefan Süllow[2], and Hans W. Schumacher[1] — [1]Physikalish-Technische Bundesanstalt (PTB), Braunschweig, Germany — [2]Institut für Physik der Kondensierten Materie, TU Braunschweig, Germany

In bulk samples, the chiral magnet MnSi shows a skyrmion phase or so called A-phase in a small temperature-magnetic field range. With decreasing this A-phase expands and the *skyrmion state* becomes more stable. One way to study this A-phase has been through measurements of the Hall effect where the topological part (topological hall effect) shows evidence of the existence of the skyrmion phase in bulk and thin film MnSi.

We propose a different method to study this A-phase, using the anomalous Nernst effect (ANE), the thermoelectric analogon to the anomalous Hall effect. For this purpose we fabricated MnSi thin films using molecular beam epitaxy and then structure them down to nanowires using electron beam lithography and sputter etching. A temperature gradient is generated by a platinum microheater placed next to the MnSi nanowire. The thermoelectric voltage generated in the wire allows us to detect the average magnetization state of the wire without applying a current.

First ANE data of our MnSi nanowires in different magnetic phases will be discussed.

MA 64.20 Fri 9:30 P2-EG

Damping of parametrically excited magnons in the presence of the longitudinal spin Seebeck effect — •Thomas Langner[1], Akihiro Kirihara[2], Alexander A. Serga[1], Burkard Hillebrands[1], and Vitaliy I. Vasyuchka[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Technische Universität Kaiserslautern, Germany — [2]IoT Devices Research Laboratories, NEC Corporation, Tsukuba, Japan

The impact of the longitudinal spin Seebeck effect (LSSE) on the magnon damping in magnetic-insulator/nonmagnetic-metal bilayers was recently discussed in several reports. However, results of those experiments can be blurred by multimode excitation within the measured linewidth. In order to avoid possible intermodal interference, we investigated the damping of a single magnon group in a platinum covered Yttrium Iron Garnet (YIG) film by measurement of the threshold of its parametric excitation. Both dipolar and exchange spin-wave branches were probed. It turned out that the LSSE-related modification of spin-wave damping in a micrometer-thick YIG film is too weak to be observed in the entire range of experimentally accessible wavevectors. At the same time, the change in the mean temperature of the YIG layer, which can appear by applying a temperature gradient, strongly modifies the damping value. Financial support by DFG within SPP 1538 "Spin Caloric Transport" is gratefully acknowledged.

MA 64.21 Fri 9:30 P2-EG

Magneto-optic detection of spin Seebeck effect in Au/YIG and Cu/YIG bilayers at picosecond time scale — Johannes Kimling[1], Gyung-Min Choi[2], Jack T. Brangham[3], •Tristan Matalla-Wagner[4], Torsten Huebner[4], Timo Kuschel[4,5], Fengyuan Yang[3], and David G. Cahill[1] — [1]University of Illinois, Urbana, USA — [2]Korea Institute of Science and Technology, Seoul, Korea — [3]The Ohio State University, Columbus, USA — [4]CSMD, Bielefeld University, Germany — [5]University of Groningen, The Netherlands

A temperature gradient perpendicular to the plane of $Y_3Fe_5O_{12}$ (YIG) / Pt bilayers drives an out-of-plane spin current in the YIG and at the YIG/Pt interface (longitudinal spin Seebeck effect), which is injected into the Pt. The inverse spin Hall effect in Pt converts the spin current into a transverse charge current and, thus, a charge voltage can be measured. However, a magnetic proximity effect (MPE) in Pt can occur, that allows for the anomalous Nernst effect, which has the same symmetry as the LSSE and, therefore, can contribute to the measured voltage as a parasitic side effect. To detect the LSSE without any MPE side effects, additional techniques such as magneto-optic means can be applied. Here, we present LSSE measurements using the time-resolved magneto-optic Kerr effect. Our results indicate angular-momentum transfer across YIG/Cu and YIG/Au interfaces on a picosecond time scale [1].

[1] J. Kimling et al., arxiv: 1608.00702

MA 64.22 Fri 9:30 P2-EG

Temperature gradient simulations in laser-induced tunnel magneto-Seebeck experiments — •Torsten Huebner[1], Alexander Boehnke[1], Andy Thomas[2], Günter Reiss[1], Markus Münzenberg[3], and Timo Kuschel[1,4] — [1]CSMD, Physics Department, Bielefeld University, Germany — [2]IMW, IFW, Dresden, Germany — [3]IFP, Greifswald University, Germany — [4]University of Groningen, The Netherlands

The Seebeck coefficient of a magnetic tunnel junction (MTJ) changes depending on the magnetization alignment of its electrodes and, thus, the measured thermovoltage changes as well. This effect is know as the tunnel magneto-Seebeck (TMS) effect and has been studied in many systems, experimentally [1-4] as well as theoretically [5,6]. Naturally, knowledge about the temperature gradient is crucial. Since this quantity is not accessible experimentally, we use FEM simulations to draw conclusions about the heat distribution. Here, we present a detailed study of the temperature gradient depending on the barrier thickness including the uncertainty of the thermal conductivity [7].

[1] Walter et al., Nat. Mater. 10, 742 (2011)
[2] Liebing et al., Phys. Rev. Lett. 107, 177201 (2011)
[3] Boehnke et al., Rev. Sci. Instrum. 84, 063905 (2013)
[4] Huebner et al., Phys. Rev. B 93, 224433 (2016)
[5] Czerner et al., J. Appl. Phys. 111, 07C511 (2012)
[6] Heiliger et al., Phys. Rev. B 87, 224412 (2013)
[7] Zhang et al., Phys. Rev. Lett. 115, 037203 (2015)

MA 64.23 Fri 9:30 P2-EG

A systematical study on the anomalous Hall and Nernst effect in Co/Pd multilayers — •Oliver Reimer[1], Daniel Meier[1], Jan-Michael Schmalhorst[1], Guenter Reiss[1], and Timo Kuschel[1,2] — [1]CSMD, Physics Department, Bielefeld University, Germany — [2]University of Groningen, The Netherlands

In spin caloric experiments the unambigous determination of the longitudinal spin Seebeck effect (LSSE) produced by metallic magnetic films or multilayers is challenging due to the simultaneously occuring anomalous Nernst effect (ANE). Thus a new methodology that can eliminate parasitic effects like the ANE is necessary. Studies of the anomalous Hall effect (AHE), i.e. the charge current based counterpart of the ANE in perpendicular magnetized Co/Pd multilayers revealed a sign change of the AHE [1,2]. The sign of the AHE change depends in particular on the temperature and the Co thickness of the multilayer. We present a systematic study on Co/Pd multilayers, which compares the AHE and the ANE for samples with varying Co thickness and base temperature within one experiment. If a sign change in the ANE could be detected, LSSE experiments could be tuned in a way that no ANE contributions would occur. This opens a way for unambiguously detecting the LSSE and for deepening the knowledge of spin-related transport phenomena.

[1] V. Keskin et al., Appl. Phys. Lett. 102, 022416 (2013)
[2] X. Kou et al., J. Appl. Phys. 112, 093915 (2012)

MA 64.24 Fri 9:30 P2-EG

Spin disorder effect on the electronic properties of NiMnSb — •Roman Kováčik, Phivos Mavropoulos, and Stefan Blügel — Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, 52425 Jülich, Germany

An important contribution to the spin-caloric transport properties in magnetic materials at elevated temperatures is the formation of a spin-disordered state due to the local moment fluctuations. We investigate how the spin disordered state affects the spectral function, self energy and transport properties of NiMnSb, a prototypical half-metallic ferromagnet. The electronic structure of NiMnSb is calculated within the full-potential Korringa-Kohn-Rostoker (KKR) Green function framework [1]. The Monte-Carlo methodology is used to simulate the effect of temperature induced spin disorder and the set of spin-disordered configurations is fed back in the KKR method to obtain statistical average of the relevant material properties [2]. As an example, we find qualitative differences between the spectral function projected on Ni and Mn sites around the Curie temperature. In comparison to the $T = 0$ K state, the majority spin spectral function only broadens at Ni site whereas it acquires rather rich landscape at Mn site. In the minority spin, the most interesting outcome is the shift of the prominent peak away from the Γ-point at Ni site and to higher energy across the Fermi level at Mn site. Support from the DFG (SPP 1538) and JARA-HPC (jara0051) is gratefully acknowledged. [1] N. Papanikolaou *et al.*, J. Phys. Condens. Matter 14, 2799 (2002), also see: www.kkr-gf.org. [2] R. Kováčik *et al.*, Phys. Rev. B 91, 014421, (2015).

MA 64.25 Fri 9:30 P2-EG

Non-local magnetoresistance by magnon transport in various magnetic insulating garnets — •Nynke Vlietstra[1], Kathrin Ganzhorn[1,2], Tobias Wimmer[1,2], Stephan Geprägs[1], Rudolf Gross[1,2,3], Sebastian T.B. Goennenwein[1,2,3,4], and Hans Huebl[1,2,3] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany — [2]Physik-Department, Technische Universität München, Garching, Germany — [3]Nanosystems Initiative Munich (NIM), München, Germany — [4]Institut für Festkörperphysik, Technische Universität Dresden, Dresden, Germany

In recent years the ferrimagnetic insulating material yttrium iron garnet (YIG) has been intensively studied, mostly in combination with an adjacent few-nm-thick platinum (Pt) layer. Besides the local generation and detection of pure spin-currents in such a bilayer system, it was shown in 2015 that it is also possible to generate non-local electrical signals by transporting spin-information through the electrical insulating YIG layer by diffusion of incoherent magnons (quantized spin-waves) [1,2]. We study this non-local magnon transport, by electrical injection as well as by thermal excitation of magnons, for various magnetic insulating garnets. By measuring as a function of temperature and both the direction and magnitude of an applied magnetic field, we investigate the influence of various magnetic structures on the magnon generation, transport and non-local detection.

[1] L. Cornelissen et al., Nat. Phys. **11**, 1022 (2015)
[2] S. T. B. Goennenwein et al., Appl. Phys. Lett. **107**, 172405 (2015)

MA 64.26 Fri 9:30 P2-EG

Spin Hall Magnetoresistance in Canted Ferrimagnets — •Richard Schlitz[1,2,3], Kathrin Ganzhorn[1,3], Matthias Opel[1], Matthias Althammer[1,3], Stephan Geprägs[1], Hans Huebl[1,3,4], Rudolf Gross[1,3,4], and Sebastian T. B. Goennenwein[1,2,3,4] — [1]Walther-Meißner-Institut, Garching, Germany — [2]Technische Universität Dresden, Dresden, Germany — [3]Technische Universität München, Garching, Germany — [4]Nanosystems Initiative Munich, München, Germany

The spin Hall magnetoresistance (SMR) results from the interplay of spin and charge currents and, thus, is a valuable tool for studying the spin structure in ferromagnetic insulator (FMI)|normal metal bilayers.

The accepted model for SMR suggests that the metal's resistance only depends on the direction of the net magnetization of the FMI. To test this, we study rare earth iron garnet|platinum (REIG|Pt) hybrid structures featuring different magnetic sublattices with a magnetic compensation point. Thus, we can investigate the SMR in a non-collinear spin configuration where the sublattice magnetizations are not aligned with one another or the external magnetic field.

In contrast to the predictuion of present models, our studies reveal a dependence of the SMR on the magnetic sublattice orientations. In particular, we observe a sign inversion of the SMR close to the magnetic compensation temperature. We discuss these findings in comparison to atomistic spin simulations and X-ray magnetic circular dichroism experiments[1].

[1] K. Ganzhorn *et al.*, Physical Review B **94**, 094401 (2016)

MA 64.27 Fri 9:30 P2-EG

Spin Hall magnetoresistance using antiferromagnetic insulators — •Johanna Fischer[1,2], Stephan Geprägs[1], Kathrin Ganzhorn[1,2], Matthias Opel[1], and Rudolf Gross[1,2,3] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany — [2]Physik-Department, Technische Universität München, 85748 Garching, Germany — [3]Nanosystems Initiative Munich, 80799 München, Germany

The phenomena of pure spin currents have mainly been investigated in ferromagnetic insulators/normal metal hybrid structures and give rise to new spintronic effects like the spin Hall magnetoresistance (SMR).[1] As ferromagnets are very sensitive to external magnetic fields, devices based on antiferromagnetic materials may be a better solution for future spintronic applications. We study the possible SMR in heterostructures of epitaxially grown antiferromagnets covered by a thin Pt layer. We measure the angle dependent magnetoresistance in magnetic fields up to 7 T at different temperatures for three rotation planes relative to the field orientation. We discuss the SMR amplitude in terms of the newly discovered sub-lattice SMR model. This work is supported by the DFG via SPP 1538.

[1] M. Althammer et al., Phys. Rev. B **87**, 224401 (2013)

MA 64.28 Fri 9:30 P2-EG

Effect of quantum tunneling on spin Hall spin-transfer torque and spin Hall magnetoresistance — •Wei Chen[1], Seulgi Ok[1,2], Manfred Sigrist[1], Jairo Sinova[3], and Dirk Manske[4] — [1]ETH Zurich, Switzerland — [2]University of Zurich, Switzerland — [3]University of Mainz, Germany — [4]Max Planck Institute for Solid State Research, Stuttgart, Germany

In the normal metal/ferromagnetic insulator bilayer (such as Pt/YIG) and the normal metal/ferromagnetic metal/oxide trilayer (such as Pt/Co/AlOx), the spin injection can be achieved by the spin Hall effect in the normal metal. We demonstrate that the quantum tunneling of spin without transferring charge is a major mechanism for the spin Hall effect induced spin-transfer torque observed in these thin films. In addition, this quantum tunneling mechanism in combination with the spin diffusion effect in the normal metal well-explain the spin Hall magnetoresistance obsered in these thin films. Our minimal model expresses these quantities in terms of generic material properties such as interface s-d coupling, insulating gap, and layer thickness, rendering an inexpensive tool for searching for appropriate materials. [1] W. Chen, M. Sigrist, J. Sinova, and D. Manske, Phys. Rev. Lett. 115, 217203 (2015). [2] S. Ok, W. Chen, M. Sigrist, and D. Manske, arXiv:1607.03409.

MA 64.29 Fri 9:30 P2-EG

Spin Hall magnetoresistance in a non-collinear ferrimagnet — Bo-Wen Dong[1,2,3], •Andrew Ross[1], Joel Cramer[1,2], Kathrin Ganzhorn[4,5], Huai-Yang Yuan[1], Er-Jia Guo[1,6], Sebastian T. B. Goennenwein[4,5], and Mathias Kläui[1,2] — [1]Johannes Gutenberg-Universität Mainz, Germany — [2]Graduate School of Excellence Materials Science in Mainz (MAINZ), Germany — [3]University of Science and Technology Beijing, China — [4]Bayerische Akademie der Wissenschaften, Germany — [5]Technische Universität München, Germany — [6]Oak Ridge National Laboratory, TN, USA

The spin Hall magnetoresistance (SMR) of a gadolinium iron garnet (GdIG)/platinum (Pt) heterostructure was investigated by angular dependent measurements around the compensation temperature of the ferrimagnet, GdIG. Around this temperature, GdIG exhibits a non-collinear magnetic structure, which displays an atypical SMR signal[1]. Far from this temperature, the GdIG is collinear and the resistance displays the usual $\sin^2\gamma$ dependence[2]. However, as the temperature is swept around the compensation temperature, the angular dependence becomes more complex with the development of additional peaks that grow until the SMR signal inverts before being suppressed, returning to the typical signal of a collinear ferrimagnet. The number and strength of the peaks appearing in the signal depend on both the temperature and the strength of the applied field. Our results demonstrate the limitations of the current SMR formalism, developed for collinear magnetic structures [1][2]. [1] Ganzhorn et al, Phys. Rev. B 94, 094401(2016), [2] Nakayama et al, Phys. Rev. Lett 110, 206601(2013)

MA 64.30 Fri 9:30 P2-EG

Relational expression between spin polarization ratio and anisotropic magnetoresistance ratio for nearly half-metallic ferromagnets — •Satoshi Kokado[1], Yuya Sakuraba[2], and Masakiyo Tsunoda[3] — [1]Shizuoka University, Hamamatsu, Japan — [2]National Institute for Materials Science, Tsukuba, Japan — [3]Tohoku University, Sendai, Japan

A current-perpendicular-to-plane giant magnetoresistance effect for ferromagnet/metal/ferromagnet junctions increases with increasing the spin polarization ratio of resistivity, P_ρ, in the ferromagnet. A simple method to estimate P_ρ, however, has scarcely been proposed. In this study, we derive a simple relational expression between P_ρ and the anisotropic magnetoresistance ratio $\Delta\rho/\rho$, and that between the spin polarization ratio of the density of states at the Fermi energy, $P_{\rm DOS}$, and $\Delta\rho/\rho$ for nearly half-metallic ferromagnets [1]. We here use the two-current model for a system consisting of a spin-polarized conduction state and localized d states with spin–orbit interaction [1-3]. We find that P_ρ and $P_{\rm DOS}$ increase with increasing $\Delta\rho/\rho$ from 0 to a maximum value. In addition, we investigate P_ρ and $P_{\rm DOS}$ for a $Co_2FeGa_{0.5}Ge_{0.5}$ Heusler alloy [4] by substituting its experimentally observed $\Delta\rho/\rho$ into the respective expressions.

[1] S. Kokado *et al.*, Jpn. J. Appl. Phys. **55**, 108004 (2016).

[2] S. Kokado *et al.*, J. Phys. Soc. Jpn. **81**, 024705 (2012).
[3] S. Kokado *et al.*, Adv. Mater. Res. **750-752**, 978 (2013).
[4] Y. Sakuraba *et al.*, Appl. Phys. Lett. **104**, 172407 (2014).

MA 64.31 Fri 9:30 P2-EG

Thin films of the room temperature antiferromagnet CuMnAs deposited by magnetron sputtering — •Tristan Matalla-Wagner, Dario Linsen, Jan-Michael Schmalhorst, Timo Kuschel, Markus Meinert, and Günter Reiss — Center for Spinelectronic Materials and Devices, Bielefeld University, Germany

Antiferromagnets (AFM) are barely affected by external magnetic fields and their magnetic properties are notoriously difficult to manipulate and detect. However, it was recently demonstrated that the metastable tetragonal phase of CuMnAs fulfills the symmetry requirements for an intrinsic spin-orbit torque, that allows magnetization switching with current pulses of moderate density and magnetization read-out by the planar Hall effect [1]. Therefore, this material holds promise to manufacture novel antiferromagnetic memory devices that are extraordinarily robust against external influences [2]. Tetragonal CuMnAs is specifically promising due to its Néel temperature being well above room-temperature [3]. It was demonstrated that high quality CuMnAs films can be grown in the tetragonal phase on GaAs and GaP substrates by molecular beam epitaxy [4]. Here, we present the results of our recent progress to deposit CuMnAs films on GaAs (001) substrates by magnetron sputtering and discuss structural, magnetic, and electrical properties of the films.

[1] P. Wadley *et al.*, Science **351** 587 (2016)
[2] T. Jungwirth *et al.*, Nat. Nanotechn. **11** 231 (2016)
[3] F. Máca *et al.*, J. Magn. Magn. Mater. **324** 1606 (2012)
[4] P. Wadley *et al.*, Nat. Commun. **4** 2322 (2013)

MA 64.32 Fri 9:30 P2-EG

Spin Hall magnetorestiance in Pt/$La_{0.875}Sr_{0.125}MnO_3$ heterostructures — •Sarah Gelder[1,2], Stephan Geprägs[1], and Rudolf Gross[1,2,3] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany — [2]Physik-Department, TU München, 85748 Garching, Germany — [3]Nanosystems Initiative Munich, 80799 München, Germany

The interconversion of spin and charge currents via the (inverse) spin Hall effect in normal metal (NM)/ferromagnetic insulator (FMI) bilayers results in the spin Hall magnetoresistance (SMR). In the past years, the SMR was extensively investigated in the prototype bilayer system platinum/yttrium iron garnet (Pt/YIG). Here, we use $La_{1-x}Sr_xMnO_3$ (LSMO) with low doping level x=0.125 as the ferromagnetic insulator, exhibiting a T_c of 180K and phase transitions at 270K and at 150K. This material allows further insight into the dependence of the SMR on the magnetic properties of the ferromagnetic material. We have fabricated Pt/LSMO bilayers on (100)-oriented $SrTiO_3$ substrates by pulsed laser deposition of LSMO and subsequent electron beam evaporation of Pt. The high crystalline quallity as well as the magnetic properties of our LSMO thin films are confirmed by X-ray diffraction and SQUID magnetometry measurements. We performed angle-dependent magnetoresistance (ADMR) measurements, providing the SMR amplitude as a function of temperature and magnetic field strength . We correlate the experimental findings with the magnetic properties of LSMO. This work is supported by the DFG via SPP 1538.

MA 64.33 Fri 9:30 P2-EG

Impact of aging process on the magnetotransport properties of Co/Pd layered structures — •Afsaneh Farhadi Ghalati[1], André Philippi-Kobs[1,2], Dieter Lott[3], Jonathan Jacobsohn[1], Gerrit Winkler[1], and Hans Peter Oepen[1] — [1]Institut für Nanostruktur- und Festkörperphysik, Universität Hamburg, Jungiusstr. 11a, 20355 Hamburg, Germany — [2]Coherent X-ray Scattering (FS-CXS), Deutsches Elektronen-Synchrotron (DESY), Notkestr. 85, 22607 Hamburg, Germany — [3]Helmholtz-Zentrum Geesthacht, Zentrum für Material- und Küstenforschung GmbH, Max-Planck-str. 1, 21502 Geesthacht, Germany

The stability of magnetic thin films is an important issue for their application. In contrast to Co/Pt sandwiches, Co/Pd shows strong changes in the magnetotransport properties over time. Here, over a time span of 600 days, we have investigated the impact of aging on the various magnetoresistance effects present in longitudinal and transverse resistivity of Pd/Co/Pd sandwiches under ambient conditions. Two Co/Pd samples with Co thicknesses of 2 & 7 nm have been prepared via sputtering techniques. The results show strong variations of the MR properties in the first three months followed by a slower change to equilibrium values. However, there are significant differences between both samples reflecting different behavior of Co/Pd systems governed by bulk-like or interface contributions. X-ray reflectivity studies accompanying the MR investigations confirm the aging of the samples and particularly reveal a gradual intermixing of Co and Pd at the interfaces that happens on a time span of several months.

MA 64.34 Fri 9:30 P2-EG

Gilbert damping of magnetostatic modes in yttrium iron garnet spheres — •Stefan Klingler[1,2], Hannes Maier-Flaig[1,2], Carsten Dubs[3], Oleskii Surzhenko[3], Rudolf Gross[1,2,4], Hans Huebl[1,2,4], Sebastian T.B. Goennenwein[1,5,6], and Mathias Weiler[1,2] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany — [2]Physik-Department, TU München, Garching, Germany — [3]INNOVENT e.V. Technologieentwicklung, Jena, Germany — [4]Nanosystems Initiative Munich, München, Germany — [5]Institut für Festköperphysik, TU Dresden, Dresden, Germany — [6]Center for Transport and Devices of Emergent Materials, TU Dresden, Germany

The ferrimagnetic insulator yttrium iron garnet (YIG) has numerous applications in fundamental research due to its low intrinsic Gilbert damping. Recently, strong coupling between magnon modes in YIG spheres and photonic modes in microwave resonators gained interest for quantum information conversion. To this end, the detailed knowledge of damping in the magnetic system plays a crucial role. Here, we investigate the magnetostatic mode (MSM) spectrum of a 300 μm diameter YIG sphere using broadband ferromagnetic resonance. The measured data allows to separate Gilbert damping and inhomogeneous line broadening of the MSMs. One and the same Gilbert damping parameter $\alpha = 2.7(5) \times 10^{-5}$ is found for all MSMs. However, the inhomogeneous line broadening differs between the investigated MSMs, which is explained by two-magnon scattering processes of the MSMs into the spin-wave manifold, mediated by surface and volume defects.

MA 64.35 Fri 9:30 P2-EG

Spin Current Detection via Interface Paramagnetic Resonance — Thomas Marzi[1], •Ralf Meckenstock[1], Sabrina Masur[2], and Michael Farle[1,3] — [1]Faculty of Physics, AG Farle, University Duisburg-Essen, 47057 Duisburg, Germany — [2]Cavendish Laboratory, Department of Physics, Cambridge CB3 0HE, United Kingdom — [3]Immanuel Kant Baltic Federal University, 236041 Kaliningrad, Russian Federation

We managed to use electron spin resonance active centers at ferromagnetic or metallic interfaces as a probe for measuring contact free pure spin currents for small spintronic devices and the temperature change at the surface of nano particles at human tissue relevant temperatures. Oleic acid is chemisorbed on surfaces of interest consisting of magnetic materials in our case Fe or Fe_xO_y or metallic or oxidized materials like Ag or TiO_2, yielding paramagnetic centers detected by electron spin resonance (ESR). To show the potential of the method epitaxially grown Fe films and single crystalline nanoparticles of diameters less than 40nm were investigated. While the paramagnetic centers are at resonance, they react extremely sensitive on local changes of magnetic, crystalline or thermal parameters of their nearest neighbors. Being at the resonance of the ESR centers, we managed to switch on and off pure spin currents emitted by the microwave excited precessional motion of the magnetic moments from a ferromagnet by adjusting the angle between an external magnetic field and the sample plane. The flow of spin momentum is reflected in the microwave power dependent absorption characteristics of the ESR. (supported by DFG SPP1538)

MA 64.36 Fri 9:30 P2-EG

Auto-oscillations in YIG/Pt microstructures driven by the spin Hall effect and the spin Seebeck effect — •Michael Schneider[1], Viktor Lauer[1], Thomas Meyer[1], Phillip Pirro[1], Thomas Brächer[1], Björn Heinz[1], Bert Lägel[1], Carsten Dubs[2], Caroline A. Ross[3], Mehmet C. Onbasli[3], Burkard Hillebrands[1], and Andrii V. Chumak[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Technische Universität Kaiserslautern, 67663 Kaiserslautern, Germany — [2]INNOVENT e.V., Technologieentwicklung, 07745 Jena, Germany — [3]Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA

We report on the experimental results of the dynamics of spin Hall effect (SHE) and spin Seebeck effect (SSE) induced magnetization auto-oscillations in YIG/Pt microstructures. The investigated structures differ with respect to their geometry and fabrication methods. DC current pulses result in a generation of a spin current due to the SHE and in a Joule heating of the Pt layer. The heating leads to the formation of a thermal gradient and to the formation of a SSE spin current, which exerts an anti-damping torque and causes magnetization precession. Time-resolved Brillouin light scattering microscopy is used to investigate the magnetization precession as a function of time and spatial position. The interplay between different excited spin-wave modes is adressed. This research has been supported by: EU-FET Grant InSpin 612759, ERC Starting Grant 678309 MagnonCircuit, and DFG (DU 1427/2-1, and SE 1771/4-2 within SPP 1538).

MA 64.37 Fri 9:30 P2-EG

Magnetic linear dichroism of 3d metal thin films — •Torsten Veltum[1], Tobias Löffler[1], Mathias Gehlmann[2], Lukasz Plucinski[2], Claus Michael Schneider[2], Stephan Borek[3], Jan Minár[3], Jürgen Braun[3], Hubert Ebert[3], and Mathias Getzlaff[1] — [1]Institut für Angewandte Physik, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf — [2]Peter Grünberg Institut PGI-6, Forschungszentrum Jülich, 52428 Jülich — [3]Dep. Chemie und Biochemie, Universität München, Butenandstr. 5-13, 81377 München

Magnetic linear dichroism in the angular distribution of photoelectrons (MLDAD) is a technique that allows the study of both the electronic band structure and the magnetic properties of thin films and single crystals. We study epitaxially grown Co(0001) thin films on a W(110) surface.

In this study linearly polarized synchrotron radiation (Beamline 5, DELTA Dortmund) in the VUV regime is used to gain angle-resolved photoelectron spectroscopy data. The theoretical calculations make use of dynamical mean-field theory (DMFT), including a complete calculation within the one-step model (1SM) of photoemission, using the local spin-density approximation (LSDA).

We compare the theoretical and experimental data to best fit peak positions and the asymmetry of the spectra as a function of excitation energy, using different values for the averaged on-site Coulomb interaction U.

MA 64.38 Fri 9:30 P2-EG

Magnon-polariton experiments at milliKelvin temperatures — •Marco Pfirrmann[1], Julius Krause[1], Yannick Schön[1], Isabella Boventer[2], Andre Schneider[1], Alexey V. Ustinov[1], and Martin Weides[1,2] — [1]Physikalisches Institut, Karlsruhe Institute of Technology — [2]Institute of Physics, Johannes Gutenberg University Mainz

While magnon dynamics in ferromagnetic materials has been studied for decades with respect to ferromagnetic resonances, Bose-Einstein condensation, and spintronics, there has been recent progress towards studying collective spin excitations in the quantum regime. Strongly coupled quantum hybrid systems of microwave photons and magnons (magnon-polaritons) mediate the interaction between well-controlled superconducting quantum-circuits and magnetic materials.

An important criterion for possible applications in quantum information processing is the magnon resonance linewidth, the information on the lifetime of a quantum memory. We investigate a strongly coupled hybrid system consisting of a YIG sphere and a 3D microwave cavity. We focus on temperature dependent magnon-polariton properties obtained by spectroscopic measurements at temperatures between 25 and 1600 mK. The coupling and the internal linewidths of resonator and magnon resonances are obtained by fitting the full complex scattering parameter using Input-Output-formalism adapted from quantum optics.

MA 64.39 Fri 9:30 P2-EG

Skyrmion lattice dynamics — •Lukas Heinen and Achim Rosch — Institute for Theoretical Physics, University of Cologne, Germany

Chiral magnets host a rich magnetic phase diagram, of which the skyrmion lattice phase is particularly interesting. Skyrmions carry an integer winding number and hence are topologically protected. In addition, making them a promising candidate for future spintronic devices, they are easy to manipulate. Early on it was demonstrated that even the small temperature gradient induced by a Lorentz Transmission Electron Microscope is enough to induce a rotation in a skyrmion lattice. We examine the dynamics of such a rotating skyrmion lattice, by combining micromagnetic simulations with point particle simulations. Of particular interest is the role of defects in the skyrmion lattice.

MA 64.40 Fri 9:30 P2-EG

Demagnetisation energy and magnetisation variation effects on the isolated skyrmion dynamics — •Marijan Beg[1], David I. Cortés-Ortuño[1], Weiwei Wang[1,2], Rebecca Carey[1], Mark Vousden[1], Ondrej Hovorka[1], and Hans Fangohr[1] — [1]Faculty of Engineering and the Environment, University of Southampton, Southampton, SO17 1BJ, United Kingdom — [2]Department of Physics, Ningbo University, Ningbo, 315211, China

Usually for simplicity, in the simulations of skyrmionic states in helimagnetic samples, the demagnetisation energy is neglected and/or thin film samples are modelled using two-dimensional meshes. In this work, we investigate how these two assumptions affect the dynamics of an isolated skyrmion state in a 150 nm diameter FeGe disk. Firstly, we simulate the isolated skyrmion state dynamics using a full three-dimensional model. Secondly, we repeat the simulation under the same conditions, but this time we set the demagnetisation energy artificially to zero. Finally, we use a 2D mesh to model a thin film sample. We compare the power spectral densities and observe that although the magnetisation dynamics associated to the identified eigenmodes do not change significantly, their frequencies change substantially. We conclude that neglecting the demagnetisation energy contribution or modelling 3D samples using two-dimensional meshes in skyrmionic state dynamics simulations is not always justified. This work was supported by the EPSRC's EP/G03690X/1 and EP/N032128/1 grants and the Horizon 2020 European Research Infrastructure project (676541).

MA 64.41 Fri 9:30 P2-EG

Simulation of magnetic fibers and textile coatings — •Tomasz Blachowicz[1] and Andrea Ehrmann[2] — [1]Silesian University of Technology, Gliwice, Poland — [2]Bielefeld University of Applied Sciences, Bielefeld, Germany

While simulations of mechanical or conductive properties of textile fibers and textile coatings are being used for a long time, their magnetic properties still lack theoretical descriptions. Due to the broad variety of possible applications of magnetic textiles, such as magnetic coils and sensors, magnetic filters, or invisible magnetic water-marks, simulations would nevertheless be supportive in further developments in this area of smart textiles.

The poster presents different possibilities of micromagnetically modeling magnetic fibers and coatings on fibers and complete textile fabrics [1]. It shows the influence of fiber and coating dimensions on the simulated magnetic properties, depending on the magnetic material and the fiber composition, including interactions between neighboring coated fibers [2]. The shape anisotropy is shown to dominate the magnetic properties of both magnetic fibers and coatings; the effect of this result on possibilities of adjusting the magnetic properties of textile fabrics to a desired application is depicted.

[1] A. Ehrmann, T. Blachowicz: Micromagnetic simulation of fibers and coatings on textiles, Journal of The Institution of Engineers (India): Series E 96, 145-150

[2] T. Blachowicz, A. Ehrmann: Simulation of magnetic coatings on textile fibers, Journal of Physics: Conference Series 738, 012057 (2016)

MA 64.42 Fri 9:30 P2-EG

Magnetically Patterned Rolled-Up Exchange Bias Tubes: A Paternoster for Superparamagnetic Beads — •Timo Ueltzhöffer[1], Robert Streubel[2], Iris Koch[1], Dennis Holzinger[1], Denys Makarov[2], Oliver G. Schmidt[2], and Arno Ehresmann[1] — [1]Institute of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Str. 40, 34132 Kassel (Germany) — [2]Institute for Integrative Nanosciences, Leibniz Institute for Solid State and Materials Research Dresden (IFW Dresden), Helmholtzstraße 20, 01069 Dresden (Germany)

A deterministic transport system for superparamagnetic microbeads through magnetically designed tubular microchannels was realized. The beads are transported in a stepwise manner exhibiting paternoster-like trajectories as they are moved through the tube and back on top of it. The transport could be controlled by a series of weak magnetic field pulses and takes advantage of the magnetic stray field that emerge from the patterned microtubes. In order to fabricate such microtubes, strain engineered layers were covered by an exchange bias system, patterned by light ion bombardment on parallel stripes and subsequently rolled up. This approach impacts several fields of 3D applications in biotechnology, including particle transport related phenomena in lab-on-a-chip and lab-in-a-tube devices.

[1] Ueltzhöffer, T. et al. Magnetically Patterned Rolled-Up Exchange Bias Tubes: A Paternoster for Superparamagnetic Beads. ACS

Nano 10, 8491-8498 (2016).

MA 64.43 Fri 9:30 P2-EG

Skyrmions at the edge: Confinement effects in Fe/Ir(111)
— •Andre Kubetzka, Julian Hagemeister, Davide Iaia, Elena Y. Vedmedenko, Kirsten von Bergmann, and Roland Wiesendanger — Department of Physics, University of Hamburg, D-20355 Hamburg, Germany

The fcc Fe atomic layer on Ir(111) hosts a unique magnetic skyrmion lattice with square symmetry and a period of only 1 nm. The lattice is induced by the 4-spin interaction already in zero magnetic field [1]. Here we employ spin-polarized STM at $T = 8\,\mathrm{K}$ and Monte Carlo simulations to investigate the effect of free and ferromagnetic edges onto the nanoskyrmion lattice [2]. In triangular islands the coupling to the edges and the mismatching symmetries lead to multidomain states. In the MC simulations, despite the lower energy of a single-domain state, multidomain states arise by the combined effect of entropy and an intrinsic domain wall pinning, which results from the skyrmionic character of the spin texture.

[1] S. Heinze *et al.*, Nat. Phys. **7**, 713 (2011).
[2] J. Hagemeister *et al.*, Phys. Rev. Lett. **117**, 207202 (2016).

MA 64.44 Fri 9:30 P2-EG

Bottom-up fabrication of periodic magnetic nanostructures based on ion-induced spontaneous surface nanopatterning —
•Denise Erb[1], Xin Ou[1,2], Kai Schlage[3], Kilian Lenz[1], Ralf Röhlsberger[3], Jürgen Lindner[1], Stefan Facsko[1], Manfred Helm[1,4], and Jürgen Fassbender[1,4] — [1]HZDR, Dresden, Germany — [2]SIMIT, Shanghai, China — [3]DESY, Hamburg, Germany — [4]TU Dresden, Dresden, Germany

Large-area nanopatterning is a key requirement in diverse applications ranging from photovoltaics to computing and biomolecule detection. We present a simple and scalable bottom-up nanopatterning approach based on ion irradiation of semiconductor surfaces and well-established thin film deposition techniques: On crystalline semiconductor substrates, nanoscale surface patterns with well-defined lateral periodicity form via the mechanism of reverse epitaxy, i.e. the non-equilibrium self-assembly of vacancies and ad-atoms under ion irradiation [1]. The nanopatterned surfaces can for instance be employed as substrates for MBE under grazing incidence, producing periodic metal nanostructures by geometrical shading. They can also be the basis for metal nanostructure growth in a variety of pattern morphologies by hierarchical self-assembly [2]. In this contribution, we outline the reverse epitaxy mechanism and present examples of periodic magnetic nanostructures based on the resulting surface patterns. We hope to stimulate discussion of further applications in magnetism by emphasizing the simplicity and versatility of this bottom-up approach. [1] Ou et al., Nanoscale 7 (2015); [2] Erb et al., Science Advances 1 (2015)

MA 64.45 Fri 9:30 P2-EG

non-collinear magnetism of mn nanostructures adsorbed on nobel metal (111) surfaces —
•ramon cardias[1,2], manoel bezerra-neto[1], marcelo ribeiro[1], anders bergman[2], angela klautau[1], and olle eriksson[2] — [1]Universidade Federal do Pará — [2]Uppsala University

The magnetic properties of Mn nanostructures adsorbed on Ag(111) and Au(111) surfaces have been investigated by means of first principles calculations allowing for noncollinear coupling between atomic spins. Our calculations of interatomic exchange interactions reveal the strong exchange interactions between Mn atoms on Ag(111), which rules the magnetic ordering for Mn clusters on this substrate. For Mn nanostructures on Au(111), the effect of spin-orbit coupling leads to the possibility of realizing complex noncollinear magnetic structures such as ring-like antiferromagnetic one, and other exotic three-dimensional magnetic structures. The effect of the structural relaxation is also investigated, showing bond-substrate distance dependent for the exchange interactions. In the end, we reveal the Dzyaloshinskii-Moriya interaction for the Mn monolayer on both surface and for some nanoclusters, studying the influence of this interaction.

MA 64.46 Fri 9:30 P2-EG

Room temperature magnetic hardening of FeCo nanowire arrays —
•Fangzhou Wang[1], Ruslan Salikhov[1], Marina Spasova[1], Sara Liébana-Viñas[1], Christina Bran[2], Yu-Shen Chen[2,3], Manuel Vázquez[2], Michael Farle[1,4], and Ulf Wiedwald[1] — [1]Faculty of Physics and Center for Nanointegration Duisburg-Essen, University of Duisburg-Essen, Germany — [2]Institute of Materials Science of Madrid, CSIC, Madrid, Spain — [3]Department of Chemical Engineering and Materials Science, Yuan-Ze University, Chung-Li, Taiwan — [4]Center for Functionalized Magnetic Materials (FunMagMa), Immanuel Kant Baltic Federal University, Kaliningrad, Russia

Exploiting the shape anisotropy in combination with the magnetocrystalline anisotropy of 3d-metal nanowires (NW) yields a large energy product, i.e. high remanent magnetization (M_R) and large coercive field (H_C). It has been shown recently that M_R and H_C can be significantly enhanced at low temperatures by oxidizing FeCo NW tips [1]. Here, we demonstrate the magnetic hardening of FeCo NWs by interfacing their tips with AFM $Fe_{50}Mn_{50}$ layers at 300 K. FM NWs with diameter of 40 nm and length of 16 μm were grown in Anodic Aluminum Oxide (AAO) nanopores. Both tips of NWs were opened by partial chemical etching of the AAO membrane and, subsequently, $Fe_{50}Mn_{50}$ was deposited by rf-sputtering forming an AFM/FM/AFM sandwich structure. As a result, the absolute enhancement of H_C is 50 mT, while the relative increase is 50% and 24% for H_C and M_R at 300 K. [1] S. Liébana-Viñas et al., Nanotechnology 26, 415704 (2015).

MA 64.47 Fri 9:30 P2-EG

Fabrication and self-organization studies of polymer nanoparticles functionalized by exchange bias layer system via nanoimprint lithography —
•Jendrik Gördes[1], Timo Ueltzhöffer[1], Sabrina Reuter[2], Uh-Myong Ha[2], Arno Ehresmann[1], and Hartmut Hillmer[2] — [1]Institute of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel — [2]Institute of Nanostructure Technologies and Analytics (INA) and Institute of Physics and Center for Interdisciplinary Nanostructure Science and Technology (CINSaT), University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel

Cuboid polymer nanoparticles have been fabricated by substrate conformal imprint lithography (SCIL [1]). The particles were functionalized by covering them with an exchange bias layer system. They were geometrically characterized by scanning electron microscopy and magnetically by Kerr magnetometry. The functionalization by an exchange bias layer system introduces a defined magnetic anisotropy along a geometric axis of the brick-shaped particles. Agglomeration characteristics of these particles were investigated indicating that magnetic functionalization can control the self-organization of macrostructures out of designed imprinted particles.

[1] V. R. Kolli, C. Woidt and H. Hillmer, Advanced Materials Research. Vol. 1119, pp. 179-183 (2015) Trans Tech Publications

MA 64.48 Fri 9:30 P2-EG

Correlation in (un-)frustrated artificial spin ice —
•Jochen Wagner[1], Stefan Freercks[1], Ralph Buss[1], Kai Bagschik[1], Robert Frömter[1], Matthias Riepp[2], André Philippi-Kobs[2], Magnus H. Berntsen[3], Leonard Müller[2], Gerhard Grübel[2], and Hans Peter Oepen[1] — [1]Institut für Nanostruktur- und Festkörperphysik, Uni Hamburg, Germany — [2]DESY, Hamburg, Germany — [3]KTH Royal Institute of Technology, Stockholm, Sweden

X-ray holographic microscopy (XHM) has become a competitive technique to investigate magnetic samples with sub-20-nm spatial resolution exploiting x-ray magnetic circular dichroism [1]. With this technique, we imaged simple-cubic (unfrustrated) and kagome (frustrated) artificial spin ice (ASI) made up of nanodots with perpendicular magnetization. The nanodots are structured by e-beam lithography from $(Co_{0-2nm}/Pt_{1.4nm})_{10}$ multilayer films prepared by dc magnetron sputtering and ion assisted sputtering on Si_3N_4 membranes. The dots have diameters of 90 nm and 110, 130 or 160 nm next-neighbor distance. The simple-cubic ASIs favor an alternating, checkerboard-like state for the 110 nm distances, indicating a short-range order due to magnetostatic interaction. For larger distances no order could be observed and the ASI show random distribution. For the kagome ASI a similar behavior is observed. Due to magnetostatic interaction, they strongly favor a two-up one-down or vice versa state, following the ice rule. This correlation was again not observed at larger distances of 130 and 160 nm.

[1] D. Stickler, et al., Appl. Phys. Lett. 96, 042501 (2010).

MA 64.49 Fri 9:30 P2-EG

Micro-Hall magnetometry on macro-, micro- and nanoscale samples —
•Mohanad K I Mamoori, Merlin Pohlit, Jonathan Pieper, and Jens Müller — Physikalisches Institut, Goethe-Universität Frankfurt, 60438 Frankfurt am Main , Germany

Micro-Hall sensors are versatile tools for studying the local magnetic induction of macro-, micro- and nano-scale samples in a wide range of temperatures and magnetic fields. Along with measurements of thermal dynamics in artificial spin ice systems [1], we recently have applied First Order Reversal Curves (FORC) – a powerful technique to characterize the hysteresis loop of magnetic materials in detail and to study various intrinsic effects as, e.g., different grain sizes, dipolar interactions, and phase mixtures – to individual and dipolar-coupled arrays of magnetic nanostructures using micro-Hall sensors [2].
In this presentation, we review the different areas of the sensor applications discussing both static and dynamic measurments, and focus on the investigation of local effects in macroscopic samples, ranging from the formation of nano-scale magnetic clusters in colossal magnetoresistance materials to avalanche dynamics in metallic glasses.
[1] Pohlit et al., J. Appl. Phys. 120, 142103 (2016).
[2] Pohlit et al., Rev. Sci. Instrum. 87, 113907 (2016).

MA 64.50 Fri 9:30 P2-EG

Magnetic properties of nanostructured Tb-Fe alloy thin films — •Sri Sai Phani Kanth Arekapudi[1,3], Olav Hellwig[1,2], and Manfred Albrecht[3] — [1]Institute of Physics, Technische Universität Chemnitz, 09107 Chemnitz, Germany — [2]Institute for Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstrasse 400, 01328 Dresden, Germany — [3]Institute of Physics, University of Augsburg, Universitätsstraße 1, 86159 Augsburg, Germany

Nanostructured ferrimagnetic Tb-Fe alloy thin films were prepared on pre-patterned substrates as underlying template, consisting of nanodot arrays with a dot diameter of 30 nm and a period of 60 nm. Two distinct magnetic configuration are possible, one where the magnetic material on the nanodot and in the trenches is decoupled from each other for film thicknesses below the nanodot height, and the other where full exchange coupling between magnetic material on the dots and in the trenches is effective for magnetic films thicker than the nanodot height. Regardless, of the magnetic configuration the reversal of the magnetic material on top of the nanodots is found to be nucleation dominated, while the magnetic material in the trenches reverses via domain wall propagation, as confirmed by in-field magnetic force microscopy. The distinct behavior in this system is attributed to the reduced exchange stiffness followed by relatively narrow domain walls (approx. 3-4 nm) present in these rare earth - transition metal alloys [1]. A systematic study of magnetic properties on nanostructured Tb-Fe alloy films as a function of composition and film thickness will be presented.

MA 64.51 Fri 9:30 P2-EG

Characterization of micromachined Si cantilever giant magnetoimpedance (GMI) device for hybrid strain and magnetic field sensing in the high frequency regime — •Gregor Büttel and Uwe Hartmann — Institute of Experimental Physics, Saarland University, P. O. Box 151150, D66041, Saarbrücken, Germany

Magnetoresistive sensors on flexible substrates and cantilevers gain more attention for high sensitivity strain gauges and wearable electronics [1]. We have developed a fabrication process relying on common lithography and Si micromachining methods to obtain a coplanar waveguide-based GMI device located across the bending edge between a Si cantilever and its support to apply local stress. The device is 50 Ω on-chip terminated with NiCr film resistors to allow for network analyzer measurements in the GHz regime while bending the cantilever with a nanomanipulator. The signal line involving a Permalloy multilayer system can be integrated onto a Si Cantilever. Magneto-optical Kerr microscopy and micromagnetic simulations complement and support the impedance measurements revealing a magnetic domain rotation under strain. We discuss appropriate ac current frequencies for a high GMI ratio under applied stress/field and possible material and layer systems to further enhance the sensors performance. [1] Tavassolizadeh, A. et al. APL 102.15 (2013): 153104.

MA 64.52 Fri 9:30 P2-EG

Combined Optical and Magnetical Trapping of Magnetic Microbeads — •Florian Ostermaier[1], Benjamin Riedmüller[1], Tobias Neckernuss[2], Othmar Marti[2], and Ulrich Herr[1] — [1]Institut für Mikro- und Nanomaterialien, Universität Ulm, Ulm, Deutschland — [2]Institut für Experimentelle Physik, Universität Ulm, Ulm, Deutschland

Optical tweezers have been established as a powerful tool for manipulation of particles in the range from nanometers to micrometers with subnanometer accuracy. On the other hand, magnetic nanoparticles are widely used for bonding and detecting biological analytes in Lab-on-Chip systems. Magnetic nanoparticles can be effectively manipulated by magnetic field gradients. In previous works, we have developed a novel method for stable positioning of superparamagnetic nanoparticles on the micro-scale using a combination of the field gradient produced by tapered conductor lines and a superimposed homogeneous magnetic field. The combination of both methods opens up new perspectives for applications of nanoparticles in absorbing media. We present first experiments aiming at integration of a magnetic microtrap on a transparent substrate into an existing optical tweezer setup. Using commercially available microbeads (Dynabeads MyOne Streptavidin T1, diameter 1 μm) it is observed that numerous influences affect the stability of the particles in the micro-trap under standard operating conditions in the optical tweezer setup. Possible origins of the instabilities are discussed.

MA 64.53 Fri 9:30 P2-EG

Characterization of single YIG microstructures using Brillouin light scattering microscopy — •Björn Heinz[1], Thomas Meyer[1], Philipp Pirro[1], Thomas Brächer[1,3], Carsten Dubs[2], Oleksii Surzhenko[2], Burkard Hillebrands[1], and Andrii Chumak[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Technische Universität Kaiserslautern, 67663 Kaiserslautern, Germany — [2]INNOVENT e.V. Technologieentwicklung Jena, 07745 Jena, Germany — [3]Université Grenoble Alpes, CNRS, CEA, INAC-SPINTEC, 38054 Grenoble, France

We investigate the magnetization dynamics in single YIG microstructures. The structures are patterned from a 98 nm thick LPE-grown YIG film and have a square shape with lateral sizes down to 800 nm. By exciting the magnetization dynamics with a microwave field and performing Brillouin light scattering microscopy measurements, different lateral standing modes are observed. Comparing the measurements to micromagnetic simulations, the spin wave modes are identified. Furthermore, a magnetic field dependent determination of the resonance frequency and the linewidth of the fundamental mode is performed. For the subsequent determination of the saturation magnetization and the Gilbert damping parameter of individual microstructures, quantization effects need to be taken into account. The results indicate a small decrease of the saturation magnetization and an increased Gilbert damping which needs to be considered for future investigation of YIG microstructures. This research has been supported by ERC Starting Grant 678309 MagnonCircuit and DFG Grant DU 1427/2-1.

MA 64.54 Fri 9:30 P2-EG

Spin pumping near the magnetic phase transition in ultrathin Fe/Pd bilayers — •Jochen Greser, Sascha Keller, Matthias R. Schweizer, Burkard Hillebrands, and Evangelos Th. Papaioannou — Fachbereich Physik, Technische Universität Kaiserslautern, Erwin-Schrödinger-Str. 56, 67663 Kaiserslautern, Germany

Spin pumping (SP) is a powerful tool to generate pure spin currents which are a key ingredient in spintronic devices. The electrical detection of a pure spin current can be accomplished by the inverse spin Hall effect (ISHE) using metals with strong spin-orbit interaction, such as Pd. In this work SP close to the ferromagnetic (FM)/paramagnetic (PM) phase transition is investigated. On the contrary to the studies so far where the phase transition has been created in samples composed of a PM layer to FM/Pt or YIG/Pt bilayers, here only one FM layer is used in order to drive the phase transition. This can be achieved by using δ-doped Fe/Pd bilayers which have the advantage of a controllable Curie temperature T_C. A high ISHE voltage has been observed for extremely thin Fe layers around the phase transition.

MA 64.55 Fri 9:30 P2-EG

Spin waves in CoFeB thin films dominated by Dzyaloshinskii-Moriya interaction — •Tobias Fischer[1,2], Frank Heussner[1], Mathias Kläui[2,3], Burkard Hillebrands[1], and Philipp Pirro[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Technische Universität Kaiserslautern, Erwin-Schrödinger-Straße 56, 67663 Kaiserslautern — [2]MAINZ Graduate School of Excellence, Staudingerweg 9, 55128 Mainz — [3]Johannes Gutenberg-Universität, Institut für Physik, Staudingerweg 7, 55128 Mainz

As predicted by Dzyaloshinskii and Moriya, in low-symmetry systems the exchange interaction exhibits an antisymmetric contribution. This effect also occurs in ultra-thin films where both the broken inversion symmetry and the selection of a capping material with a large spin-orbit interaction can lead to a strong interfacial Dzyaloshinskii-Moriya interaction (DMI) [1]. In consequence, an additional term which is linear in the spin-wave wave vector enters the dispersion relation of spin waves propagating perpendicular to the static magnetization.

We present results of the investigation of the spin-wave spectrum in ultra-thin CoFeB (0.6 nm) films covered with Pt and W, respectively, employing wave-vector resolved Brillouin light scattering spectroscopy. We find a strong influence of the DMI which leads to a collinear group velocity for both positive and negative wave vectors raising interesting questions on the nature of scattering processes in such systems.

Financial support within the SFB/TRR 173 *Spin+X* is gratefully acknowledged.

[1] A. A. Stashkevich *et al.*, Phys. Rev. B **91**, 214409 (2015).

MA 64.56 Fri 9:30 P2-EG

Spin-dependent magnetization dynamics in the Tb(0001) surface state — •Sang-Eun Lee, Beatrice Andres, and Martin Weinelt — Fachbereich Physik der Freien Universität Berlin, Arnimallee 14, 14195 Berlin, Germany

Ultrafast laser-induced demagnetization of heavy lanthanides differs from that of transition metals, since its dynamics is described by more than one exponential time constant. Employing spin-, time- and energy-resolved photoemission spectroscopy we have studied the case of Gd(0001) [1]. With the same tool, in this study, we investigate the demagnetization of Tb when it is excited with ultrafast laser pulses. From the broadening of the Fermi function we can extract the spin-dependent temporal evolution of the electron temperature. Comparing this to the changing spin-polarization and binding energy of the Tb(0001) surface state, we are able to distinguish between different processes driving the demagnetization, such as Eliott-Yafet scattering or spin transport. To show a distinctive behavior of laser-induced demagnetization, we compare the spin-polarization and binding energy change of this process to those of the equilibrium phase transition. We further compare the magnetization dynamics of Tb and Gd.

[1] B. Andres *et. al.*, *Phys. Rev. Lett. 115* **20**, 207404 (2015).

MA 64.57 Fri 9:30 P2-EG

Photon energy dependent fs-demagnetization dynamics of thin Ni films — •Jonas Hoefer, Sebastian Weber, Ute Bierbrauer, David Schummer, Moritz Barkowski, Benjamin Stadtmüller, Bärbel Rethfeld, and Martin Aeschlimann — Department of Physics and Research Center OPTIMAS, University of Kaiserslautern, Erwin-Schroedinger-Strasse 46, 67663 Kaiserslautern, Germany

After the first observation of the ultrafast demagnetization process of ferromagnetic thin films on the femtosecond timescale, a huge experimental and theoretical effort was devoted to reveal the microscopic mechanism governing the ultrafast optically induced loss of magnetic order in ferromagnetic materials.

In this context, almost all experimental studies so far employed fs light pulses of 1.55eV to trigger the fs-demagnetization dynamics. Hence, the role of the photon energy of the exciting light pulse has not been investigates so far. Therefore, we have implemented an all optical time resolved MOKE setup with variable pump photon energy in the range of 1.55 to 3.10eV. As prototypical system, we first investigated the ultrafast demagnetization dynamics of thin Ni films on insulating and conducting substrates for various excitation photon energies. The characteristic parameters of the demagnetization process, i.e., the demagnetization time and the quenching of magnetization, will be compared to simulations describing the non-equilibrium dynamics of the spin-carrying excited electrons.

MA 64.58 Fri 9:30 P2-EG

DPC measurements of local hysteresis loops on annealed cobalt thin films — •Felix Schwarzhuber, Thomas Beer, and Josef Zweck — Institute for Experimental and Applied Physics, University of Regensburg, Germany

Differential Phase Contrast Microscopy (DPC) in a Scanning Transmission Electron Microscope allows us to obtain detailed information about microscopic distributions of the magnetic induction within a specimen.

In this work we performed DPC tilting series on 50 nm thick annealed cobalt thin films to gather information about their magnetic properties. By tilting the specimen relative to the magnetic field of the objective lens we change the effective in-plane field acting on our samples, leading to a change of the in-plane induction distribution in our cobalt thin films. This change can be imaged in detail with our DPC setup. As we investigate a small area of the specimen (few microns square) we are able to measure local magnetic hysteresis effects. The obtained hysteresis loops and DPC images let us clearly distinguish whether the remagnetization processes included a vortex core or not. In addition, we are also able to observe pinning of magnetic features on larger cobalt crystallites.

MA 64.59 Fri 9:30 P2-EG

Magnon Supercurrents by Thermal Gradients — •Alexander J.E. Kreil[1], Dmytro A. Bozhko[1,2], Alexander A. Serga[1], and Burkard Hillebrands[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, Technische Universität Kaiserslautern, 67663 Kaiserslautern, Germany — [2]Graduate School Materials Science in Mainz, Germany

Currently, supercurrents in a room-temperature magnon Bose-Einstein condensate (BEC) have been reported [1]. The condensate created by parametric microwave pumping in a tangentially magnetized yttrium-iron-garnet (YIG) film is studied by means of the time-resolved Brillouin light scattering (BLS) spectroscopy technique. The heating in the focus of a probing laser beam leads to the temperature-induced spatial variation in the saturation magnetization and, thus, to the variation in the local magnon frequencies across the heated film area. Because the magnon condensate is coherent across the entire heated area, a spatially varying phase shift is imprinted into its wavefunction. This spatial phase gradient propels a magnon supercurrent flowing out the the probing point. The evidence of these supercurrents was obtained by an observation of the different relaxation behaviors of the magnon BEC at different heating times.

Now, by adding an external heat source, namely a second laser, we are able to perform spatial-resolved measurements and are therefore able to study the transport properties of the magnon supercurrents. We present here the measured data of the performed experiment.

[1] Bozhko *et al.* Nature Physics **12**, 1057 (2016)

MA 64.60 Fri 9:30 P2-EG

Magneto-dynamics of single crystal Gadolinium Iron Garnet — •Lukas Liensberger[1,2], Hannes Maier-Flaig[1,2], Andreas Erb[1], Stephan Geprägs[1,2], Sebastian T.B. Goennenwein[1,2,3,4], Rudolf Gross[1,2,4], Hans Huebl[1,2,4], and Mathias Weiler[1,2] — [1]Walther-Meißner-Institut, Garching, Germany — [2]Physik-Department, Technische Universität München, Garching, Germany — [3]Institut für Festkörperphysik, Technische Universität Dresden, Germany — [4]Nanosystems Initiative Munich, Munich, Germany

For many decades, the ability to tune the magneto-dynamical properties of doped rare-earth iron garnets has triggered a multitude of investigations and resulted in numerous applications. One prime example for tunable magnetic properties in the iron garnets is Gadolinium Iron Garnet (GdIG) because its sublattice magnetizations can be controlled via temperature. In particular, the net magnetization M_{net} of GdIG exhibits a compensation point at the so-called compensation temperature ($T_{\mathrm{comp}} = 289\,\mathrm{K}$) where M_{net} vanishes.
We present an investigation of the magneto-dynamics of a single crystal GdIG disk using broadband magnetic resonance in the microwave frequency range as a function of temperature. Our measurements reveal that the magnetic eigenmodes of GdIG show a distinct evolution with temperature. Below 270K, the Gd sub-lattice magnetization dominates the total GdIG moment and we mainly observe a ferromagnetic-like mode. Near T_{comp}, the antiferromagnetic exchange modes of GdIG fall within our experimentally accessible frequency range. We quantitatively discuss the data and model the observed resonance modes.

MA 64.61 Fri 9:30 P2-EG

Temperature dependence of magnetic damping in yttrium iron garnet spheres — •Hannes Maier-Flaig[1,2], Stefan Klingler[1,2], Carsten Dubs[3], Oleksii Surzhenko[3], Mathias Weiler[1,2], Sebastian T.B. Goennenwein[1,2,4,5], Rudolf Gross[1,2,5], and Hans Huebl[1,2,5] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany — [2]Physik-Department, Technische Universität München, Germany — [3]INNOVENT e.V. Technologieentwicklung, Jena, Germany — [4]Institut für Festköperphysik, Technische Universität Dresden, Germany — [5]Nanosystems Initiative Munich, München, Germany

The ferrimagnetic insulator Yttrium iron garnet (YIG) is considered one of the prototypical material systems for applications in spintronics and quantum information processing. In order to predict and optimize the performance of devices, detailed knowledge of the frequency and temperature dependence of the damping in YIG is of key importance. We investigate the microwave absorption spectrum of an YIG sphere as a function of temperature and frequency. We observe the typical magnetostatic magnon modes of a YIG sphere. Above 100 K, their magnetic resonance linewidth scales linearly with temperature and also shows a Gilbert-like linear frequency dependence. At lower temperatures, the linewidth exhibits a characteristic peak that coincides with a non-Gilbert like magnetic resonance damping mechanism. We model the temperature and frequency evolution of the linewidth assuming a slowly relaxing rare-earth impurity and either the Kasuya-LeCraw mechanism or the scattering with optical magnons.

MA 64.62 Fri 9:30 P2-EG

Progress in wavevector-resolved Brillouin light scattering spectroscopy of magnon gases and condensates — •Pascal Frey[1], Dmytro A. Bozhko[1,2], Vitaliy I. Vasyuchka[1], Alexander A. Serga[1], and Burkard Hillebrands[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, Germany — [2]Graduate School Materials Science in Mainz, Germany

Brillouin light scattering spectroscopy is a powerful technique for studying dynamic properties of magnetic materials and devices with both frequency and wavevector resolution. Here, we report on an improvement of this technique in a backward scattering geometry. Previously, we presented a method to detect magnons with wavevectors collinear to the applied magnetic field by turning the entire setup, including the magnet system. Here, instead of rotating the magnet itself, we realized a method where we rotate a probing beam around a sample. The method allows for probing of arbitrary magnetized samples in a wide range of magnetic fields with improved resolution. For further refinement, we place a dielectric mirror beneath the sample to enhance the signal from the backward scattering process. To minimize optical aberrations, we strive for deposition of a dielectric mirror directly on the sample. In combination with a new generation of multipass tandem Fabry-Pérot interferometry, the reported wavevector-resolved technique promises significant improvement in the determination of magnon states in energy and phase space. The work is supported by the European Research Council within the ERC Advanced Grant "Supercurrents of Magnon Condensates for Advanced Magnonics".

MA 64.63 Fri 9:30 P2-EG

Surface acoustic wave devices for magnon-phonon interaction — •Clemens Mühlenhoff[1,2], Stefan Klingler[1,2], Hans Huebl[1,2,3], Rudolf Gross[1,2,3], and Mathias Weiler[1,2] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany — [2]Physik-Department, Technische Universität München, Garching, Germany — [3]Nanosystems Inititative Munich, München, Germany

Surface acoustic wave (SAW) delay line bandpass filters are of major importance in today's communication technology. From a more fundamental perspective, SAWs represent coherent phonon states at GHz frequencies which can be employed to study the interplay of phonons with other degrees of freedom in a solid state environment. In particular, we are interested in the magnon-phonon interaction within a ferromagnetic thin film. We employ electron-beam lithography to define SAW delay lines on a $LiNbO_3$ substrate. The interdigital transducers (IDTs) converting the electrical stimulus to a SAW are realized with metallic electrodes with a width of less than 1 μm. We present fabrication strategies and microwave transmission measurements to quantify the performance of our SAW delay lines. Our devices are capable of generating and detecting SAWs at frequencies exceeding 10 GHz. This frequency range is ideally suited for the study of phonon-driven magnetization dynamics in a ferromagnetic thin film deposited in the area between the two IDTs. This dynamics is induced by the resonant interaction of the coherent phonon drive and the magnons at the ferromagnetic resonance frequency.

MA 64.64 Fri 9:30 P2-EG

Driving Ultrafast Magnetization Dynamics of Gd with Near-Infrared Laser Pulses — •Kamil Bobowski[1], Beatrice Andres[1], Robert Carley[2], Björn Frietsch[1], Markus Gleich[1], Cephise Cacho[3], Emma Springate[3], Serguei Molodtsov[2], and Martin Weinelt[1] — [1]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin — [2]European XFEL GmbH, Holzkoppel 4, 22869 Schenefeld — [3]Rutherford Appleton Laboratory, Didcot, OX11 0QX, UK

We investigated the ultrafast magnetization dynamics of a single-crystalline Gd(0001) thin film with the high-harmonic source at the Artemis Facility at Rutherford Appleton Laboratory. In contrast to most studies, we employ 1300-nm pump pulses. In agreement with our earlier measurements, we observe a considerable redistribution of the electronic population around the Fermi level and a fast decrease of the exchange splitting of the valence bands [1]. However, within the first 200 fs we find an increase of the exchange splitting, which was also observed in MOKE experiments [2], caused by a dip in the majority band binding energy. In addition, we observe oscillations in the energetic position of the valence bands and the surface state before excitation. We discuss these oscillations in the framework of ponderomotive acceleration by a transient grating formed by the interference of the incoming and outgoing pump pulses [3].

[1] R. Carley *et. al.*, Phys. Rev. Lett. **109**, 057401 (2012).
[2] M. Sultan *et. al.*, Phys. Rev. B **85**, 184407 (2012).
[3] U. Bovensiepen *et. al.*, Phys. Rev. B **79**, 045415 (2009).

MA 64.65 Fri 9:30 P2-EG

Polarization Control of High Harmonics for Ultrafast Magnetic Imaging — •Christina Nolte[1], Sergey Zayko[2], Ofer Kfir[2,3], Sascha Schäfer[2], Daniel Steil[1], Birgit Hebler[4], Manfred Albrecht[4], Oren Cohen[3], Stefan Mathias[1], and Claus Ropers[2] — [1]1st Physical Institute, University of Göttingen — [2]4th Physical Institute, University of Göttingen — [3]Physics Department, Technion, Israel — [4]Institute of of Physics, University of Augsburg

The generation of circularly polarized extreme ultraviolet and soft X-ray radiation from high-harmonic light sources [1,2] in combination with lensless imaging techniques opens a new and powerful route for the spatially resolved study of ultrafast magnetization dynamics [3].

We utilize a stable and compact method of generating bright circularly polarized high harmonics [4] and extend the approach to tailor the radiation ellipticity by a precise control of recollision trajectories. We characterize the XUV polarization in two spectral regions (25-30 eV and 50-60 eV) using two methods: (i) polarization selective nanoscale waveguides [5] and (ii) magneto-optical activity in Co [1]. In addition, we present diffraction data and discuss current progress towards the imaging of magnetic structures.

[1] O. Kfir et al., Nature Photonics 9, 99-105 (2015)
[2] T. Fan et al., PNAS 112, 14206 (2015)
[3] S. Mathias et al., JESRP 189, 164 (2013)
[4] O. Kfir et al., Appl. Phys. Lett. 108, 211106 (2016)
[5] S. Zayko et al., Optica 3, 239 (2016)

MA 64.66 Fri 9:30 P2-EG

Ultrafast demagnetization dynamics in non-collinear magnetic multilayers — •Sakshath Sadashivaiah[1], Martin Steihl[1], Fabian Ganss[2,3], David Schummer[1], Moritz Barkowski[1], Ute Bierbrauer[1], Manfred Albrecht[3], Mirko Cinchetti[4], Benjamin Stadtmueller[1], Stefan Mathias[5], and Martin Aeschlimann[1] — [1]T U Kaiserslautern, Erwin-Schroedinger-Strasse 46, 67663 Kaiserslautern, Germany — [2]T U Chemnitz, 09107 Chemnitz, Germany — [3]University of Augsburg, Universitätsstraße 1 Nord, 86159 Chemnitz, Germany — [4]T U Dortmund, 44221 Dortmund, Germany — [5]University of Göttingen, Friedrich Hund Platz 1, 37077 Göttingen, Germany

Non-collinear magnetic multilayers are ideal sample systems to study optically excited spin currents in magnetic materials. Our sample system consists of two magnetic layers, a Pd/Co multilayer layer films and a NiFe alloy, separated by a non-magnetic spacer layer. Using an external magnetic field, the relative magnetization direction of both magnetic layers can be tuned from non-collinear or to collinear. Optical excitation of the NiFe layer by fs laser pluses creates spin currents that are injected into the subsequent layers. Using the complex nature of the Kerr response [1], we study the magnetization dynamics of individual layers. This allows us to determine the role of ultrafast spin currents for the fs-demagnetization in the collinear and non-collinear configurations, as well as for different spacer materials.

References: J. Hamrle et al, Phys. Rev. B 66, 224423 (2002)

MA 64.67 Fri 9:30 P2-EG

Influence of the pump pulse photon energy on the ultrafast magnetization dynamics of gadolinium — •Markus Gleich[1], Kamil Bobowski[1], Niko Pontius[2], Christian Schüssler-Langeheine[2], Christoph Trabant[1], Marko Wietstruk[1], Björn Frietsch[1], and Martin Weinelt[1] — [1]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin — [2]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Albert-Einstein-Straße 15, 12489 Berlin

We have investigated the dependence of the pump pulse photon energy on the ultrafast magnetization dynamics of gadolinium. Single-crystalline Gd(0001) thin films were grown on a W(110) substrate. This allows us to study the magnetization dynamics by X-ray magnetic circular dichroism in reflection at the FEMTOSPEX facility of BESSY II. To clarify the role of electron transport, we performed simulations of the magnetization dynamics based on the microscopic three temperature model (M3TM) [1]. The M3TM was modified and extended to include the laser excitation process [2]. To reproduce the measured dynamics, we have varied several parameters such as the thermal conductivity and the heat capacity.

[1] B. Koopmans *et al.*, Nat. Mater. **9**, 259–265 (2010).
[2] Y. P. Meshcheryakov *et al.*, Appl. Phys. A **82**, 363–368 (2005).

MA 64.68 Fri 9:30 P2-EG

Extraction of Magnetic Nanoparticles from Magnetotactic Bacteria — •Lea Schwengels, Nadja Juric, Maryam Youhannayee, and Mathias Getzlaff — Institute of Applied Physics, Heinrich-Heine-Universität, Düsseldorf, Germany

Nanoparticles attract fascinating attention because of their capability in using for biological and medical application and research. Therefore, it seems to be promising to apply magnetic nanoparticles for different cancer treatments like hypothermia. Our research deals with the extraction and separation of chains of magnetite nanoparticles from magnetotactic bacteria (MTB) called Magnetospirillum magnetotacticum (MS-1) and subsequently the extraction of single magnetic nanoparticles from these obtained magnetosomes. Cultured Magnetospirillum magnetotacticum were purchased from DSMZ as an actively growing culture in specific liquid medium. In our research we use two different techniques to separate the nanoparticles from bacteria, ultrasonic and applying a combination of lysozyme and EDTA (Ethylenediaminetetraacetic). The combination of using lysozyme and EDTA represents a useful method to extract the magnetosome chains from our enriched bacteria without affecting the magnetite nanoparticle and its membrane. Using ultrasonic cause the lysis of bacteria and separation of magnetosome chains who are still surrounded by cell residues. Transmission electron microscopy has been applied in order to characterize the morphological structure of magnetite nanoparticles like shape and size.

MA 64.69 Fri 9:30 P2-EG

Stabilization of phase noise in vortex spin torque nano oscillators by a Phase Locked Loop — Martin Kreissig[2], •Steffen Wittrock[1], Romain Lebrun[1], Samh Menshawy[1], Karla Merazzo-Jaimes[3], Marie-Claire Cyrille[4], Ricardo Ferreira[5], Frank Ellinger[2], Paolo Bortolotti[1], Ursula Ebels[3], and Vincent Cros[1] — [1]Unité Mixte de Physique CNRS/Thales, Univ. Paris-Sud, Univ. Paris-Saclay, 91767 Palaiseau, France — [2]Chair for Circuit Design and Network Theory, Technische Univ. Dresden, 01062 Dresden, Germany — [3]Univ. Grenoble Alpes, CEA, INAC-SPINTEC, CNRS, SPINTEC, 38000 Grenoble, France — [4]Univ. Grenoble Alpes, CEA-LETI MINATEC-CAMPUS, 38000 Grenoble, France — [5]International Iberian Nanotechnology Laboratory (INL), 471531 Braga, Portugal

After a decade of research, large expectations have been anticipated on how the rich physics of spin transfer induced magnetization dynamics could give birth to a new generation of multi-functional microwave spintronic devices. One major issue of spin-torque nano-oscillators (STNOs) is their relatively poor spectral coherence given by their highly nonlinear behavior. Within this work, we tackle this concern and could efficiently control the phase noise of vortex based STNOs by implementation of an integrated Phase Locked Loop (PLL) circuit. Focussing on vortex based STOs presenting higher spectral coherences than other kinds of STOs, a reduction of phase noise by more than 50dB at 10kHz from the carrier frequency is achieved under various field and current conditions.