MA 51: Magnetism Poster B

Time: Thursday 15:00–18:00 Location: Poster C

MA 51.1 Thu 15:00 Poster C

Ultrafast spin dynamics in antiferromagnetic semiconductors and dielectrics — •Fabian Mertens, Davide Bossini, and Mirko Cinchetti — Experimentelle Physik VI, TU Dortmund, Otto-Hahn-Straße 4, 44227 Dortmund, Germany

The ultrafast manipulation of spins is of great interest, both in regard to possible future applications and for the exploration of novel dynamical magnetic phenomena. Our group focusses on the investigation of antiferromagnetic semiconductors and delectrics. Antiferromagnets have intrinsically faster spin dynamics compared to ferromagnetic materials. The strong exchange coupling and absence of a stray field could allow for a more robust and densly packed design of possible future memory devices. However the strong exchange coupling makes a manipulation of spins with external magnetic fields difficult, that is why we use light as stimulus. In semiconductors and dielectrics there are no free electrons and thus the energy dissipations are limited, because no Joule heating takes place. Consequently, coherent spin dynamics can be be induced and observed. In addition, the physical interpretation of the detected spin dynamics is simplified since, unlike in a metal, this signal is not dominated by the laser-heating. We plan to perform pump-probe measurements with femtosecond time-resolution, with the possibility to excite and detect different processes by independently tuning the pump and the probe photon energies between 0.5 eV and 3.5 eV.

MA 51.2 Thu 15:00 Poster C

Approaching THz spin-wave generation in optically-driven acoustic resonators — •Dennis Meyer[1], Vitaly Bruchmann-Bamberg[1], Jakob Walowski[2], Vasily Moshnyaga[1], and Henning Ulrichs[1] — [1]I. Physikalisches Institut, Georg-August Universität Göttingen, Germany — [2]Institut für Physik, Universität Greifswald, Germany

Coherent spin-wave generation between 100 GHz and a few THz is hard to achieve with current methods which either produce incoherent or non-monochromatic spin-waves. While normally an unwanted dissipation channel in spintronics, it was already shown that magneto-elastic coupling can be exploited to generate spin currents and coherent magnetic oscillations in the low GHz regime. Here, we propose a novel design to generate THz spin waves by laser excitation of an acoustic nano oscillator magneto-elastically coupled to a ferromagnetic layer.

We acknowledge financial support by the DFG within CRC1073.

MA 51.3 Thu 15:00 Poster C

Ultrafast Spintronic Devices — •Bikash Das Mohapatra[1] and Georg Schmidt[1,2] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, Von-Danckelmann-Platz 3, D-06120 Halle, Germany — [2]Interdisziplinäres Zentrum für Materialwissenschaften, Martin-Luther-Universität Halle-Wittenberg, Heinrich-Damerow-Straße 4, D-06120 Halle, Germany

Spin valves based on GMR (Giant Magnetoresistance) are to be investigated in the Terahertz frequency range. The GMR structures are fabricated using sputter deposition and spin valve stacks are formed by e-beam lithography and ion beam etching with end-point detection. These structures will be used for magnetoresistance measurements and optimization for ultrahigh frequency AC transport experiments. It was shown earlier that the magnetoresistance becomes frequency dependent and can even change its sign due to time dependent spin accumulation in spacer layers at high frequencies which would be relevant for Spintronic application in the THz regime. Furthermore, it is planned to integrate the structures into Coplanar waveguides and to study the electrical response to optical demagnetization on the picosecond timescale. The measurements will be done using a VNA (vector network analyzer). This study can lead to new insights into the ultra high frequency response of GMR structures and to an extension of the Valet Fert Model to very high frequencies.

MA 51.4 Thu 15:00 Poster C

THz-2D Scanning Spectroscopy — •Finn-Frederik Lietzow[1], Yuta Sasaki[2], Nina Meyer[1], Jakob Walowski[1], Christian Denker[1], Markus Münzenberg[1], and Shigemi Mizukami[2] — [1]Institut for Physics, University Greifswald, Germany — [2]Advanced Institute for Materials Research, Tohoku University, Sendai, Japan

THz radiation has become an increasingly important tool for quality control in the food industry as well as in the medicine sector [1,2]. Since most seald plastic packaging compounds are transparent to THz radiation, it is possible to verify the food or drug ingredients by detecting their absorption lines even without unpacking the investigated substances [1].

We customized a standard commercial THz Fourier Transform spectrometer based on an LT-GaAs Auston switch emitter and detector from Menlo systems by adding a motorized 2D scanning unit. To test this 2D THz spectrocopy scanning system, we investigated a test stripe pattern of Au on glass with decreasing slitwidth and pitch. The measured resolution is very close to the diffraction limit and at 1 THz (300 μm) we can distinguish two points separated by a distance around 338 μm. The next step is to replace the commercial system by a spintronic emitter and a ZnTe detector so that we reach a higher bandwidth.

[1] A. G. Davies et al., Mat. Today 11 (2008) 18.
[2] S. K. Mathanker et al., ASABE 56 (2013).

MA 51.5 Thu 15:00 Poster C

Emission properties of spintronic terahertz emitters — •Rieke von Seggern[1], Christopher Rathje[1], Nina Meyer[2], Christian Denker[2], Markus Münzenberg[2], and Sascha Schäfer[1] — [1]Institute of Physics, University of Oldenburg, Germany — [2]Institute of Physics, University of Greifswald, Germany

In recent studies, the emission of strong single-cycle terahertz (THz) pulses from spintronic bilayer structures has been demonstrated, using the inverse Spin-Hall effect [1] of optically excited spin-polarized currents [2]. The emission shows a gapless spectrum with a bandwidth of up to 30 THz and high peak fields, offering promising avenues for THz spectroscopy.

In this work, we investigate the THz emission properties of Pt(2 nm)/$Co_4Fe_4B_2$(2.08 nm) driven by ultrashort optical pulses (1030-nm central wavelength, 255-fs pulse duration). We present our approach for controlling the emission properties by structured emitter surfaces and characterize the emitted THz pulses by electro-optic sampling. Nano- and microstructured spintronic THz emitters may enable a detailed tailoring of spatial and spectral emission poroperties and have the potential for large amplitude THz near-field excitation.

[1] Saitoh et al., Appl. Phys. Lett. 88, 182509 (2006)
[2] Seifert et al., Nat. Photonics 10, 483-488 (2016)

MA 51.6 Thu 15:00 Poster C

Spin- and charge transport at THz frequencies in metallic multilayers — •Marcel Burgard[1], Dennis M. Nenno[1], Hans Christian Schneider[1], Tobias Kampfrath[2,3], and Lukáš Nádvorník[3] — [1]Physics Department and Research Center OPTIMAS, TU Kaiserslautern — [2]Department of Physical Chemistry, Fritz Haber Institute of the Max Planck Society, Berlin — [3]Department of Physics, Freie Universität Berlin

We theoretically investigate spin and charge currents in metallic films and magnetic multilayers. These currents are driven by THz-fields via the inverse spin-Hall effect [1]. Frequencies in the THz regime have been shown to drastically alter the transport properties for electrons close to the Fermi energy, as they are described a wave-diffusion equation instead of the quasi-static Fick's law [2]. Here, we solve the wave-diffusion equations self-consistently with Maxwell's equations for the fields set up by charge accumulation and study the effects of screening on the transport at THz frequencies.

[1] L. Nadvornik *et al.*, in preparation
[2] Y. H. Zhu, B. Hillebrands, and H. C. Schneider, Phys. Rev. B **78**, 054429 (2008)

MA 51.7 Thu 15:00 Poster C

VSM4VTI - thin film measurements with DIY-magnetometer — •Alfons Georg Schuck, Jörg Franke, and Michael Huth — Institute of Physics, Goethe University, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany

A Vibrating Sample Magnetometer (VSM), which is designed as a top loading probe for a variable-temperature insert (VTI) is described. It is constructed as an affordable "do-it-yourself" alternative to commercial Physical Properties Measurement Systems (PPMS) with small samples

like thin films in mind. The magnetometer uses a voice-coil drive in a resonator-setup. The sample oscillation is monitored by a quadrature encoder. The correct positioning of the sample in the center of a gradiometer coil is ensured by a stepper-motor driven linear actuator. Details of the VSM design are presented.

In combination with a common lock-in-amplifier, the device is highly sensitive. Measurements of a thin film at low temperatures are performed as well as complemental numerical simulations. Influences of the sample holder and the substrate on the measurements are described.

MA 51.8 Thu 15:00 Poster C

Fabrication of diamond tips for optical magnetometry — STEFAN DIETEL[1], •SEVERINE DIZIAIN[1], ROBERT STAACKE[1], LUKAS BOTSCH[1], BERND ABEL[2], JAN MEIJER[1], and PABLO ESQUINAZI[1] — [1]Universität Leipzig - Felix-Bloch-Institut für Festkörperphysik, Linnéstraße 5, 04103 Leipzig — [2]Leibniz Institute of Surface Engineering (IOM), Permoserstr. 15, 04318 Leipzig

Nanoscale optical magnetometers based on negatively charged nitrogen - vacancy (NV) centers in diamond have been demonstrated for the detection and imaging of magnetic fields with both high spatial resolution and high sensitivity. They consist either of a diamond nanocrystal hosting a single NV center attached to the extremity of an atomic force microscopy tip or of a diamond nanopillar with a single NV center etched in a diamond cantilever. The latter allows for higher sensitivity and better light collection efficiency. However its fabrication is not very efficient since a large quantity of diamond has to be damaged for the production of only a few tips. We propose a technique that consumes less diamond. By angle etching only the surface of the diamond is used for the tip fabrication. With this technique the crystalline orientation can be chosen to optimize the light coupling and the NV center orientation.

MA 51.9 Thu 15:00 Poster C

Sensitivity enhancement of EPR-on-a-chip with sensor array — •SILVIO KÜNSTNER[1], ANH CHU[2], BENEDIKT SCHLECKER[3], BORIS NAYDENOV[1], JENS ANDERS[2], and KLAUS LIPS[1,4] — [1]Berlin Joint EPR Laboratory, Institut für Nanospektroskopie, Helmholtz-Zentrum Berlin für Materialien und Energie — [2]Institut für Mikroelektronik, Universität Ulm — [3]Institut für Intelligente Sensorik und Theoretische Elektrotechnik, Universität Stuttgart — [4]Berlin Joint EPR Laboratory, Fachbereich Physik, Freie Universität Berlin

Electron paramagnetic resonance (EPR) is the method of choice to investigate and quantify paramagnetic impurities in e.g. semiconductor devices, proteins, catalysts and molecular nanomagnets. The current design of conventional EPR spectrometers, however, limits the versatility for *operando* measurements. Here, we present an improved design of a miniaturised EPR spectrometer, implemented on a single microchip (EPRoC). On the chip, an array of coils each with a diameter of a few 100 μm is used as both a mw source and detector, allowing to perform both EPR spectroscopy and imaging. Due to its compactness, EPRoC can be incorporated in growth reactors, (electro)chemical cells or in UHV environments. The sensitivity of the new design is tested with standard EPR samples for various conditions such as conductive and polar environments to demonstrate its excellent capabilities for *operando* investigations of thin film solar cell materials and catalysts for solar fuel devices.

MA 51.10 Thu 15:00 Poster C

Examination of phase transition temperatures of magnetically doped polymer solutions — •SAMIRA WEBERS[1], MELISSA HESS[2], JOACHIM LANDERS[1], ANNETTE M. SCHMIDT[2], and HEIKO WENDE[1] — [1]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen — [2]Institute for Physical Chemistry, University of Cologne

Magnetic cobalt ferrite nanoparticles incorporated in dilute and semidilute polymer solutions are used as tracer particles to probe the phase transitions of the hybrid material by measuring the temperature dependent magnetization. Here, a detailed investigation of polyethylene glycol/water systems are carried out to reveal the melting, freezing and glass transition temperature. Those results are compared to differential scanning calorimetry, which underlines the results measured by magnetization curves. By further studying the influence of nanoparticles in solutions to DSC curves, it was found that the corresponding glass features are suppressed. This work is supported by the DFG priority program SPP1681 (WE2623-7).

MA 51.11 Thu 15:00 Poster C

Studying chain formation in ferrofluids and ferrogels by Mössbauer spectroscopy — •DAMIAN GÜNZING[1], JOACHIM LANDERS[1], SOMA SALAMON[1], HAJNALKA NÁDASI[2], ALEXEY EREMIN[2], and HEIKO WENDE[1] — [1]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen — [2]Institute of Physics, University of Magdeburg

In this study we investigated the magnetic field induced chain formation of spherical iron oxide nanoparticles (diameter d $\approx$ 10 nm) dispersed in n-dodecan as a ferrofluid. The ferrogel was prepared by the mentioned ferrofluid and an additional gelator. The chain length was evaluated by measuring the diffusive mobility and orientation of the particles simultaneously via Mössbauer spectroscopy. The Mössbauer spectra were recorded at temperatures from 234 to 258 K in an applied magnetic field parallel (up to 150 mT) and perpendicular (up to 750 mT) to the incident γ-rays. The results from the Mössbauer spectra were compared to magnetometry data. From the comparison to numerical models we determined a magnetic field driven reversible chain formation with a mean chain length of up to ca. 3 particles. This work is financially supported by the DFG priority program SPP1681 (WE2623-7).

MA 51.12 Thu 15:00 Poster C

Finding magnetic ground state of deposited clusters from first principles — •BALÁZS NAGYFALUSI[1], LÁSZLÓ UDVARDI[1,2], and LÁSZLÓ SZUNYOGH[1,2] — [1]Department of Theoretical Physics, Budapest University of Technology and Economics, Budapest, Hungary — [2]MTA-BME Condensed Matter Research Group, Budapest University of Technology and Economics, Budapest, Hungary

As the size of spintronic devices approaches the size of clusters containing few hundred of atoms the role of the simulations which are able to describe the magnetic properties of such a systems are more pronounced. We developed a method in the framework of the embedded cluster Green's function method[1] based on the the minimization of the overall torque on the magnetic moments. In order to find the local minimum we used the gradient descent method combined with the Newton-Raphson iteration where the torque and the Hessian matrix were calculated directly from first principles instead of relying on an effective spin Hamiltonian.

The procedure were applied on Fe trimers and on Fe chains deposited on Rh(111) surface. The geometry and the layer-layer distances were obtained from previous *ab initio* calculations. The sensitivity of the magnetic configuration on the geometry were studied by determining the ground state at different lattice relaxations. The overall results show the inherent symmetry and are more complex magnetic configuration than a trivial ferromagnetic alignment.

[1] B. Lazarovits, L. Szunyogh and P. Weinberger, Phys. Rev. B **65**, 104441 (2002)

MA 51.13 Thu 15:00 Poster C

Size-controlled synthesis of hexagonal magnetite nanoparticles — •ILONA WIMMER[1], BASTIAN TREPKA[2], SEBASTIAN POLARZ[2], and MIKHAIL FONIN[1] — [1]Department of Physics, University Konstanz, D-78457 Konstanz — [2]Department of Chemistry, University Konstanz, D-78457 Konstanz

Magnetic nanoparticles show a variety of unique properties such as superparamagnetism, magnetic single domain states, enhanced magnetic moments and magnetic anisotropies. These phenomena are not found in their bulk counterparts and make magnetic nanoparticles highly interesting for many applications ranging from medicine to data storage. The orientation of the magnetization, the coercivity, the energy barriers which have to be overcome upon reversal and the blocking temperature of nanoparticles are affected by the crystal lattice in connection with the surfaces of nanoparticles.

Here we report on monodisperse magnetite (Fe_3O_4) nanoparticles which were synthesized by means of a solvothermal synthesis and characterized by means of x-ray diffraction and transmission electron microscopy. The particles show a pronounced hexagonal shape with the average particle size of 15 nm. Magnetic measurements reveal superparamagnetic behavior with a blocking temperature of 135 K.

MA 51.14 Thu 15:00 Poster C

Mössbauer study of the particle-matrix interaction of cobalt ferrite nanoparticles — •JURI KOPP[1], SAMIRA WEBERS[1], MELISSA HESS[2], JOACHIM LANDERS[1], ANNETTE M. SCHMIDT[2], and HEIKO WENDE[1] — [1]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen — [2]Institute

for Physical Chemistry, University of Cologne

Previous magnetorheological measurements of cobalt ferrite nanoparticles in a polymer sucrose solution showed a polymer length dependent particle-matrix interaction between the polymer and the nanoparticles. Here, we study cobalt ferrite nanoparticles in a sucrose solution without the polymer as a reference measurement. For this purpose, sucrose solutions of different concentration were used to study the temperature dependent particle mobility via the change in line broadening observed in Mössbauer spectra. As expected, lower sucrose concentration showed a more water-like behavior and a more sudden increase of the line broadening than the one with higher sucrose concentration. Subsequently the results from the reference measurement are compared to Mössbauer spectra of the polymer sucrose solution. This work is supported by the DFG priority programme SPP1681.

MA 51.15 Thu 15:00 Poster C

Optimizing the cultivation of Magnetospirillum gryphiswaldense bacteria by setup of a hypoxic chamber — •Fabian Kugel, Paula Weber, Maryam Youhannayee, and Mathias Getzlaff — Institut für Angewandte Physik, Heinrich-Heine-Universität Düsseldorf, Deutschland

Nano-magnetic hyperthermia as a novel cancer therapy commonly uses iron oxide nanoparticles (NP) to heat up tumor tissue. Magnetotactic bacteria such as Magnetospirillum gryphiswaldense (MSR-1) synthesize magnetite NP by biomineralisation. These bacterial particles have unique properties that are advantageous in hyperthermia applications.

We established a cost-efficient method to cultivate MSR-1. The necessary microaerobic environment was implemented by setup of a hypoxic chamber and an oxygen control system.

The cultured bacteria were studied by transmission electron microscopy (TEM). According to the TEM images the quality of the cultivated samples was comparable to commercial products. The diameter of the internal NP was found to be (46.4 ± 8.8) nm which corresponds to a magnetic single-domain state.

Further variations in the cultivation process where examined for their influence on the NP growth. The cultivation of MSN-1 at higher oxygen concentrations led to suppression of size in adolescent NP.

MA 51.16 Thu 15:00 Poster C

Wet-chemically prepared magnetic nanoparticles: Influence of different preparation methods — •Jan Martin Henke, Maryam Youhannayee, and Mathias Getzlaff — Institut für Angewandte Physik, Heinrich-Heine-Universität, Düsseldorf, Deutschland

Iron oxide nanoparticles (NP) are often used in hyperthermia for cancer therapy due to their unique magnetic properties in order to heat up the tumor cells. In this project magnetite nanoparticles are synthesized in coprecipitation method under different variable parameters such as iron salt, stirring speed and temperature. After synthesizing the particles, they are coated by 3-aminopropyltriethoxysilane (APTES) and tetramethylammoniumhydroxide (TMAOH).

The morphology and crystalline structure of the particles are characterized by transmission electron microscopy (TEM) and X-ray diffraction (XRD), resp. The average size measured by TEM is about (10.40 ± 2.88) nm. The crystalline structure of magnetite was confirmed by XRD.

The properties of particles prepared by different salts do not show significant changes in size and crystalline structure. The XRD-data were fitted with Gaussian and Voigt functions. The size was calculated with the Scherrer equation and confirm approximately the same diameter as measured by TEM. A reduced stirring speed did also not affect the particles diameter, but an increased temperature leads to smaller particles. The stability of the particles in aqueous solution was increased by APTES and TMAOH coating.

MA 51.17 Thu 15:00 Poster C

Magnetoimpedance biosensor for detecting stray fields of nanoparticles: experiment and model — •Elizaveta Golubeva[1], Benjamin Spetzler[2], Franz Faupel[2], and Galina Kurlyandskaya[1] — [1]Ural Federal University, Ekaterinburg, Russia — [2]Kiel University, Kiel, Germany

Magnetic nanoparticles (MNPs) offer great potential to be involved in a wide range of biomedical applications. One of the main challenges for the utilization of MNPs is their detection and precise localization in a patient's body. Magnetic field sensors based on the giant magnetoimpedance effect (GMI) are promising candidates for detection, due to potentially large sensitivities [1] and small detection limits [2]. However, a compromise must be reached between an optimum magnetic bias field for GMI sensitivity and the maximum net stray field of the MNPs. With this work, a comprehensive model is presented that describes the mutual interaction of the sample and the sensing element as well as the resulting electrical impedance. The model is used to find the optimum operation parameters for the sensor, including the geometric and magnetic configuration of the system. Finally, the results are compared with measurements on sensor prototypes with an amorphous wire or a ribbon as a sensitive element. General consequences are derived.

[1] N.A. Buznikov, et al., Biosensors and Bioelectronics, 117,366-372, (2018) [2] T. Uchiyama, et al., Physica Status Solidi (a), 206, 639-643, (2009)

This work is supported by the RSF grant 18-19-00090.

MA 51.18 Thu 15:00 Poster C

Perpendicular Magnetic Anisotropy for xMR Sensor Technology — •Clemens Mühlenhoff[1,2], Wolfgang Raberg[1], Armin Satz[1], Klemens Prügl[1], Dieter Süss[3,4], and Manfred Albrecht[2] — [1]Infineon Technologies AG, 85579 Neubiberg, Germany — [2]Institute of Physics, University of Augsburg, 86135 Augsburg, Germany — [3]Physics of Functional Materials, University of Vienna, 1090 Vienna, Austria — [4]Advanced Magnetic Sensing and Materials, Christian Doppler Research Association, 1090 Vienna, Austria

Magnetoresistive (xMR) technology has replaced Hall sensors in many high frequency and low field applications due to its higher sensitivity and large bandwidth. However, there are still yet unsolved challenges. For example, xMR sensors lack the ability to measure magnetic fields in a wide linear range, which is needed for high field applications, e.g. detecting high electrical current. Furthermore, there are no xMR sensors available that substitute z-sensitive Hall sensors with comparable linearity and low hysteresis. These challenges we tackle by introducing a magnetic layer with perpendicular magnetic anisotropy (PMA) into the xMR stack system. PMA is achieved by orbital hybridizations at the interfaces in CoFeB/MgO systems, as well as in Co/Pt multilayers. The influence of a Ru/Ta/Pt seed layer and a Ta(N) capping layer was studied in connection with deposition and annealing temperatures. Depending on the choice of anisotropy in free and reference layer, we obtain linear field ranges of +/-150 mT and realize a z-sensitive xMR technology with a perpendicular reference layer applicable up to 600 mT.

MA 51.19 Thu 15:00 Poster C

Noise level optimisation in PHE sensors for magnetic nanoparticles detection — •Anastasiia Moskaltsova, Luca Marnitz, Jan-Michael Schmalhorst, and Günter Reiss — Center for Spinelectronic Materials and Devices, Physics Department, Bielefeld University, Universitätsstraße 25, Bielefeld 33615, Germany

Magnetoresistive (MR) sensors are well known for their various applications, including magnetic nanoparticles (MNPs) detection. In frame of the EU H2020 MADIA project [1] we focus on real-time MNPs detection using planar Hall effect (PHE) MR sensors. The main goal of the project is to develop a versatile and cost-effective tool for early diagnosis of Alzheimers and Parkinsons diseases. This can be achieved by combining high sensitivity sensors with microfluidics and functionalized MNPs. Noise level is among the relevant sensor characterisitics, as it gives the information on the minimum detectable magnetic field for a given frequency. Recently, the noise level of $\sim$ pT/$\sqrt{Hz}$ was achieved for magnetic tunnel junctions [2].

In this work we study PHE sensors noise in the frequency range from 1 Hz to 10 kHz. A study on influence of the PHE sensor size and the applied current on the noise level is conducted, as these parameters are inlcuded in the phenomenological Hooge model of noise [3].

[1] http://www.madia-project.eu
[2] Chaves et al. Appl. Phys. Lett. 91, 102504 (2007)
[3] F. N. Hooge, IEEE T. Electron. Dev., 41, 1926, (1994)

MA 51.20 Thu 15:00 Poster C

Influence of sputter conditions on domain configurations in patterned thin films — •Sukhvinder Singh[1], Leon Abelmann[2], Haibin Gao[1], and Uwe Hartmann[1] — [1]Institute of Experimental Physics, Saarland University, Saarbrücken, Germany — [2]Korea Institute of Science and Technology (KIST)-Europe, Saarbrücken, Germany

Well-defined and technically relevant domain configurations are sought in patterned magnetic thin films [1,2]. We used Magnetic Force

Microscopy to investigate domain configurations in square and disc shaped patterned Permalloy thin films. The films were prepared with sputter deposition by varying the Argon pressure from 1.5 micro-bar upto 30.0 micro-bar. The four domain configurations in squares and single vortex states in discs are found as the lowest energy states in the films prepared at 1.5 micro-bar Argon pressure. With the increase of the Argon pressure, higher energy complex domains are formed and irregularity in the domain configurations increases. From the magnetic and structural characterizations, an increase of the coercivity and a decrease of the film density with the increase of Argon pressure is observed. Moreover, the change in microstructure and composition of the films with the change of Argon pressure is linked to the formation of domain configurations inside the patterned samples.

[1] S. Cherifi et. al., Journal of Applied Physics, 98, 043901 (2005).
[2] J. McCord, Journal of Applied Physics, 95, 6855 (2004).

MA 51.21 Thu 15:00 Poster C

Surface acoustic wave driven magnetic resonance in CoFe thin films — •Adrian Gomez[1,2], Lukas Liensberger[1,2], Luis Flacke[1,2], Matthias Althammer[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

In communication technology, surface acoustic waves (SAWs) are ubiquitous as delay lines and bandpass filters. In research, SAWs regained interest for the investigation of the interplay of coherent phonons with other degrees of freedom in a solid state environment. In particular, we are interested in the magnon-phonon interaction within a low-damping thin film ferromagnet. We employ optical lithography to define SAW delay lines on a lithium niobate substrate. Our devices use interdigital transducers (IDTs) to convert the electrical stimulus to SAWs. In this presentation, we quantify the key performance aspects of our SAW delay lines operating in the GHz frequency range. Those frequencies enable the investigation of the resonant magnetoelastic excitation of spin waves in a ferromagnetic thin film of CoFe by coherent phonons. Technically, the film is sputter-deposited between the two IDTs. In addition to the phonon transmission information, we optically detect the generated magnetic excitations. We acknowledge financial support by DFG via projects WE5386/4 and WE5386/5.

MA 51.22 Thu 15:00 Poster C

Spin-resolved electronic structure of 3d transition metals during ultrafast demagnetization — •Beatrice Andres, Jonathan Weber, Wibke Bronsch, and Martin Weinelt — Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin

Spin-resolved experiments on magnetization dynamics are still rare. Few photoemission works have been published, which show not only spin- but also energy-resolved magnetization dynamics [1-3]. Refs. [1] and [3] demonstrated that in one material spin dynamics can be very different for the various electronic states and thus the outcome of any ultrafast demagnetization experiment depends on the probed electronic states. This emphasizes the importance of spin-resolved measurements in magnetization dynamics.

Continuing the research of these works, here we present new results on the ultrafast demagnetization of thin Fe films on W(110). In laser photoemission ($h\nu_{\mathrm{Probe}} = 6.2$ eV) we find an ultrafast breakdown of the spin polarization after pumping the system with 70-fs pulses at $h\nu_{\mathrm{Pump}} = 1.6$ eV. Measuring a minority-spin surface resonance close to the Fermi level at ~ 0.1 Å^{-1} in Γ-H direction, we observe only marginal changes in binding energy, while there is a pronounced drop of spin polarization. These findings corroborate a band mirroring effect similar to the ones observed in Refs. [1] and [2].

[1] Gort *et al.*, *Phys. Rev. Lett.* **121**, 087206 (2018)
[2] Eich *et al.*, *Sci. Adv.* **3**, e1602094 (2017)
[3] Andres *et al.*, *Phys. Rev. Lett.* **115**, 207404 (2015)

MA 51.23 Thu 15:00 Poster C

Fluence-dependent ultrafast magnetization dynamics in TbGd bilayers and their interfacial spin-coupling — •Markus Gleich[1], Kamil Bobowski[1], Dominic Lawrenz[1], Can Çağıncan[1], Niko Pontius[2], Daniel Schick[2], Christian Schüssler-Langeheine[2], Björn Frietsch[1], Unai Atxitia[1], Nele Thielemann-Kühn[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 studied the fluence-dependent ultrafast magnetization dynamics in TbGd bilayers by XMCD in reflection at the FemtoSpex facility of BESSY II. The bilayers were grown on a W(110) substrate and show a two-step demagnetization as observed in previous experiments on Gd and Tb [1-4]. Interestingly, the static magnetic properties and the spin dynamics of a Gd thin film can be significantly altered by depositing only a few monolayers of Tb on top. The temperature-dependent magnetization of Gd in TbGd bilayers is influenced by the Tb layer depending on the distance from the interface, which suggests a substantial spin-coupling between Gd and Tb.

[1] M. Wietstruk *et al.*, Phys. Rev. Lett. **106**, 127401 (2011).
[2] M. Sultan *et al.*, Phys. Rev. B **85**, 184407 (2012).
[3] A. Eschenlohr *et al.*, Phys. Rev. B **89**, 214423 (2014).
[4] K. Bobowski *et al.*, J. Phys.: Condens. Matter **29**, 234003 (2017).

MA 51.24 Thu 15:00 Poster C

Spin structure of superparamagnetic iron oxide nanoparticles — •Tobias Köhler[1], Artem Feoktystov[1], Oleg Petracic[2], Emmanuel Kentzinger[2], Tanvi Bhatnagar[2,4], Sascha Ehlert[3], Ulrich Rücker[2], Rafal Dunin-Borkowski[4], Andras Kovacs[4], and Thomas Brückel[2] — [1]Forschungszentrum Jülich GmbH, JCNS at MLZ, 85748 Garching, Germany — [2]Forschungszentrum Jülich GmbH, JCNS-2 and PGI-4, JARA-FIT, 52425 Jülich, Germany — [3]Forschungszentrum Jülich GmbH, JCNS-1, 52425 Jülich, Germany — [4]Forschungszentrum Jülich GmbH, Ernst Ruska-Centrum für Mikroskopie und Spektroskopie mit Elektronen, 52425 Jülich, Germany

We have studied superparamagnetic iron oxide nanoparticles by various experimental techniques in order to characterize the observed reduced saturation magnetization as compared to bulk. Particles of the size of 12 and 15 nm have been studied via small-angle X-ray scattering (SAXS), X-ray diffraction (XRD), high-resolution transmission electron microscopy (HRTEM), inductively coupled plasma with optical emission spectroscopy (ICP-OES) and magnetometry to obtain a detailed understanding of the internal magnetization distribution. Small amounts of spherical particles were dispersed in paraffin, so that inter-particle interactions can be neglected. The shapes of the magnetometry curves confirm a superparamagnetic behavior. The presence of exchange bias indicates an antiferromagnetic, wüstite contribution to the particle composition. Small-angle scattering of polarized neutrons (SANSPOL) will provide insights into the inner spin structure.

MA 51.25 Thu 15:00 Poster C

Growth, Structuring and Characterization of $La_{1-x}Sr_xMnO_3$|Pt-heterostructures — •Cinja Seick[1], Lukas Szabadics[2], Vitaly Bruchmann-Bamberg[1], Christian Jooss[2], Vasily Moshnyaga[1], Stefan Mathias[1], Daniel Steil[1], and Henning Ulrichs[1] — [1]I. Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany — [2]Institut für Materialphysik, Universität Göttingen, 37077 Göttingen, Germany

The main goal of our project is the investigation of ultrafast magnetization dynamics in correlated materials under the influence of injected spins via the inverse spin Hall effect. For an effective spin injection, we need samples with a high SOC material in contact with the respective correlated material.

On our poster, we report on the fabrication of corresponding LSMO|Pt bilayer systems. We have tested a multitude of preparation techniques, namely metalorganic aerosol deposition, xenon ion sputtering and thermal vaporization, and compare our fabricated samples with respect to quality of epitaxial growth, interface quality and to the magnetic properties of the LSMO.

We acknowledge financial support by the DFG within the SFB 1073 - Atomic scale control of energy conversion.

MA 51.26 Thu 15:00 Poster C

Magnetic patterning of TMR thin film systems for controlled movement and detection of superparamagnetic beads — •Rico Huhnstock[1], Andreas Becker[2], Jendrik Gördes[1], Maximilian Merkel[1], Dennis Holzinger[1], Arno Ehresmann[1], and Andreas Hütten[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]Thin Films and Nanostructures, Department of Physics, Bielefeld University, P.O. Box 100131, D-33501 Bielefeld

Designing point-of-care diagnostic devices using magnetic particles as labels for disease specific biomolecules, an obstacle presents itself in

directing the particles towards a highly sensitive detection area [1]. As a solution, we propose the novel combination of a magnetically patterned exchange bias thin film system for initialising particle movement with magnetic tunnel junction based sensor elements. In this work we demonstrate the successful fabrication of such hybrid systems by means of keV-He ion bombardment and verify the induced magnetic domain pattern. It is shown, that the magnetoresistance of the sensor elements is unharmed by the bombardment process and thus enables a detection of delivered magnetic particles. Finally the experimental realization of a directed particle transport above the hybrid system in a microfluidic environment proves the potential application of the here presented system within biomedicine.

[1] Weddemann *et al.* (2010), Biosensors and Bioelectronics, 26: 1152-1163.

MA 51.27 Thu 15:00 Poster C

Increased power transfer and heat generation in inductive heating applications through proper materials selection — •Marius Wodniok, Michael Feige, Werner Klose, Mikhail Tolstykh, Lennart Weber, and Sonja Schöning — Bielefeld Institute for Applied Materials Research (BIfAM), Bielefeld University of Applied Sciences, Department of Engineering Sciences and Mathematics, Interaktion 1, 33619 Bielefeld, Germany

Inductive heating is a well-established application of wireless power transfer. However, in this particular case there is a substantial need for optimization. Increasing the converted power while maintaining a high energy efficiency in combination with a homogeneous heat distribution are the leading requirements in that field.

We have performed finite element simulations using COMSOL Multiphysics in order to find the optimal material parameters of the transmitter coil environment and the receiving ferromagnetic metal film as well. An experimental induction heating setup is used to validate the simulated predictions. We have investigated a series of different ferrite materials, electrical steels and coil embedding environments.

According to our findings, it is possible to tailor the coil environment as well as the receiver's materials properties in a way that the energy transfer leads to in substantially increased heating performance.

MA 51.28 Thu 15:00 Poster C

The role of structural anisotropy in the magnetooptical response of an organoferrogel with mobile magnetic nanoparticles — Hajnalka Nadas1[1], Ralf Stannarius[1], Jing Zhong[2], Karin Koch[2], Annette M. Schmidt[3], Frank Ludwig[2], and •Alexey Eremin[3] — [1]Institute of Physics, Otto von Guericke Universität Magdeburg Germany — [2]Institute of Electrical Measurement Science and Fundamental Electrical Engineering, TU Braunschweig — [3]Institut fü Physikalische Chemie, Universität zu Köln, Köln, Germany

We study magnetooptical and dynamic magnetic properties of organoferrogels containing mobile and bound magnetic nanoparticles (MNPs). The aim of the study is to investigate the coupling between the MNPs and a fibrillar gel network on the gel structure and magnetooptical properties. We demonstrate that the mobile MNPs forming doublets are responsible for the field-induced birefringence. The magnetooptical response becomes strongly suppressed in samples where the magnetic particles are bound via hydrogen bonds. We show that the structural anisotropy of the gel has a profound effect on the optical and magnetic response of the ferrogel.

MA 51.29 Thu 15:00 Poster C

Ferromagnetic writing on B2 $Fe_{50}Rh_{50}$ thin films using ultra-short laser pulses — •Alexander Schmeink[1,2], Benedikt Eggert[3], Jonathan Ehrler[1], Mohamad Mawass[4], René Hübner[1], Kay Potzger[1], Jürgen Lindner[1], Jürgen Fassbender[1,2], Florian Kronast[4], Heiko Wende[3], and Rantej Bali[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [2]Fakultät für Physik, Technische Universität Dresden, Germany — [3]Fakultät für Physik and CENIDE, Universität Duisburg-Essen, Germany — [4]Helmholtz-Zentrum Berlin, Germany

Laser manipulation of magnetic properties has potential applications in data storage. B2 $Fe_{50}Rh_{50}$ alloy is well-known to show a temperature-driven antiferromagnetic (AFM) to ferromagnetic (FM) transition at ≈380 K. In contrast to the temperature-driven transition, FM regions can be induced via atomic rearrangements leading to antisite disorder, to form A2 $Fe_{50}Rh_{50}$. The above B2 → A2 transition can be realised in alloy thin films using ion beams as well as laser pulses, resulting in localized non-volatile FM writing.[1] Here, we irradiate B2 $Fe_{50}Rh_{50}$ thin films of ≤30 nm thicknesses with ∼100 fs short laser pulses and observe the induced magnetic and structural changes. Depending on the laser fluence, transitions of B2 $Fe_{50}Rh_{50}$ to A2 and with further disordering to the A1 structure are observed. The deposited energy influences the resolidifcation of the alloy, thereby determining the structure.

This work is funded by the DFG (BA 5656/1-1).

[1] J. Ehrler et al. *ACS Applied Materials & Interfaces* **2018** 10 (17), 15232-15239

MA 51.30 Thu 15:00 Poster C

Fabrication of anisotropic magnetic nanostructures — •Irene Iglesias, Marina Spasova, Ulf Wiedwald, and Michael Farle — University Duisburg-Essen and Center for Nanointegration Duisburg-Essen (CENIDE), Germany

The study of anisotropic magnetic micro- and nanostructures is of great interest due to their potential use in a wide range of applications, ranging from biomedicine to storage devices. While the fabrication of the microstructured systems is nowadays widely studied, downsizing to the nanoscale is still a great challenge. In this work, we present the fabrication and magnetic properties of one-dimensional ferromagnetic functional nanostructures, such as nanowires, nanorods, nanotubes and semi-tubes, grown by electrodeposition in ion-track membrane templates. The shape and size, as well as the structural properties of the nanostructures, can be tuned by controlling the deposition parameters such as precursors, deposition potential, pH, Ar flow and others. Moreover, a novel approach for the fabrication of ferromagnetic core-shell nanorods with dimensions in the submicron scale was developed and established. As an example, we present here Co-Fe core-shell nanorods with a length of 1 μm and diameters ranging from 50 nm to 70 nm. The nanorods were structurally and magnetically characterized by scanning and transmission electron microscopy and SQUID magnetometry.

MA 51.31 Thu 15:00 Poster C

Thickness dependence of compensation temperature in GdCoFeB ferrimagnets — •Fabian Kammerbauer[1], Nico Kerber[1], and Boris Seng[1,2] — [1]Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany. — [2]University of Lorraine, 54506 Vandoeuvre-lès-Nancy, France.

Magnetic skyrmions are topologically protected spin textures particularly suitable for next generation spintronics devices, like the skyrmion-based racetrack memory. Recent studies confirmed the current-driven skyrmion dynamics in ultrathin ferromagnets[1]. However, the topological Magnus effect leads to a transverse motion of ferromagnetic skyrmions due to their non-zero topological charge[1]. Antiferromagnetically exchange-coupled skyrmions or compensated ferrimagnets could suppress this effect owing to an overall zero topological charge. Especially at the angular momentum compensation temperature skyrmions dynamics is predicted to be collinear with the current[2].

We report here on a decrease in compensation temperature in the thin film ferrimagnetic system [Pt(5 nm)/GdCoFeB(d)/MgO(1.2 nm)/Ta(2 nm)] for increasing thickness d of the GdCoFeB alloy observed in multiple alloy compositions. Although this limits the accessible range of structures near compensation, it also allows for tuning the compensation through an additional parameter.

[1] K. Litzius et al., Nature Phys. 13, 170 (2017)
[2] Barker et al. Phys. Rev. Lett. 116, 147203 (2016)

MA 51.32 Thu 15:00 Poster C

A multiscale approach for magnetic skyrmion simulations — •Thomas Brian Winkler[1], Andrea de Lucia[1,2], Kai Litzius[1,2,3], Oleg Tretiakov[4], Benjamin Krüger[1], and Mathias Kläui[1,2] — [1]Johannes Gutenberg Universtät Mainz, — [2]Graduate School of Excellence - Material Science in Mainz, Staudingerweg 9, 55128 Mainz, Germany — [3]Max Planck Institute for Intelligent Systems, 70569 Stuttgart, Germany — [4]Institute for Material Research, Tohoku University, Sendai 980-8577 Sendai

Simulations of magnetization dynamics in a multiscale Environment enable a rapid evaluation of the Landau-Lifshitz-Gilbert equation in a mesoscopic samples. This approach [1] combines the necessary nanoscopic accuracy in areas where such precision is required. The normal micromagnetic solving routine of the micromagnum software package [2] has been expanded to include an accurate Heisenberg model in areas with strongly varying spin structures. The model is applied to study for instance the (thermal) stability of skyrmions [3]. [1] A. de Lucia et al., Phys. Rev. B 94, 184415(2016), [2] URL: http://micromagnum.informatik.uni-hamburg.de/, with addi-

tional modules for DMI and SOT from our Group, [3] A. de Lucia et al., Phys. Rev. B 96, 020405(R) (2017)

MA 51.33 Thu 15:00 Poster C

Designing non-conventional 3-D coils — •Assja Laas and Christian Schröder — Bielefeld Institute for Applied Materials Research (BIfAM), Computational Materials Science and Engineering (CMSE), University of Applied Sciences Bielefeld, Department of Engineering Sciences and Mathematics, Interaktion 1, D-33619 Bielefeld

Compact devices for inductive energy and information transfer require the design of appropriate non-conventional 3-D induction coils. This is because only a small volume for placing the coil inside the device is available, and one is only interested in the near-field characteristics of the generated magnetic field. In our study we focus on design strategies for appropriate three-dimensional induction coils by exploiting an inverse methodology. A target field is specified over a certain region and an approximation of the current density through a Fourier series expansion is derived which generates the desired field. Because of the ill-posed nature of this problem a Tikhonov regularization with a penalty term is used to calculate the unknown parameters of the Fourier series expansion. In this contribution we discuss the effect of different penalty terms, i.e. a 2-norm term, a gradient and a laplace term on the resulting current densities. Based on this, we obtain the coil windings by calculating the maximum of a current density map and applying a stream function approach.

MA 51.34 Thu 15:00 Poster C

Using Non-Linear Material Properties for the Optimization of Heat Generation in Inductive Heating Applications — •Lennart Weber, Christian Schröder, and Sonja Schöning — Bielefeld Institute for Applied Materials Research (BIfAM), Bielefeld University of Applied Sciences, Department of Engineering Sciences and Mathematics, Interaktion 1, D-33619 Bielefeld

Inductive power transfer is nowadays a widely used technology, e.g. for inductive heating in industrial applications and household appliances. An inductive heating system usually consists of a coil (transmitter) which is powered by an alternating current and a ferromagnetic material (receiver) which is heated by the generated eddy currents where the dissipated power is proportional to the square of the current density. With regard to energy efficiency and comfort it is desirable to be able to manipulate the current density distribution within the ferromagnetic material in a specific way. Here, we propose an approach which utilizes the non-linear material properties of the receiver in combination with a variable magnetic field generated by the transmitter that allows us to optimize the heat generation.

MA 51.35 Thu 15:00 Poster C

Why Your Computer Should Learn the Maxwell-Ampère Equation on its own — •Simon Bekemeier and Christian Schröder — Bielefeld Institute for Applied Materials Research (BIfAM), Computational Materials Science and Engineering (CMSE), Bielefeld University of Applied Sciences, Department of Engineering Sciences and Mathematics, Interaktion 1, 33619 Bielefeld, Germany

Neural networks are powerful tools for modelling unknown or complex functional relations in a relatively simple way. Using cascades of simple operations they can fit highly non-linear functions. In this contribution, we show how neural networks can be used to predict the magnetic field of coils given only the coil geometry. Namely, black-and-white raster graphics are used to present the geometry to the neural net, while colored graphics provide the training data for the respective magnetic field. Using a combination of an auto-encoder layout and elements of convolutional neural nets our network can learn the relationship between simple coil geometries and their generated magnetic fields. Finally, we present the application of such neural networks as surrogate models for the use in optimization problems. Using a surrogate model of the Maxwell-Ampère equation, we are able to find novel induction coil geometries very efficently using an iterative optimization approach rather than performing accurate but very time-consuming conventional simulations.

MA 51.36 Thu 15:00 Poster C

spin-phonon coupling in FCC-Fe — •duo wang and biplab sanyal — Departmenf of Physics and Astronomy, Uppsala University, Uppsala, Sweden

Unlike BCC-Fe, some theoretical studies show that FCC-Fe is a weak magnet exhibiting magnetovolume instability and non collinear magnetic structures under compression. We performed ab initio calculations for studying the volume dependence of spin-spiral dispersion in FCC-Fe by plane wave projector augmented wave method. It is shown that at low volumes, the magnetic configuration corresponding to the ground state is a spin-spiral of $q_2 = 2\pi/a(0.2, 0, 1)$, whereas for higher volumes, the ground state occurs for $q_1 = 2\pi/a(0, 0, 0.6)$. Our results are very much consistent with the data from full-potential linearized augmented-plane-wave method (FP-APW+lo) study (Physical Review B, 2002, 66(1): 014447). Moreover, our calculations of phonon dispersion spectra for different collinear and non-collinear magnetic structures show a strong dependence of phonon frequencies on the magnetic structures indicating strong spin-phonon interactions.

MA 51.37 Thu 15:00 Poster C

Transparent boundary conditions in micromagnetic simulations eliminate finite size effects — •Jan Masell — Institut für Theoretische Physik, Universität zu Köln, Köln, Deutschland

In systems where the magnetic texture varies on a considerably larger scale than the atomic lattice structure, effective micromagnetic models provide powerful approximations to the numerically too complex atomistic descriptions. However, even these effective models soon face the limits of numerical runtime or accuracy, in particular, when the considered effects require a long-ranged healing length. Common examples include the propagation of magnons through nanostructures, where a reflection and back-propagation from the end of the simulated area is usually suppressed by artificial absorbing boundary conditions but also the simulation of complex defects such as skyrmions or defects in a helical phase.

Here, I present my work on transparent boundary conditions which can be used in micromagnetic simulations to overcome the size limitations in these types of systems by effectively providing half-infinite boundary conditions.

MA 51.38 Thu 15:00 Poster C

Growth of La0.67 Sr0.33 MnO3/BaTiO3 and La0.67 Sr0.33 MnO3/PMN-PT: An approach for Voltage Control of Magnetism — •tanvi bhatnagar[1,2], anirban sarkar[1], markus waschk[1], emmanuel kentzinger[1], andras kovacs[2], lei jin[2], patrick schöffmann[3], michael faley[4], rafal e. dunin-borkowski[2], and thomas brückel[1] — [1]Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, 52425 Jülich, Germany — [2]Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons and Peter Grünberg Institute, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany — [3]Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS) at MLZ, 85747 Garching, Germany — [4]Forschungszentrum Jülich GmbH, Peter Grünberg Institute (PGI-5), 52425 Jülich, Germany

The voltage control of magnetism in oxide heterostructures has been extensively investigated for future spintronic devices. We grow single crystalline La0.67Sr0.33MnO3/BaTiO3 and La0.67Sr0.33MnO3/PMN-PT heterostructures by High Oxygen Pressure Sputtering System (HOPSS) and Oxide Molecular Beam Epitaxy (OMBE). Magnetometry measurements confirm the stability of the tetragonal phase of BaTiO3 down to 10K and the ferromagnetic state of La0.67Sr0.33MnO3. The manipulation of magnetization as a function of electric field will be studied with the combination of advanced scattering (neutron and X-ray) methods, electron microscopy and spectroscopy.

MA 51.39 Thu 15:00 Poster C

Non-reciprocal THz response of chiral Ni3TeO6 in magnetic field — •David Maluski[1], Malte Langenbach[1], David Szaller[2], István Kézsmárki[3], Vladimir Tsurkan[3], Sang-Wook Cheong[4], Joachim Hemberger[1], and Markus Grüninger[1] — [1]II. Physikalisches Institut, Universität zu Köln — [2]Institut für Festkörperphysik, Technische Universität Wien — [3]Experimentalphysik V, Universität Augsburg — [4]Department of Physics and Astronomy Rutgers, The State University of New Jersey

In the realm of multiferroicity, Ni3TeO6 stands out for the observation of non-hysteretic magnetic switching and the record linear magneto-electric coupling constant in single-phase materials [1]. The structure of Ni3TeO6 is both chiral and polar already at room temperature. The antiferromagnetically ordered phase below $T_N = 53$K features collinear ordered moments and a significantly enhanced electric polarization due to magneto-electric coupling [1]. In an external magnetic field, chiral structures show both natural optical activity as well as magnetic opti-

cal activity (Faraday effect). However, one may also expect more exotic non-reciprocal effects such as magneto-chiral dichroism or quadrochroism [2]. We use circularly polarised light in the THz range and high magnetic fields to prove the existence of this effect in Ni3TeO6 at low temperatures.

[1] Y. S. Oh et al., Nat. Commun. 5:3201 (2014) [2] I. Kézsmárki et al., Nat. Commun. 5:3203 (2014)

MA 51.40 Thu 15:00 Poster C

Growth and characterization of magnetite based artificial multiferroic heterostructure — •Anirban Sarkar and Thomas Brückel — Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science JCNS and Peter Grünberg Institute PGI, JARA-FIT, 52425 Jülich, Germany.

We study the morphology, electric, magnetic, magneto-electric coupling and magneto-transport properties of Fe_3O_4/Nb:$SrTiO_3$(001) and Fe_3O_4/PMN-PT(011) heterostructures. Studies like, interfacial capacitance, magnetic depth profile, ferroelectric ordering, stress and charge screening-control of the Verwey transition are of special interest. The Fe_3O_4 films are grown in an oxide molecular beam epitaxy system. We use x-ray diffraction and reflectometry for the structural characterizations, and atomic force microscopy (AFM) for the morphology of thin film. Magnetic and transport properties of the heterostructure are studied using superconducting quantum interference device (SQUID) magnetometer and physical property measurement system, respectively. We propose that probing the depth profile of magnetization using polarized neutron reflectrometry (PNR) can reveal more information about the magnetic properties near the interface of such ferromagnetic/semiconductor heterostructures.

MA 51.41 Thu 15:00 Poster C

Spectroscopic and thermodynamic investigation of the new alternating chain system $Fe(Te,Se)_2O_5Cl$ — •Ksenija Denisova[1,2,3], Dirk Wulferding[1,2], Peter Lemmens[1,2], Peter Berdonosov[4], Ekaterina Kozlyakova[3], and Alexander Vasiliev[3] — [1]IPKM, TU-BS, Braunschweig, Germany — [2]LENA, TU-BS, Braunschweig, Germany — [3]Dept. of Phys., MSU, Moscow, Russia — [4]Dept. of Chem., MSU, Moscow, Russia

In the search for new materials with specific magnetic properties, the exploration of isostructural relatives of already known multiferroics [1,2] is essential. Alternating antiferromagnetic spin chains of Fe in a high spin state and Te, Se, both containing lone pair electrons, make $Fe(Te,Se)_2O_5Cl$ a promising candidate for particular magnetic properties [3]. Being sensitive to many degrees of freedom, Raman scattering is a helpful tool to reveal an interplay of lattice dynamic and magnetism. Supported by DFG-LE967/16-1, RFBR project 16-03-00463a.

[1] Choi, et al. JPCM 26, 086001 (2014). [2] Kim, et al., Phys. Status Solidi B 252, No. 4, 653 (2015). [3] Akhrorov, et al., Solid State Sciences 74, 37 (2017).

MA 51.42 Thu 15:00 Poster C

Interactions between superconductor-ferromagnet thin films — •Annika Stellhorn[1], Anirban Sarkar[1], Emmanuel Kentzinger[1], Sonja Schröder[1], Markus Waschk[1], Patrick Schöffmann[2], Zhendong Fu[2], Vitaliy Pipich[2], and Thomas Brückel[1] — [1]Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, 52425 Jülich GERMANY — [2]Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science at MLZ, Lichtenbergstr. 1, 85748 Garching Germany

Interactions at superconductor-ferromagnet (S/F) interfaces have been studied on a prototype Nb (S)/ FePd (F) system. Our goal is to understand the proximity effects of FePd with different strength of perpendicular magnetic anisotropy (PMA) and magnetic domain texture on the superconducting Nb layer. Proximity effects at S/F interfaces with an inhomogeneous magnetic field texture result in various effects, like domain-wall superconductivity and long-ranged triplet cooper pairs in the F-layer, making them good candidates for superconducting spintronics. Epitaxial heterostructures of Nb/FePd are prepared on MgO (001) substrate using Molecular Beam Epitaxy. Magnetic Force Microscopy images of FePd grown by shuttered growth reveal a striped domain structure. Macroscopic magnetization measurements show weak PMA. However, a method combining co-deposition and shuttered growth results in samples with high PMA and a striped domain structure. Grazing-Incidence-Small-Angle-Neutron-Scattering reveals the depth profile of the magnetization in the heterostructure.

MA 51.43 Thu 15:00 Poster C

Spin-polarized ARPES studies of copper-based molecular spinterfaces — •David Janas, Henning Sturmeit, Giovanni Zamborlini, Stefano Ponzoni, and Mirko Cinchetti — Experimentelle Physik VI, TU Dortmund, Otto-Hahn-Straße 4, 44227 Dortmund, Germany

Spin-resolved angle-resolved photoelectron spectroscopy (spin-ARPES) is a powerful method to study the spin-dependent properties of molecular spinterfaces [1]. In a recent work [2] it was reported that layered structures of C_{60} deposited on metallic thin films show emerging ferromagnetic properties even on dia- or paramagnetic metals. Although the physical origin of the ferromagnetic order is not yet fully understood, there are strong evidences that the magnetic moment is localized at the metal-organic interface. In order to shed a light on the mechanism leading to these unexpected magnetic properties, we have performed spin-ARPES measurements on different prototypical copper-based interfaces where all the experimental conditions - e.g. metal and molecular film thickness, metal-molecule interaction - can be controlled at the nanoscale level. We will discuss the results on the different systems and highlight the observed similarities and differences.

[1] M. Cinchetti, V. A. Dediu, and L.E. Hueso, Nature Materials 16, 507 (2017)
[2] F. Al MaMari et al., Nature 524, 69 (2015)

MA 51.44 Thu 15:00 Poster C

Macrospin-based demonstration of a Boltzmann machine — •Timo Pulch, Daniele Pinna, and Karin Everschor-Sitte — Institut of Physics, Johannes Gutenberg University, Mainz, Germany

Spintronics has consistently proven itself in new technological applications such as racetrack storage and magnetic logic gates. Proper modeling of such devices requires an intimate understanding of spin-torque and thermal effects. In this work we present how a suitable combination of magnetic logic gates and ambient noise within the macrospin model to demonstrate a Boltzmann machine. We will argue that randomization is performed efficiently by energy harvesting of thermal fluctuations, and that the proposed design can be used to invert the operation of logic gates by efficiently sampling across all possible inputs. Advances in this area are expected to yield novel approaches capable of tackling non-deterministic Boolean problems.

MA 51.45 Thu 15:00 Poster C

Optimization of a Fabrication Process for Metallic Nanoconstrictions for Spin-Hall nano-oscillators — •Stephanie Lake[1], Philipp Dürrenfeld[1], Frank Heyroth[2], and Georg Schmidt[1,2] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, 06120 Halle, Germany — [2]Interdisziplinäres Zentrum für Materialwissenschaften, Martin-Luther-Universität Halle-Wittenberg, 06120 Halle, Germany

Generating high frequency signals without a microwave source has been demonstrated using the spin-Hall Effect (SHE) in nano-oscillator devices.[1] The SHE can drive pure spin currents into a ferromagnetic material exciting spin waves detected electrically with powers up to 10 pW.[2] However, the efficiency of generating such signals significantly depends on device geometry. It is thus important to have excellent control of the nanoconstriction (NC) shape and dimensions.

In this poster, several parameters of the fabrication process are investigated to understand their effect on the dimensions and quality of Py-based NCs. The structures are made by first sputtering 5 nm of Py and 6 nm of Pt onto silicon. A positive bi-layer resist is patterned with sets of varied NC designs by e-beam lithography. Afterward, aluminum oxide is deposited and lifted off to serve as an etching mask for the metal stack. Variations of exposed pattern and exposure strategy during the e-beam lithography process result in different shapes and sizes of the NC structures and allow for future optimization.

[1]Vladislav E. Demidov *et al. Nat. Materials* **11**, 1028-1031 (2012).
[2]A. A. Awad *et al. Nat. Physics* **13**, 292-299 (2017).

MA 51.46 Thu 15:00 Poster C

Superconductor/Ferromagnet-Heterostructures for superconducting spintronics — •Manuel Müller[1,2], Mathias Weiler[1,2], Hans Huebl[1,2,3], Rudolf Gross[1,2,3], and Matthias Althammer[1,2] — [1]Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany — [2]Physik-Department, Technische Universität München, Germany — [3]Nanosystems Initiative Munich, München, Germany

The interplay and competition of superconducting and ferromagnetic ordering phenomena in thin film structures has attracted considerable attention over the last decade. In particular, the control of spin current transport properties in superconductors offer promising new possibilities in the field of spintronics. We here investigate the injection of quasiparticle spin currents into superconductors by spin pumping from an adjacent ferromagnetic layer. To this end, $NbN/Co_{25}Fe_{75}$ heterostructures are grown by reactive DC-sputtering under ultra-high vacuum conditions. For the broadband spin pumping experiments we excite the ferromagnetic resonance in the $Co_{25}Fe_{75}$ layer by placing the samples onto a coplanar waveguide. We study the spin pumping induced magnetization damping as function of temperature, especially in vicinity of the NbN superconducting transition temperature. A phase sensitive detection of the microwave transmission signal cite is used to quantitatively extract the inductive coupling strength and spin current transport in our heterostructures. We find that the inductive coupling strength is strongly influenced by the superconducting transition. In addition, we compare our results to theoretical models.

MA 51.47 Thu 15:00 Poster C

Effect of interlayer insertion on spin pumping in $Co_{40}Fe_{40}B_{20}$/X/Pt heterostructures — •Matthias Reinhard Schweizer[1], Sascha Keller[1], Evangelos Papaioannou[1], Simon Häuser[1], Moritz Hofherr[1,2], Benjamin Stadtmüller[1,2], Martin Aeschlimann[1], Burkard Hillebrands[1], and Andrés Conca[1] — [1]FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, Germany — [2]Graduate School Materials Science in Mainz, Mainz, Germany

In many spin pumping experiments, Pt is used to detect a spin current indirectly via the inverse spin Hall effect (ISHE). However, Pt has been shown to also exhibit the magnetic proximity effect (MPE), which could have a substantial impact on the interface transparency and damping parameter. In this work, we investigate the $Co_{40}Fe_{40}B_{20}$/X/Pt multilayer system (X=Al,Ta,Cr) with varying thicknesses. Direct contact between $Co_{40}Fe_{40}B_{20}$ and Pt induces MPE in Pt. In this case, even a thin NM spacing layer is expected to suppress the MPE completely. We present VNA-FMR data on these systems and angle-resolved rectification voltage measurements, where anisotropic magnetoresistance (AMR) and the anomalous Hall effect signals are separated from the ISHE signal. We find that the formation of FM Pt gives rise to a strong AMR signal, but does not have a significant influence on the induced spin current. The existence of magnetic moments in Pt is verified my means of element sensitive measurements with pulses from high-harmonic generation. Support by M-era.Net, HEUMEM and SFB/TRR 173 SPIN+X is acknowledged.

MA 51.48 Thu 15:00 Poster C

Theory of antiferromagnetic resonance in Cu(en)(H2O)2SO4. — •Jaroslav Chovan[1,2] and Dominik Legut[1] — [1]IT4Innovations National Supercomputing Center VSB - Technical University Ostrava, CZ 708 33 Ostrava, Czech Republic — [2]Department of Physics, Matej Bel University, Banska Bystrica, Slovakia

Cu(en)(H2O)2SO4 is a quasi-two-dimensional antiferromagnet that orders below 0.9 K. Its magnetic anisotropy was thought to be easy-plane. However, recent experimental and theoretical study suggested the existence of the easy-axis within the easy-plane, and confirmed its existence via the observation of a spin-flop transition in the field applied along the b-axis. Thus the system should display two magnon modes. Follow-up AFMR study confirmed this picture, but also observed additional weak splitting of the two magnon modes, attributed to weak interplane coupling. Here we show theoretically that the interplane coupling - whether in the simple isotropic, or the most general anisotropic form - does not explain this splitting. In particular, the symmetry allowed coupling leads to four magnon modes, but two of them do not couple to the rf-field and should not be observed. We discuss the possible explanation.

MA 51.49 Thu 15:00 Poster C

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MA 51.50 Thu 15:00 Poster C

Field-induced anomalous Hall effect in 2D transition metal dichalcogenides — •Franz Fischer[1], Nicki F. Hinsche[1], and Ingrid Mertig[1,2] — [1]Martin Luther University Halle-Wittenberg , Institute of Physics, 06099 Halle/S., Germany — [2]Max Planck Institute of Microstructure Physics, 06120 Halle/S., Germany

Atomically thin layers of transition metal dichalcogenides (TMDC) attract remarkable interest due to their extraordinary electronic and optical properties. Their inherent crystal structure lacks inversion symmetry and therefore enables an extra valley degree of freedom in addition to charge and spin. Combining heavy metal atoms and chalcogenes results in strong spin-orbit interaction. The latter gives rise to large spin splittings in the Brillouin zone (BZ), leading to presumably large Berry curvature in those valleys. A consequence of the momentum-locked Berry curvature is the valley Hall effect, which can be validated via photo-optical experiments.

We are extending these concepts by gaining access to a net Berry curvature in the BZ as we tune the electronic band structure via applying electrical and magnetic fields. The latter entails time and spatial symmetry breaking, that allows us to induce spin-polarized currents and the realization of an anomalous Hall effect (AHE). We report on theoretical calculations based on a tight-binding model, for several TMDCs, e.g. MoS_2. In dependency on various parameters the evolution of the Berry curvature and with that the AHE is discussed. Our results will give a leap forward on new spin- and valleytronic devices incorporating TMDC/ferromagnet/ferroelectric interfaces.

MA 51.51 Thu 15:00 Poster C

Brillouin zone unfolding: Recovering information from supercell transmission maps — Michael Czerner, •Jonas F. Schäfer, Felix Scholler, and Christian Heiliger — Institut für Theoretische Physik, JLU Giessen

In order to accurately describe transport through tunnel barriers, it is often required to take perturbations into account. These could be chemical disorder, lattice defects, but also non-collinear magnetic structures in a ferromagnetic background. Within the NEGF formalism, which is implemented in our KKR code, it is possible to incorporate such effects using CPA with vertex corrections . However, it is sometimes more appropriate to describe the defect structure using supercells. In order to get a deeper insight into the underlying transport mechanism, it is often helpful to see k-resolved transmission maps. This method is not applicable for supercells, since here the information is contained in a much smaller BZ. To solve this issue we unfold the transmission into the specular and diffusive contribution, with a separate diffusive distribution map for each lead. This allows us to identify the relevant electronic states on both sides of the barrier even for k-scattering transport. As an example we take a look at a skyrmion in a thin magnetic iron layer adjacent to an MgO barrier. In this structure, the skyrmion may increase transport by allowing k-scattering to the Gamma-point.

MA 51.52 Thu 15:00 Poster C

Theoretical analysis of electronic states at the interface between MgO and nonmagnetic metals — •Ather Ahmad, Philipp Risius, Michael Czerner, and Christian Heiliger — Institut für theoretische Physik, Justus-Liebig-Universität Gießen, Gießen

A number of nonmagnetic metals may be grown epitaxially on magnesium oxide (MgO). In combination with a ferromagnetic material, semimagnetic tunnel junctions (SMTJ) can be constructed. These tunnel junctions may show tunnelling anisotropic magnetoresistance (TAMR), where the electronic transmission varies with the magnetization direction of the ferromagnetic layer. TAMR, which exploits the spin-orbit coupling at the ferromagnet-MgO interface, is a valuable tool for examining phenomena such as spin torque [1]. To find promising combinations of materials for MgO-based SMTJs, we calcu-

late the Bloch spectral function (BSF) at the interfaces of MgO with various nonmagnetic metals. These BSFs can be compared to the BSF at ferromagnet-MgO interfaces to predict the electronic transmission of an SMTJ combining the two materials. We show that the transmission across an SMTJ can indeed be predicted from the combination of the interfaces' BSFs. Comparing the BSF of ferromagnet-MgO- and nonmagnet-MgO interfaces could thus help find nonmagnetic metals which provide a sizeable TAMR, enabling further studies.

[1] S. Miwa, J. Fujimoto, P. Risius, K. Nawaoka, M. Goto, and Y. Suzuki. "Strong Bias Effect on Voltage-Driven Torque at Epitaxial Fe-MgO Interface". *Physical Review X* **7**(3), 031018 (2017).

MA 51.53 Thu 15:00 Poster C

Fluctuation spectroscopy of the ferromagnetic semiconductor $HgCr_2Se_4$ — •Merlin Mitschek[1], Shuai Yang[2], Yongqing Li[2], and Jens Müller[1] — [1]Physikalisches Institut, Goethe-Universität, Frankfurt am Main, Germany — [2]Institue of Physics, Chinese Academy of Sciences, Beijing, China

$HgCr_2Se_4$ has been well known for several years as a member of the spinel family where one can observe the colossal magnetoresistance (CMR) effect, a field of research that expanded the knowledge of electron correlations, phase transitions and magnetism. The complexity of the physics behind the CMR makes it desirable to study a preferably simple system, where the relevant degrees of freedom, including spin, charge, orbital, and lattice, along with disorder and strong electron correlations are less intertwined as, e.g., for the mixed-valence perovskite manganites. This is true for the model system EuB_6 [1], and also for $HgCr_2Se_4$, which exhibits MR ratios of up to five orders of magnitude [2]. The phase transition from the paramagnetic to the ferromagnetic phase coincides with an insulator-metal transition at $T_C \approx 105\,\mathrm{K}$. Strikingly, the CMR effect is most pronounced when spin correlations between superexchange-coupled Cr^{3+} are significant. As a powerful probe to test possible scenarios for explaining the CMR effect, we employ fluctuation (noise) spectroscopy [1]. We analyze and discuss the observed generic $1/f$-type noise below the transition, which is superimposed by distinct two-level fluctuations above T_C, in terms of a model of percolating magnetic polarons.

[1] Phys. Rev. B 94, 224404,(2016). [2] Phys. Rev. B 86, 184425, (2012).

MA 51.54 Thu 15:00 Poster C

Comparative investigation of the magnetic proximity effect by XRMR and XMCD and the influence of patterning — •Dominik Graulich[1], Jan Krieft[1], Anastasiia Moskaltsova[1], Tristan Matalla-Wagner[1], Tobias Pohlmann[2,3], Joachim Wollschläger[2], Sonia Francoual[3], and Timo Kuschel[1] — [1]Center for Spineletronic Materials and Devices, Bielefeld University, Germany — [2]Center of Physics and Chemistry of New Materials, Osnabrück University, Germany — [3]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

X-ray resonant magnetic reflectivity (XRMR) is a very sensitive technique to detect the proximity-induced spin polarization in heterostructures of the heavy metal Pt in contact to ferromagnetic (FM) materials [1]. This synchrotron-based reflectivity technique is directly sensitive to the interfacial spin polarization, which makes it independent of the total Pt thickness in contrast to more common x-ray magnetic circular dichroism (XMCD) measurements. In addition, the XRMR analysis provides information on the spin depth profile of the induced spin polarization. In this study, we quantitatively compare the results of the XRMR and XMCD analysis for different Pt/FM bilayers. Furthermore, the influence of patterning the samples on the XRMR and XMCD results as well as on the validity of the current analysis procedure are investigated to explore non-equilibrium spin polarizations by XRMR in future work.

[1] T. Kuschel et al., Phys. Rev. Lett. 115, 097401 (2015)

MA 51.55 Thu 15:00 Poster C

Spin Seebeck, proximity-induced, and ferromagnetic-induced anomalous Nernst Effect in Pt/ferromagnet bilayers — •Oliver Ritter, Tobias Peters, Jan Krieft, Panagiota Bougiatioti, and Timo Kuschel — Center for Spinelectronic Materials and Devices, Bielefeld University, Germany

The generation, manipulation and detection of spin currents has recently been extensively studied. Spincaloritronic effects such as the spin Seebeck effect (SSE) enable the generation of spin currents in ferro(i)magnetic metals (FMM) and insulators (FMI) by applying a temperature gradient. Usually normal paramagnetic metals, such as Pt on top of the ferromagnet are used to detect spin currents via the inverse spin Hall effect. Using Pt as a spin detector can cause a spin polarization of the Pt at the Pt/FMM Interface due to the magnetic proximity effect (MPE). As a result of the MPE, a proximity-induced ANE can occure. In case of studying FMMs, the ferromagnetic-induced ANE can additionally contribute to the SSE signal [1].

In this work, we investigated different Pt/FMM and Pt/FMI bilayers concerning their SSE and ANE contributions. For the FMI samples the measured signal only consists of the SSE response. In case of Pt/FMM bilayers, different ANE contributions arise as discussed in this presentation.

[1] P. Bougiatioti et al., Phys. Rev. Lett. 119, 227205 (2017)

MA 51.56 Thu 15:00 Poster C

Enhancement of the spin Seebeck effect in lattice matched $NiFe_2O_4$ thin films — •Tobias Peters[1], Ankur Rastogi[2], Zhong Li[2], Amit Vikam Singh[2], Arunava Gupta[2], Panagiota Bougiatioti[1], Günter Reiss[1], and Timo Kuschel[1] — [1]Center for Spinelectronic Materials and Devices, University of Bielefeld, Germany — [2]MINT Center, University of Alabama, USA

We investigated the spin Seebeck effect (SSE) in Pt/$NiFe_2O_4$ films and studied the influence of thickness and film quality. Therefore, nickel ferrite (NFO) has been deposited in various thicknesses ranging from 50 nm to 1 μm on different substrates $MgAl_2O_4$ (MAO), $MgGa_2O_4$ (MGO) and $CoGa_2O_4$ (CGO) using pulsed laser deposition. These substrates present various lattice mismatches with respect to NFO ranging from 3.2 % for MAO to 0.2 % for CGO [1]. SSE measurements have been performed to investigate the influence of NFO-thickness and lattice mismatch, possibly accompanied by lattice defects and strain, on the magnon transport. For these measurements systematic errors could be eliminated via the normalization of the SSE driven electrical field to the applied heat flux instead to the temperature difference [2]. For the MGO- and CGO-samples we consistently found larger SSE signals compared to the MAO-samples, which could be connected to the lower lattice mismatch. Furthermore, magnon propagation lengths in the range of 100 nm to 1 μm have been determined, with the largest value attributed to NFO/MGO.

[1] A. V. Singh et al., Adv. Mater. 29, 1701222 (2017)
[2] A. Sola et al., Sci. Rep. 7, 46752 (2017)

MA 51.57 Thu 15:00 Poster C

Spin Seebeck effect in ultra-thin gadolinium iron garnet films — •Maxim Dietlein[1,2], Stephan Geprägs[1], and Rudolf Gross[1,2,3] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany — [2]Fakultät für Physik, Technische Universität München, Garching, Germany — [3]Nanosystems Initiative Munich, München, Germany

The generation of a spin current in a magnetic material as a result of a temperature gradient known as spin Seebeck effect (SSE) has triggered intense research in the field of spin caloritronics. Recently, it has been demonstrated that the SSE is sensitive to the complexity of the magnon dispersion relation and can therefore be used as a probe for magnon properties in complex magnets [1]. In magnetically compensated ferrimagnetic insulator $Gd_3Fe_5O_{12}$ (GdIG) | heavy metal (Pt) heterostructures, the temperature dependence of the SSE amplitude shows two sign changes. One sign change is caused by the reversal of the sublattice magnetizations at the magnetic compensation temperature of GdIG, while the second sign change arises from the superposition of two main magnon modes with opposite chirality. We here discuss the temperature dependence of the SSE signal in ultra-thin epitaxial GdIG|Pt heterostructures on $Y_3Al_5O_{12}$ (YAG) substrates. We show that the temperature of both SSE sign changes as well as the SSE amplitude in GdIG|Pt heterostructures are highly sensitive to the thickness of the GdIG thin film. With this, we are able to draw conclusion on the magnon dispersion in ultra-thin GdIG films. [1] S. Geprägs *et al.*, Nature Comm. 7, 10452 (2016).

MA 51.58 Thu 15:00 Poster C

Vertical spin valves using the novel two-dimensional material $FeGe_2$ — •Dietmar Czubak, Samuel Gaucher, Jens Herfort, Holger T. Grahn, and Manfred Ramsteiner — Paul-Drude-Institut für Festkörperelektronik, Leibniz-Institutim Forschungsverbund Berlin e. V., Hausvogteiplatz 5–7, 10117 Berlin, Germany

The formation of $FeGe_2$ in a layered tetragonal structure has been recently achieved by solid-phase epitaxy of Ge on Fe_3Si. This two-dimensional (2D) polymorph of $FeGe_2$ does not exist in bulk form and appears to be a promising material for spintronic applications.

We investigate vertical spin valve structures based on this novel 2D material as an intermediate layer between the two Heusler alloy films Fe_3Si (bottom) and Co_2FeSi (top). At room temperature, these spin valves exhibit a magnetoresistance effect of around 0.1 % originating from the switching between the parallel and antiparallel magnetization configurations of the Fe_3Si and Co_2FeSi layers. A decrease of the operating temperature leads to a reduced magnetoresistance effect due to a phase change in the $FeGe_2$ layer from a non-magnetic into the ferromagnetic state. At cryogenic temperatures, the magnetoresistance value depends in a complex manner on the sample orientation relative to the external in-plane magnetic field. Two spin valve-like signals appear with opposite signs for particular orientations. The analysis of the observed anisotropic behavior allows for the extraction of information on the magnetization behavior of the $FeGe_2$ film sandwiched between two ferromagnetic Heusler alloy films.

MA 51.59 Thu 15:00 Poster C

Reduction of dead layer in $La_{0.7}Sr_{0.3}MnO_3$ at the $(SrO)_2$ buffered interface with $SrTiO_3$ — •Vitaly Bruchmann-Bamberg[1], Alexandr Belenchuk[2], Yury Khaydukov[3,4], Vladimir Roddatis[5], and Vasily Moshnyaga[1] — [1]I. Physik. Inst., G.-A.-Universität Göttingen, Friedrich-Hund-Pl. 1, 37077 Göttingen — [2]IIEN, Academy of Sciences of Moldova, str. Academiei 3/3, MD-2028 Kishinev, Republic of Moldova — [3]Max Planck Institute for Solid State Research, 70569 Stuttgart — [4]Max Planck Society Outstation at the Heinz Maier-Leibnitz Zentrum (MLZ), 85748 Garching — [5]Institut für Materialphysik, G.-A.-Universität Göttingen, Friedrich-Hund-Pl. 1, 37077 Göttingen

Magnetic tunnel junctions (MTJ) formed of $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) and $SrTiO_3$ (STO) show very large tunneling magnetorisistance at low temperatures [1]. However, the TMR effect is negligible at room temperature due to the presence of magnetic "dead" layers at the interfaces.

The LSMO/STO and LSMO/$(SrO)_2$/STO (Ruddlesden-Popper buffered) superlattices and ultrathin films were grown by means of metalorganic aerosol deposition technique and studied by polarized neutron reflectometry. A reduction of the dead layer was found at the buffered LSMO interfaces in contrast to the unbuffered LSMO at room temperature. An improvement of the MTJ performance of the LSMO-$(SrO)_2$-STO heterostructures is expected.

We gratefully acknowledge the financial support provided by the DFG within the SFB 1073 and the FRM II at the MLZ Garching.

[1] Werner, R. et al., Applied Physics Letters 98, 162505 (2011)

MA 51.60 Thu 15:00 Poster C

Spatially resolved observation of helicity dependent switching by PEEM — •Nina Novakovic[1], Mohamad A. Mawass[1], Alexander Steigert[1], Oleksii Volkov[2], Denys Makarov[2], and Florian Kronast[1] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie, 12489, Berlin, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf e. V., Institute of Ion Beam Physics and Materials Research, 01328 Dresden, Germany

Controlling the magnetization by light as opposed to magnetic fields has appeared as a promising alternative to current magnetic data storage technologies as it may lead to faster and denser memory devices. It has been shown that circularly polarized femtosecond laser pulse can switch the magnetization of a thin film as function of laser helicity. Such effect is known as all-optical helicity dependent switching (AO-HDS).

We combine excitation by a diffraction limited laser spot with photoelectron emission microscopy to study AO-HDS on *m to nm length scale. Imaging the magnetic state before, during and after excitations by an ultrafast laser pulse allows us to observe helicity and relaxation driven effects. We will demonstrate all-optical switching in various systems from FeTb ferrimagnetic films to CoPt multilayers and discuss novel effects such as a thickness dependent inversion of the driven direction of AO-HDS. The research was done at the UE49PGMa beamline at BESSY II Synchrotron facility at Helmholtz-Zentrum Berlin using the SPEEM station.

MA 51.61 Thu 15:00 Poster C

2D Maps of Laser Induced Photocurrents in Ferromagnet-Topological Insulator Heterostructures — •Tobias Kleinke[1], Thomas Schumann[1], Nina Meyer[1], Gregor Mussler[2], Eva Schmoranzerová[3], Petr Němec[3], Helena Reichlová[4], Tobias Kampfrath[5], Christian Heiliger[6], and Markus Münzenberg[1] — [1]Physikalisches Institut, Universität Greifswald, Germany — [2]Peter Grünberg Institute (PGI-9), Forschungszentrum Juelich, Germany — [3]MFF, Charles University, Prague, Czech Republic — [4]FZU, Prague, Czech Republic — [5]FHI Berlin, Germany — [6]University of Gießen, Germany

Topological insulators provide theoretically dissipationless and 100 % spin polarized conduction channels for electrons. This property make them appealing for spintronic applications.[1] We will present 2D polarization dependend maps of laser induced photocurrents with fixed applied external magnetic field of +/- 30 mT. The sample consists of a topological insulator rectangle with a small 3 nm thick CoFeB rectangle on top. For the edges of the ferromagnet we found a lateral accumulation of spin polarization due to the spin Nernst effect. [2] We can also show that the spin-polarized current is dependend of the direction of the magnetization.

[1] C. L. Kane, E. L. Mele, Phys. Rev. Lett. 95, 146802 (2005)
[2] T. Schumann et al., arXiv:1810.12799

MA 51.62 Thu 15:00 Poster C

Dynamic control of cavity-magnon coupling — •Tim Wolz[1], Alexander Stehli[1], Andre Schneider[1], Isabella Boventer[2], Sergey Danilin[1], Alexey V. Ustinov[1,3], Mathias Kläui[2], and Martin Weides[1,4] — [1]Karlsruhe Insitute of Technology, Karlsruhe, Germany — [2]Johannes Gutenberg University, Mainz, Germany — [3]National University of Science and Technology MISIS, Moscow, Russia — [4]University of Glasgow, United Kingdom

Cavity-magnon-polaritons are hybrid modes consisting of magnon and photon excitations and are expected to pave ways for novel microwave technology based on magnon Rabi oscillations [1]. Static and dynamic control of the coupling strength between these two quasi-particles is imperative for future devices. Such a control is realized with an additional drive tone directly applied to the magnon. Depending on the relative phase and amplitude ratio between the two tones, the coupling strength can be reduced and turned off [2,3]. In our work, as the next step, we are implementing a dynamic control of the coupling on time scales similar to the inverse of the coupling strength. Using a heterodyne detection setup with single-sideband mixing, we are able to apply independent control pulses to magnon and cavity while recording the time resolved cavity response. For instance, for phase and amplitude matched excitations to magnon and cavity, both oscillators will "swing" in-phase and no energy exchange will take place, similarly to coupled mechanical pendula. Stopping one oscillator with another pulse will start the magnon Rabi oscillations again. [1] Zhang et al., PRL (2014); [2] Grigoryan et al., PRB (2018); [3] Boventer et al., in preparation

MA 51.63 Thu 15:00 Poster C

Structural and magnetic properties of hexagonal Mn_3X (X = Ga, Sn) thin films — •Philipp Zilske[1], Samer Kurdi[2], Jungwoo Koo[1], and Günter Reiss[1] — [1]Center for Spinelectronic Materials and Devices, Department of Physics, Bielefeld University, Germany — [2]Department of Materials Science and Metallurgy, University of Cambridge, United Kingdom

In the last decade, antiferromagnetic spintronics has established as an important field for future magnetic memory or logic [1]. Recently, $D0_{19}$ ε-Mn_3Y (Y = Ga, Ge, Sn) systems have emerged as new candidates for an active element in such systems. Theoretical calculations and first experimental results show large anomalous Hall and anomalous Nernst effects for those non-collinear antiferromagnets. However, these properties are only studied in detail for single crystalline bulk samples [2-4].

Here, we report on structural and magnetic properties of Mn_3X (X = Ga, Sn) thin films. Epitaxial Ru/Mn_3X films were grown on Al_2O_3 (0001) substrates via magnetron co-sputtering. For detailed structural analysis, we performed X-ray diffraction measurements and atomic force as well as transmission electron microscopy. Furthermore, the magnetic and transport properties of optimized samples will be discussed.

[1] T. Jungwirth et al., Nature Nanotech. 11, 231 (2016)
[2] Y. Zhang et al., Phys. Rev. B 95, 075128 (2017)
[3] S. Nakatsuji et al., Nature 527, 212 (2015)
[4] N. Kiyohara et al., Phys. Rev. Appl. 5, 064009 (2016)

MA 51.64 Thu 15:00 Poster C

Ab initio calculation of the magneto-optical Kerr effect in transition metal alloys — •Andreas Held[1], Ján Minár[2], and Hubert Ebert[1] — [1]Department Chemie, Ludwig-Maximilians-Universität München — [2]New Technologies-Research Center, University of West Bohemia, Pilsen

The magneto-optical Kerr effect (MOKE) is by now a well-established tool for investigating the properties of magnetic systems. Originating from the subtle interplay between magnetic order and spin-orbit coupling, a proper theoretical description of MOKE requires an appropriate framework. We included a calculation scheme based on the work of Huhne [1] into our fully relativistic spin-polarized Korringa-Kohn-Rostoker code that allows us to investigate both ordered and substitutionally disordered systems by means of the coherent potential approximation (CPA). With our code package we have access to the full optical conductivity tensor and this way to the complex Kerr angle. We present studies on Fe_xCo_{1-x} and Co_xPt_{1-x} in the full concentration range of these alloys. Manipulating the strength of the spin-orbit coupling further enabled us to investigate its impact on the MOKE in these alloys.

[1] T. Huhne, H. Ebert, *Phys. Rev. B* **60**, 12982 (1999); T. Huhne, H. Ebert, *Phys. Stat. Sol. B* **215**, 839 (1999)

MA 51.65 Thu 15:00 Poster C

Atom-by-atom engineering of associative memories in finite size spin systems — Alex Kolmus[1], Mikhail Katsnelson[2], •Alexander Khajetoorians[2], and Hilbert Kappen[1] — [1]Donders Institute for Neuroscience, Nijmegen, The Netherlands — [2]Institute for Molecules and Materials, Nijmegen, The Netherlands

We demonstrate that a two-dimensional finite and periodic array of spins coupled via RKKY-like exchange can exhibit tunable magnetic phases ranging from robust double well potentials, multi-well attractor potentials, towards spin glass-like landscapes. These magnetic phases can be tuned by one gate-like parameter, namely the ratio between the lattice constant and the long-range interaction wavelength. We characterize theoretically the various magnetic phases, quantifying the distribution of low energy states, aging relaxation dynamics, and scaling behavior. The glassy and multi-well behaviors result from the competing character of RKKY interactions at different distances, no disorder is assumed. The multi-well structure features multiple attractors, each with a sizable basin of attraction, which are the requirement for associative memory. We show that by embedding the atom array in a bi-associative memory, we obtain a learnable associative memory system.

MA 51.66 Thu 15:00 Poster C

Local magnetic properties and couplings of $Co_{2-x}Mn_xB$: A ^{59}Co and ^{55}Mn zero field NMR study — •P. Fritsch[1], F. Hammerath[1], S. Ener[2], M. Fires[2], I. Opahle[2], E. Simon[2,3], S. Wurmehl[1,4], H. Zhang[2], and O. Gutfleisch[2,5] — [1]Leibniz Institute for Solid State Research IFW, Dresden, Germany — [2]Department of Material Science, Technische Universität Darmstadt, Darmstadt, Germany — [3]Department of Theoretical Physics, Budapest University of Technology and Economics, Budapest, Hungary — [4]Institute for Solid State Physics, Technische Universität Dresden, Dresden, Germany — [5]Fraunhofer-Projektgruppe für Wertstoffkreisläufe und Ressourcenstratgie IWKS, Hanau, Germany

Co_2B and its substitution variants show a magnetovolume effect around T_C, which is promising for magnetocaloric applications and the generation of thermomagnetic power. A series of $Co_{2-x}Mn_xB$ alloys was synthesized and the macroscopic magnetic properties were investigated. An anomalous behaviour of spontaneous magnetization and T_C with increasing Mn content as a result of competing exchange interactions. Zero field Nuclear Magnetic Resonance spectroscopy (NMR) was measured for ^{59}Co and ^{55}Mn nuclei to determine the element specific magnetic moments supported by density functional theory (DFT) calculations. A mutual combination of experimental and theoretical methods reveals that the observed anomaly originates in complex magnetic coupling, as shown by the exchange interactions.

S. Ener et al., accepted by Acta Materialia (2018)

MA 51.67 Thu 15:00 Poster C

New PLY Molecules for Spintronics — •Neha Jha[1], Christian Denker[1], Anand Paryar[2], Pavan K. Vardhanapu[2], Heba Mohamad[1], Christiane Helm[1], Swadhin Mandal[2], and Markus Münzenberg[1] — [1]Institut für Physik, Universität Greifswald, Germany — [2]Department of Chemical Sciences, IISER, Kolkata, India

Phenalenyl (PLY) based molecules, which can be regarded as Graphene fragments are promising candidates for molecular spintronic applications due to their flexibility and low spin-orbit interaction. We investigate organic magnetic tunnel junctions (OMTJ) using a closed shell PLY molecule barrier with different metal complexes (Cu, Zinc). The voltage dependent current shows non-linear behavior and yields a magnetoresistance effect (MR). TR-MOKE measurements give an insight into the Co/Molecule interface properties. They show an enhancement of exchange interaction and a tunability of the Gilbert damping due to π-d hybridization at the interface compared to bare Co, providing evidence for spin pumping. This is important effect for the development of STT-MRAM devices and molecular-scale quantum spin memory.

[1] Sanvito, S. Molecular spintronics: "The rise of spinterface science", Nature Phys. 6, 562-564 (2010)

[2] K.V. Raman, "Interface-engineered templates for molecular spin memory devices". Nature, 509-513 (2013)

MA 51.68 Thu 15:00 Poster C

Theory of noncollinear interactions beyond Heisenberg exchange — •Attila Szilva[1], Danny Thonig[1], Pavel Bessarab[2], Yaroslav O. Kvashnin[1], Debora C. M. Rodrigues[3], Ramon C. Cardias[3], Manuel Pereiro[1], Lars Nordström[1], Anders Bergman[1], Anagela B. Klautau[3], and Olle Eriksson[4] — [1]Department of Physics and Astronomy, Division of Materials Theory, Uppsala University, Box 516, SE-75120 Uppsala, Sweden — [2]Science Institute of the University of Iceland, 107 Reykjavik, Iceland, Department of Nanophotonics and Metamaterials, ITMO University, 197101 St. Petersburg, Russia — [3]Department of Physics and Astronomy, Division of Materials Theory, Uppsala University, Box 516, SE-75120 Uppsala, Sweden, Faculdade de Física, Universidade Federal do Pará, Belém, 66075-110, Brazil — [4]Department of Physics and Astronomy, Division of Materials Theory, Uppsala University, Box 516, SE-75120 Uppsala, Sweden, School of Science and Technology, Örebro University, SE-701 82 Örebro, Sweden

We show for a simple noncollinear configuration of the atomistic spins (in particular, where one spin is rotated by a finite angle in a ferromagnetic background) that the pairwise energy variation computed in terms of multiple-scattering formalism cannot be fully mapped onto a bilinear Heisenberg spin model even in the absence of spin-orbit coupling. An Eg T2g symmetry analysis based on the orbital decomposition of the exchange parameters in bcc Fe leads to the conclusion that the nearest-neighbor exchange parameters related to the T2g orbitals are essentially Heisenberg-like.

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Magnetic ordering and spin dynamics in the honeycomb lattice compound InCu2/3V1/3O3 — •Margarita Iakovleva[1,2], Hans-Joachim Grafe[1], Angela Möller[3], T. Taetz[4], Evgeniia Vavilova[2], Bernd Büchner[1], and Vladislav Kataev[1] — [1]IFW Dresden, Dresden, 01069, Germany — [2]KPhTI, Kazan, 420029, Russia — [3]IAAC, JGU Mainz, Mainz, 55128, Germany — [4]Institut für Anorganische Chemie, Universität zu Köln, Köln, 50939, Germany

We report Nuclear Quadrupole Resonance (NQR) investigation of the $S = 1/2$ quasi-two-dimensional (2D) honeycomb lattice antiferromagnet $InCu_{2/3}V_{1/3}O_3$. Previous studies on this compound have revealed signatures of an antiferromagnetic transition at $T_N = 38\,K$ [1,2], though the nature of the magnetic ground state still remains an open question. In the NQR experiment the ^{115}In spectra exhibit a line splitting at $T < T_N$ signaling the development of local magnetic fields in the vicinity of a magnetic phase transition. The T-dependence of the longitudinal nuclear relaxation rate T_1^{-1} shows a characteristic sharp peak upon approaching T_N=38 K, which we associate with 2D magnetic order. Remarkably, with further decreasing temperature a second, much broader peak develops at $T^* = 15\,K$ suggesting rearrangement of the magnetic state. We discuss this peculiar feature and possible scenarios of magnetic order in $InCu_{2/3}V_{1/3}O_3$.

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MA 51.70 Thu 15:00 Poster C

Competing orders of spin-orbit entangled j=1/2 moments in frustrated fcc magnets — •Dominik Kiese[1], Finn Lasse Buessen[1], Jan Attig[1], Arun Paramekanti[2], and Simon Trebst[1] — [1]Institute for Theoretical Physics, University of Cologne, Germany — [2]Department of Physics, University of Toronto, Canada

The interplay of spin-orbit coupling, crystal field effects, and electronic correlations in 4d and 5d materials can give rise to Mott insulators with local spin-orbit entangled j=1/2 moments. Motivated by the recent synthesis of the double perovskite Ba2CeIrO6, we have explored the physics of j=1/2 moments on the fcc lattice subject to both geometric and exchange frustration. Using a pseudo-fermion functional RG approach(pf-FRG), we have identified an extensive phase diagram of competing magnetically ordered and spin liquid states. Exploring

thermodynamic signatures such as the Curie-Weiss temperature and magnetic ordering transition, we can not only quantify the amount of frustration in this model system, but can also connect back to a number of experimental measurements of the actual material.