MA 52: Poster II

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

MA 52.1 Thu 15:00 Poster C

Time-resolved Raman scattering in exotic magnetic materials — •Rolf B. Versteeg[1], Anuja Sahasrabudhe[1], Jingyi Zhu[1], Christoph Boguschewski[1], Petra Becker[2], and Paul H.M. van Loosdrecht[1] — [1]II. Physikalisches Institut, Universität zu Köln, Zülpicher Straße 77, D-50937 Köln, Deutschland — [2]Abteilung Kristallographie, Institut für Geologie und Mineralogie, Universität zu Köln, Greinstraße 77, D-50937 Köln, Deutschland

Magnetic materials show fascinating physical phenomena when brought out of their thermal equilibrium state. Many of these phenomena show a large potential towards applications. For strongly perturbed magnetic systems, these phenomena include magnetization reversal, non-thermal ultrafast magnetization recording, and the creation of metastable light-induced states. Closer to equilibrium non-thermal states can provide insight into energy and angular momentum transfer between the lattice, electronic, orbital and magnetic degrees of freedom. A less common technique to study magnetization dynamics is presented: time-resolved spontaneous Raman scattering. This technique allows to simultaneously track transient changes in quasiparticle population, excitation energies, and optical constants related to the lattice and magnetic degrees of freedom. It thereby provides a unique way to study magnetization dynamics in exotic magnetic materials, such as the helimagnet Cu_2OSeO_3, or other net-zero magnetization materials like spin cycloids and antiferromagnets.

MA 52.2 Thu 15:00 Poster C

Layout of a new experiment to measure ultrafast spin dynamics — •Marc Terschanski, Fabian Mertens, Stefano Ponzoni, Davide Bossini, and Mirko Cinchetti — Experimentelle Physik 6, TU Dortmund, Otto-Hahn-Straße 4, 44227 Dortmund

In this contribution, we will present the layout of a newly-established experimental setup for the ultrafast manipulation of the magnetic order in solids. The setup is based on a turn-key amplified laser system with a repetition rate up to 1 MHz. This system has an output of 20 W and pulses with femtosecond duration. Using two optical parametric amplifiers it is possible to tune the photon energy of both the pump and probe beam independently from 0.5 eV to 3.5 eV. The sample is positioned on a cryostat in a superconducting magnet allowing to cool down to 4 K and apply strong DC-magnetic (9 T) and electric fields.

Investigating ultrafast spin dynamics by detecting magneto-optical effects demands to measure rotation or ellipticity of the probe polarization. In this regard designing and building a balanced detection scheme operating up to 1 MHz and able to integrate the signal of single-pulses is one of the major challenges. Therefore we will present the layout of the setup with special attention given to the home build detector.

MA 52.3 Thu 15:00 Poster C

Monte Carlo simulation of non-equilibrium spin dynamics — •Johan Briones, Sebastian Weber, Sanjay Ashok, and Baerbel Rethfeld — Department of Physics and Optimas Research Center, University of Kaiserslautern, Germany

The complex phenomenon arising after a magnetic film is excited by a femtosecond laser pulse is studied using a Monte Carlo trajectory simulation. In this stochastic model we will include not only spin-dependent scattering processes and spin-flip probabilities, but also the electron-electron interaction. The magnetization dynamics will be investigated by using a two-bands dynamic model and it will be first applied to the case of Nickel. The results of this simulation contain the time evolution of the electron number, their energy distribution, the energy dissipation and the quenching of the magnetization.

The long-term perspective of this project is to develop a model that can describe the non-equilibrium transport and its effect on magnetization dynamics.

MA 52.4 Thu 15:00 Poster C

Ultrafast demagnetization dynamics including spin and charge transport. — •Sanjay Ashok, Sebastian T. Weber, Johan Briones, and Baerbel Rethfeld — Fachbereich Physik and OPTIMAS Research Center, TU Kaiserslautern, Kaiserslautern, Germany.

Subpicosecond Demagnetization of ferromagnetic materials due to excitation with an ultrafast laser pulse was discovered by Beaurepaire et. al. in 1996 [1]. Understanding its mechanism is still an important problem in cutting edge physics due to its applicability in faster spintronic and magnetic data storage devices.

A recently proposed μT-model [2] traces the equilibration of chemical potentials and temperatures of spin-up and spin-down electrons seperately. Their dynamics is modelled using coupled transport equations. So far, ultrafast demagnetization using μT-model has been studied only in cases where the thickness of the sample is of the order of penetration depth (where transport can be neglected). Here, we study the space and time resolved dynamics in case of thicker samples including the transport and present preliminary results.

References:

[1] E. Beaurepaire, J.-C. Merle, A. Daunois and J.-Y. Bigot, Phys. Lett. 76, 4250 (1996).

[2] B. Y. Mueller and B. Rethfeld, Phys. Rev. B 90, 144420 (2014).

MA 52.5 Thu 15:00 Poster C

Element-selective investigation of femtosecond spin dynamics in NiPd magnetic alloys using extreme ultraviolet radiation — •Seung-gi Gang[1], Roman Adam[1], Moritz Plötzing[1], Moritz von Witzleben[1], Christian Weier[1], Umut Parlak[1], Daniel E. Bürgler[1], Jan Rusz[2], Pablo Maldonado[2], Peter M. Oppeneer[2], and Claus M. Schneider[1] — [1]Peter Grünberg Institut PGI-6, Research Centre Jülich, 52425, Jülich, Germany — [2]Department of Physics and Astronomy, Uppsala University, P.O. Box 516, SE-75120 Uppsala, Sweden

We studied the influence of spin-orbit coupling on femtosecond spin dynamics in NiPd alloys by optically pumping the system with infrared (1.55eV) laser pulses and subsequent recording of the transient resonant reflectivity using synchronized extreme ultraviolet light. The measurements were performed in the transversal magneto-optical Kerr effect geometry. The measurements with XUV light enables separate, but simultaneous detection of spin dynamics in the elemental subsystems with femtosecond time resolution. In static measurements, we measured an induced bipolar magnetic asymmetry of the Pd subsystem due to exchange coupling of the Pd subsystem to the ferromagnetic Ni subsystem. In dynamic measurements, we observed spin dynamics in $Ni_{0.5}Pd_{0.5}$ at both the Ni- and Pd-edges with element selectivity. Increasing the Pd concentration results in a shorter demagnetization time. Here, spin-flip scattering probability plays a critical role in the control of the demagnetization time. The observed behavior is ascribed to an increase of the Pd-mediated SOC in the system.

MA 52.6 Thu 15:00 Poster C

Electron-phonon scattering in Ni studied by temperature dependent RIXS. — •Artur Born, Régis Decker, Robby Büchner, Anette Pietzsch, and Alexander Föhlisch — Helmholtz Zentrum Berlin

In order to study electron-phonon interaction, we measured electron-phonon scattering rates in nickel, using temperature dependent Resonant Inelastic X-ray Scattering (RIXS). By exciting the electrons into the continuum, we created 2p core holes and observed the radiative decay from s and/or d orbitals. By changing the temperature, we created a controlled amount of phonons and got a direct access to the electron-phonon scattering rate in the valence band. We could observe a temperature dependent loss of intensity in the valence to p1/2 decay, which indicates an angular momentum transfer between the valence electrons and the lattice. The angular momentum transfer by electron-phonon scattering was proposed as a main channel for ultrafast spin dissipation, the so-called Elliott-Yafet (EY) scattering in order to explain ultrafast demagnetization processes [1]. In this study, we present a new approach to get access to the EY scattering only, and eliminate laser-induced components of the demagnetization process like super-diffusive spin transport or optical spin manipulations.

[1] B. Koopmans et.al. Explaining the paradoxical diversity of ultrafast laser-induced demagnetization. Nature Mat. 9, 259-265, (2009).

MA 52.7 Thu 15:00 Poster C

Resonant interaction of coherent magnons and phonons in a ferromagnetic nanograting — •Felix Godejohann[1], Alexey Scherbakov[1,2], Boris Glavin[3], Serhii Kukhtaruk[1,3], Mu Wang[4], Alexey Salasyuk[2], Alexey Danilov[1], Andrew

Rushforth[4], Polina Nekludova[5], Sergei Sokolov[5], Andrey Elistratov[6], Dimitri Yakovlev[1,2], Andrey Akimov[4], and Manfred Bayer[1,2] — [1]Exp. Phys. 2, TU Dortmund, Germany — [2]Ioffe Inst., RAS, St. Petersburg, Russia — [3]Dept. of Theo. Phys., V.E. Lashkaryov Inst. of Semiconductor Phys., Kyiv, Ukraine — [4]School of Phys. and Astronomy, Univ. of Nottingham, UK — [5]Inst. of Nanotech. of Microelectronics, RAS, Moscow, Russia — [6]All-Russia Research Inst. of Automatics, Moscow, Russia

We investigate the magneto-phonon interaction in a ferromagnetic nanograting produced by focused ion beam in a 100 nm $Fe_{0.81}Ga_{0.19}$ film. The nanograting with lateral period of 150 nm consists of parallel grooves of 40 nm depth and width milled along [110]-crystallographic direction. We perform magneto-optical time-resolved measurements in a conventional pump-probe scheme with micron spatial resolution: the femtosecond pump pulse excites the nanograting, while the probe pulse serves to detect coherent lattice and magnetic response in time domain. We observe interaction of the localized surface phonon mode at the frequency of 20 GHz and quantized magnon spectrum. By external magnetic field we tune a certain magnon mode to the resonance with coherent phonons to control its spectral amplitude and lifetime.

MA 52.8 Thu 15:00 Poster C

Magnetization dynamics in laser-excited alloys

— •Sebastian T. Weber, Sanjay Ashok, Johan Briones, and Baerbel Rethfeld — Department of Physics and Research Center Optimas, University of Kaiserslautern, Erwin Schroedinger-Strasse 46, 67663 Kaiserslautern, Germany

Irradiating ferromagnetic films with an ultrashort laser pulse leads to a quenching of the magnetization on a subpicosecond timescale [1]. With the help of a spin-resolved Boltzmann description, which allows to describe microscopic collision processes including spin-flips, we have identified the equilibration of chemical potentials of majority and minority electrons as a driving force for ultrafast magnetization dynamics [2].

Since the discovery of ultrafast demagnetization, a multitude of questions and challenges arised. One of the heavily discussed topics is the element-specific dynamics in exchange coupled ferromagnetic alloys [3]. We calculate the joint and partial density of states using DFT methods. The results are put into kinetic simulations [2] and temperature-based descriptions [4]. Here, we want to extend existing models, to trace the electron dynamics with spin-resolution and in dependence on the material in the alloy.

[1] E. Beaurepaire et al., PRL 76, 4250 (1996)
[2] B. Y. Mueller et al., PRL 111, 167204 (2013)
[3] S. Mathias et al., PNAS 109, 4792 (2012)
[4] B. Y. Mueller et al., PRB 90, 14420 (2014)

MA 52.9 Thu 15:00 Poster C

Development of an experimental setup for ultrafast imaging with high harmonics — •Michael Lohmann, Sergey Zayko, Ofer Kfir, and Claus Ropers — 4th Physical Institute - Solids and Nanostructures, University of Göttingen, 37077 Göttingen, Germany

High-harmonic generation (HHG) is a unique source for spatially resolved quantitative studies of nanoscale polarisation anisotropies [1] leading to high-resolution magneto-optical imaging using lensless techniques [2]. However ultrafast HHG imaging remains challenging.

Here, we present the development of a pump-probe setup to extend the capabilities of our HHG-microscope for comprehensive studies of ultrafast dynamics in nanostructured solids. Combining nanometer spatial with femtosecond temporal resolution, this instrument will provide for further insights into ultrafast processes in materials science, including ultrafast magnetism.

[1] Zayko *et al.*, Optica, **3**(3) (2016)
[2] Kfir and Zayko *et al.*, in press

MA 52.10 Thu 15:00 Poster C

No significant effect of spin-pumping in Fe/Ag/Pt heterostructures — •Paul Wendtland, Babli Bhagat, Michael Farle, and Florian M. Römer — Fakultät für Physik und Center for Nanointegration (CENIDE) Universität Duisburg-Essen

Goal of this experiment was to determine the influence of conductive capping layers on the magnetic damping in an Fe thin film.

We created an epitaxial 5 nm Fe film on GaAs(100) and performed in-situ multifrequency Ferromagnetic Resonance (FMR) measurements from 9-15 GHz in [110]-direction. The static properties were determined as well. The *same* film was then capped with increasing amounts of Ag (up to 25 nm) and finally Pt (4 nm), with FMR measurements conducted in between.

By fitting the FMR lines with a dyson-shape model, we determined the FMR linewidth with an accuracy of about 5 %. The resulting Gilbert damping factors are in the range of $((3.8 \ldots 4.1) \pm 0.3) \cdot 10^{-3}$ without a systematic capping dependence. Thus, contrary to theoretical predictions, no effect of spin-pumping was observed as the Gilbert damping factor did not change within the error bars. However, a frequency-independent linewidth increase of up to 80 % was observed.

MA 52.11 Thu 15:00 Poster C

Ferromagnetic Resonance measurements on ultrathin Yttrium-Iron-Garnet grown by LPE — •Ronny Thomas[1,2], Julia Osten[1], Tobias Schneider[1,2], Oleksii Surzhenko[3], Olav Hellwig[1,2], Jürgen Lindner[1], Kilian Lenz[1], and Carsten Dubs[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physic and Materials Research, Bautzner Landstraße 400, 01328 Dresden — [2]Technische Universität Chemnitz, Straße der Nationen 62, 09111 Chemnitz — [3]INNOVENT e.V. Technologieentwicklung, Prüssingstraße 27B, 07745 Jena

Yttrium-Iron-Garnet (YIG) is known to have one of the lowest Gilbert-damping parameter ($\alpha \sim 10^{-5}$) of all magnetic materials, making it interesting for spintronics and magnonics. One of the most promising application is to use spin-waves for data processing, faced with the problem of fabricating ultrathin YIG-films with the same magnetic properties as their bulk analogue.

Two different YIG-series, each with different thicknesses in the range of 10-80 nm were grown on (111) oriented GGG substrates by liquid phase epitaxy in lead oxide-boron oxide based high-temperature solutions. Using VNA-FMR we determine the anisotropy and damping parameters performing frequency-dependent measurements over a range of 1-40 GHz as well as angle-dependent measurements.

MA 52.12 Thu 15:00 Poster C

Magnetic Damping of normal metal/CoFe heterostructures — •Luis Flacke, Mathias Weiler, Matthias Althammer, Stephan Geprägs, and Rudolf Gross — Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany

The generation of high frequency from a dc-current is an important aspect in microwave technology. Such a generation can be achieved by driving auto-oscillations in a ferromagnet (FM) using a pure spin current generated by the spin Hall effect in an adjacent normal metal (NM) by a dc charge current drive. The required electrical current densities J to achieve auto-oscillations are still of the order of $10^7\,\mathrm{A\,cm^{-2}}$ [1]. A possible pathway to reduce J is to use materials with low intrinsic magnetic damping. To this end, we fabricated NM/FM/NM heterostructures by DC-sputtering using $Co_{25}Fe_{75}$ as the FM and Ta, Pt, Al as the NM and varying their respective deposition parameters and thicknesses. The magnetic properties of these multilayers were then investigated by broadband ferromagnetic resonance spectroscopy at room temperature. From these measurements we extracted the Gilbert damping parameter for all investigated multilayers. We discuss the obtained damping parameters with respect to contributions originating from spin pumping and intrinsic effects. Moreover, we show how our results can be employed to optimize auto-oscillations in such multilayerstructures based on the $Co_{25}Fe_{75}$ alloys.

[1] C. Stamm et al., Phys. Rev. Lett. **119**, 087203 (2017)

*Financial support via the Nanosystems Initiative Munich is gratefully acknowledged.

MA 52.13 Thu 15:00 Poster C

Optically Modified Spin Pumping — •Tanja Strusch, Babli Bhagat, Michael Farle, and Florian M. Römer — Fakultät für Physik und Center for Nanointegration (CENIDE) Universität Duisburg-Essen

We will present a setup in which we can determine the influence of non polarized and circular polarized light on the different damping mechanisms as a function of wavelength, polarization, helicity, intensity and angle between magnetization (M) and input direction of the polarized light.

Therefore we have a new setup in which it is possible to do multi-frequency Ferromagnetic Resonance (FMR) and Magneto-Optical Kerr Effect (MOKE) measurements simultaneously. The FMR setup is used with a microwave short-circuit and has a frequency range of 1 up to 40 GHz. In addition the setup enables us to do measurements with and without field modulation. The MOKE setup can be used at longitudinal and transversal geometry and one can measure from infrared to visible light by using different types of lasers.

By combining this two setups we will determine the interaction of Ferromagnetic Resonance with light of different polarization, helicity and wavelength.

MA 52.14 Thu 15:00 Poster C

Relaxation of a classical spin coupled to a conventional superconductor — •Cassian Plorin and Michael Potthoff — I. Institut für Theoretische Physik, Universität Hamburg

The effect of a superconducting substrate on the real-time dynamics of the local magnetic moment of an adatom is investigated numerically within a variant of the s-d exchange model. To this end, we solve the equations of motion for a classical spin, which is exchange-coupled to the local magnetic moment of a conduction-electron system. The electron system is given as a negative-U Hubbard model and treated by a mean-field decoupling. Its real-time dynamics is governed by a von-Neumann-type equation for the normal and for the anomalous blocks of the one-particle reduced density matrix.

We study the time dependence of the classical spin, of the electron spin density and of the local s-wave order parameter after a sudden flip of the direction of a magnetic field coupling to the spin. The spin relaxation and the alignment to the new field direction is found to be strongly U-dependent. Incomplete relaxation is observed when the superconducting gap exceeds a certain value. This effect is beyond a Landau-Lifschitz-Gilbert-type approach but can be understood on the level of linear-response theory in the exchange coupling. The feedback of the spin dynamics on the superconducting order parameter, however, is beyond linear-response theory.

MA 52.15 Thu 15:00 Poster C

Ab-initio analysis of longitudinal and transverse spin relaxation times of magnetic single adatoms: — •Julen Ibanez-Azpiroz[1], Manuel dos Santos Dias[2], Stefan Blugel[2], and Samir Lounis[2] — [1]Centro de Fisica de Materiales — [2]Forschungszentrum Jülich

We present a systematic *ab initio* investigation of the longitudinal and transverse spin relaxation times of magnetic single adatoms deposited on metallic substrates. Our analysis based on time-dependent density functional theory shows that the longitudinal time, $T_{\parallel}$, is of order femtosecond while the transverse time, $T_{\perp}$, is of order picosecond, i.e. $T_{\perp} \gg T_{\parallel}$. This comes as a consequence of the different energy scales of the corresponding processes: $T_{\parallel}$ involves spin-density excitations of order eV, while $T_{\perp}$ is governed by atomic spin-excitations of order meV. Comparison to available inelastic scanning tunneling spectroscopy $\mathrm{d}I/\mathrm{d}V$ experimental curves shows that the order of magnitude of $T_{\perp}$ agrees well with our results. Regarding $T_{\parallel}$, the time scale calculated here is several orders of magnitude faster than what has been measured up to now; we therefore propose that an ultrafast laser pulse measuring technique is required in order to access the ultrafast spin-dynamics described in this work.

MA 52.16 Thu 15:00 Poster C

Towards a complete first principles parameterisation of magnetic materials as input for atomistic spin dynamics simulations — •Mario Galante, Matthew O. A. Ellis, Alessandro Lunghi, and Stefano Sanvito — School of Physics, Trinity College Dublin, Ireland

Atomistic spin dynamics has proven to be an invaluable tool to investigate the behaviour of magnetic nanomaterials. It is based on a Heisenberg spin model, where the spin magnetic moment is localised to each atomic site and obeys the Landau-Lishfitz-Gilbert-like (LLG) equations of motion. The solution of such equations requires the knowledge of some material-dependent microscopic properties such as the interatomic exchange, the magnetic anisotropy and the Gilbert damping. In nanoscale systems strain and interfaces can greatly alter the electronic structure, hence input parameters from *ab-initio* are desirable since they can provide system-tailored and atom resolved information. Furthermore, methods based on density functional theory including spin orbit interactions are suitable to perform high-throughput calculations of such quantities. In this work we analyse the suitability of the recipes provided in Refs. [1,2] to calculate the magnetic anisotropy and the inter-atomic exchange parameters respectively, using our own implementation based on the SIESTA code [3]. We then discuss a new parameter-free method to estimate the Gilbert damping based on a finite difference solution of the Liouville equation. [1] Schmitt *et al*, J. Chem. Phys. 134, 194113 (2011) [2] Korotin *et al*, PRB 91, 224405 (2014) [3] Soler *et al*, J. Phys.: Cond. Mat. 14, 2745 (2002)

MA 52.17 Thu 15:00 Poster C

Electrical detection of internally pumped magnons — •Timo Noack, Vitaliy Vasyuchka, Dymitro Bozhko, Burkard Hillebrands, and Alexander Serga — TU Kaiserslautern, Fachbereich Physik and Landesforschungszentrum OPTIMAS, Germany

The method of parallel parametric pumping is a widely used method for the generation of dence groups of magnons with well defined wavevectors and frequencies. In the process of four-magnon scattering these magnons thermalize in a wide range of energy-momentum spin-wave spectrum. As well, Bose-Einstein condensation of the thermalized magnons is possible at the lowest energy state. In this contribution we show an impact of parametrically pumped, thermalized, and condensed magnons on the electrical detection of spin currents in yttrium iron garnet/platinum bilayers. Therefore, spin pumping magnitude was time dependent measured using the inverse Spin Hall effect (ISHE). In ISHE waveforms an enhancement in the voltage amplitude is observed after the external pumping pulse is switched off. This enhancement is understood as a result of the excitation of secondary magnons at the YIG/Pt interface in the process of nonlinear thermalization of freely evolving parametric magnons. Financial support from the Deutsche Forschungsgemeinschaft in the frame of SFB/TR 49 is acknowledged.

MA 52.18 Thu 15:00 Poster C

Material selection for spin-transfer-torque magnetic random access memories — •Emanuele Bosoni and Stefano Sanvito — School of Physics and CRANN, Trinity College Dublin, College Green, Dublin 2, Ireland

The sensitive element in a Spin-Transfer-Torque Magnetic Random Access Memory (STT-MRAM) is formed by two ferromagnetic layers sandwiching an insulator acting as a tunnel barrier. At present the state-of-the-art materials set for the STT-MRAM technology is CoFeB/MgO, but it is not clear whether further improvement over this will be possible. Fundamental research is then needed to design new efficient junctions and, in this respect, *ab-initio* simulations offer a powerful tool to carry out a systematic study.

In this contribution we describe a computational strategy for the selection of promising materials for STT-MRAMs. Some peculiar material-related features are essential for the device operation and looking for these properties will lead to a pre-selection of suitable ferromagnets and insulators to be combined into efficient STT-MRAM structures. In order to accomplish this goal, we have adopted an approach based on high-throughput Density Functional Theory (DFT) calculations. Our guiding criterion is to appropriately match the complex band-structure of the insulator with the real one of the magnetic electrodes along directions where the growth of heterojunctions is possible. The result of such screening offers a preliminary step before carrying out more computational demanding simulations on the transport and STT properties of the junction itself.

MA 52.19 Thu 15:00 Poster C

Ultrafast demagnetization dynamics in an FePtMn alloy — •Cinja Seick[1], Ute Bierbrauer[2], Moritz Hofherr[2], Nataliia Safonova[3], Manfred Albrecht[3], Benjamin Stadtmüller[2], Martin Aeschlimann[2], Daniel Steil[1], and Stefan Mathias[1] — [1]I. Physikalisches Institut, Universität Göttingen, Germany — [2]Department of Physics and Research Center OPTIMAS, University of Kaiserslautern, Germany — [3]Institute of Physics, University of Augsburg, Germany

The speed and efficiency of ultrafast magnetization dynamics is known to depend on the interplay of the electron, spin, and lattice system in combination with the magnetic moments and the exchange interaction. In order to study the influence of the exchange interaction, one approach is to study alloys with varying with varying stoichiometry and hence exchange coupling between different magnetic constituents. In our work, we chose a sample system with two magnetic sub-lattices with varying contributions, namely the alloy $[\mathrm{FePt}]_{1-\chi}\,\mathrm{Mn}_{\chi}$, which we study with the time-resolved magneto-optical Kerr effect. In this material system, we consistently find a peculiar speed-up of the average demagnetization time at intermediate pump fluencies. In order to understand this process, we use a modified microscopic three temperature model with two interacting spin systems.
We will present experimental results and first simulations.

MA 52.20 Thu 15:00 Poster C

Nonlinear response of thin magnetic films to short electromagnetic pulses — •Alexander F. Schäffer and Jamal Berakdar — Institute of Physics, Martin-Luther-Universität Halle-Wittenberg, 06099 Halle (Saale), Germany

We study the response of thin magnetic layers affected by electromagnetic fields induced by short optical or electron pulses, beyond the linear response regime. As multiple excitations exist in such systems, a cornucopia of possible interaction mechanisms has to be investigated. In this work, we will present consequences of the excited thermal, electric and magnetic components on the subsequent magnetization dynamics.

MA 52.21 Thu 15:00 Poster C

Phase-sensitive Detection of Inverse Spin-Orbit Torques in Normal Metal/Ferromagnet Bilayers at GHz-Frequencies — •Lukas Liensberger[1,2], Satya Prakash Bommanaboyena[3], Björn Gliniors[3], Oliver Gückstock[4], Tom Seifert[4], Tobias Kampfrath[4], Rudolf Gross[1,2,5], Markus Meinert[3], and Mathias Weiler[1,2] — [1]Walther-Meißner-Institut, Garching — [2]Physik-Department, Technische Universität München, Garching — [3]Center for Spinelectronic Materials and Devices, Department of Physics, Bielefeld University, Bielefeld — [4]Department of Physical Chemistry, Fritz Haber Institut of the Max Planck Society, Berlin — [5]Nanosystems Initiative Munich, Munich

Quantitative understanding of direct and inverse spin-orbit torques (SOT) in ferromagnet/normal metal bilayers is required to develop novel and efficient spintronic devices. Established methods to quantify SOTs require patterning and/or impedance matching. Here, we use a novel, contactless inductive measurement technique to quantify the SOTs in different normal metal/ferromagnet bilayer systems at room temperature and microwave frequencies using a coplanar waveguide (CPW) and a vector network analyzer [1]. This method is based on the broadband ferromagnetic resonance technique and utilizes that the CPW detects any source of AC magnetic flux. The phase-sensitive method can distinguish between field- and damping-like SOTs. We study SOTs in thin film bilayers consisting of the ferromagnet CoFeB and varying binary alloys of TaAu and AuPt as well as W with varied degree of oxidation. [1] A. Berger *et al.*, arXiv: 1611.05798 (2016)

MA 52.22 Thu 15:00 Poster C

Time resolved MOKE measurements with calibrated lattice temperatures — •Lisa Willig[1,3], Jan-Etienne Pudell[1], Marc Herzog[1], Matthias Kronseder[2], Christian Back[2], Alexander von Reppert[1], and Matias Bargheer[1,3] — [1]Institut für Physik und Astronomie, Universität Potsdam, Potsdam, Germany — [2]Institut für Experimentelle und Angewandte Physik, Universität Regensburg, Germany — [3]Helmholtz-Zentrum Berlin, Berlin, Germany

We measure the response of the spin system in thin Ni films after excitation with a 800nm pump pulse via the time-resolved magneto-optical Kerr effect (MOKE) for various pump fluences. We calibrate the absorbed energy by ultrafast x-ray diffraction (UXRD), which is sensitive to the transient temperature of the Nickel lattice. We are particularly interested in high fluence measurements, where the lattice temperature rises above the Curie temperature. The tr-MOKE signal confirms that the spin system is fully disordered for long times up to 100 ps. We analyze the recovery of the magnetization.

MA 52.23 Thu 15:00 Poster C

Spin waves in CoFeB thin films dominated by Dzyaloshinskii-Moriya interaction — •Tobias Fischer[1,2], Frank Heussner[1], Samridh Jaiswal[3,4], Gerhard Jakob[3], Mathias Kläui[2,3], Burkard Hillebrands[1], and Philipp Pirro[1] — [1]Fachbereich Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, Erwin-Schrödinger-Straße 56, 67663 Kaiserslautern — [2]MAINZ Graduate School of Excellence, Staudingerweg 9, 55128 Mainz — [3]JGU, Institut für Physik, Staudingerweg 7, 55128 Mainz — [4]Singulus Technologies AG, Hanauer Landstraße 103, 63796 Kahl am Main

The asymmetric exchange contribution in ultra-thin magnetic films with both broken inversion symmetry and an adjacent capping material with a large spin-orbit interaction can lead to a strong interfacial Dzyaloshinskii-Moriya interaction (DMI) [1]. As a result, an additional term linear in the spin-wave wave vector appears in the dispersion relation of spin waves. Brillouin light scattering (BLS) spectroscopy is employed to probe the spin-wave spectrum and to determine the DMI constant. We present results of the investigation of the spin-wave spectrum in ultra-thin CoFeB (0.6 nm) films deposited on Pt and W, respectively. For both single and multilayers these findings are compared with results obtained earlier using methods other than BLS. Furthermore, a detailed analysis of the signal peak behavior is provided.

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

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

MA 52.24 Thu 15:00 Poster C

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

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

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

MA 52.25 Thu 15:00 Poster C

Towards ultrafast transmission electron microscopy at high repetition rates — •John H. Gaida, Marcel Möller, and Claus Ropers — 4th Physical Institute, Georg-August-University, Göttingen, Germany

Lorentz microscopy is a widely applied technique for the nanoscale mapping of magnetization structures. Its adaptation to time-resolved imaging offers fascinating prospects for studying ultrafast magnetization dynamics.

The Göttingen Ultrafast Transmission Electron Microscope (UTEM) is a newly developed instrument, which allows to study ultrafast magnetization and demagnetization dynamics, which are either optically induced or driven by radiofrequency excitation [1].

In this contribution, we investigate the generation of photoelectron pulses and the possibility to carry out ultrafast Lorentz microscopy at high MHz repetition rates.

[1] A. Feist et al., Ultramicroscopy 176 (2016)

MA 52.26 Thu 15:00 Poster C

Fluence-dependent ultrafast magnetization dynamics in Gd and Tb thin films and TbGd bilayers studied by XMCD in reflection — •Markus Gleich[1], Kamil Bobowski[1], Dominic Lawrenz[1], Can Çağıncan[1], Niko Pontius[2], Daniel Schick[2], Christoph Trabant[1], Marko Wietstruk[1], Björn Frietsch[1], Christian Schüssler-Langeheine[2], and Martin Weinelt[1] — [1]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin — [2]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Albert-Einstein-Straße 15, 12489 Berlin

We have investigated the fluence-dependent ultrafast magnetization dynamics of lanthanide thin films. Single-crystalline films were grown on a W(110) substrate providing sufficient cooling to observe de- and remagnetization in pump-probe spectroscopy. The transient magnetization was probed element-specifically by X-ray magnetic circular dichroism in reflection at the FEMTOSPEX facility of BESSY II. All samples show a two-step demagnetization as observed in previous experiments on Gd and Tb [1-4]. On the ultrafast time scale (< 2 ps) Tb is demagnetized most effectively followed by Gd and, surprisingly, Gd in a 3 ML Tb on Gd bilayer. On the long time scale Tb shows a much faster magnetization recovery than Gd. We attribute the difference in dynamics to the stronger spin-lattice coupling in 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 52.27 Thu 15:00 Poster C

Critical exponents of magnon transport coefficients — Alexander Mook[1], •Till Hanke[1], Jürgen Henk[1], and Ingrid Mertig[1,2] — [1]Institut für Physik, Martin-Luther-Universität, D-06120 Halle — [2]Max-Planck-Institut für Mikrostrukturphysik, D-06120 Halle

The spin and heat transport through magnetic insulators is a centerpiece in the fields of spintronics, spin caloritronics, and magnonics. We report on the development of a method that simulates magnon transport over the entire temperature range, from zero Kelvin up to and beyond the critical temperature. It is based on equilibrium atomistic spin dynamics simulations and the Green-Kubo relations [1], relating the equilibrium fluctuations of currents to the magnon transport coefficients, such as the spin conductivitiy σ, the spin Seebeck coefficient S, and the thermal conductivity κ. We study the dependence of these conductivities on temperature in generic three-dimensional magnets. Focussing on the thermal second-order phase transition from the ordered to the paramagnetic phase, we extract the critical exponents of σ, S, and κ. The connection to recent experimental results on the spin Seebeck effect in yttrium iron garnet [2] is discussed.

[1] A. Mook *et al.*, Phys. Rev. B **94**, 174444 (2016)
[2] K. Uchida *et al.*, Phys. Rev. X **4**, 041023 (2014)

MA 52.28 Thu 15:00 Poster C

Extrinsic Spin Nernst effect and thermoelectric transport coefficients — •Franziska Töpler[1], Christian Herschbach[1], Dmitry Fedorov[2], Martin Gradhand[3], and Ingrid Mertig[1,4] — [1]Martin Luther University Halle-Wittenberg, Halle, Germany — [2]University of Luxembourg, L-1511 Luxembourg, Luxembourg — [3]University of Bristol, Bristol, United Kingdom — [4]Max Planck Institute of Microstructure Physics, Halle, Germany

The field of spin caloritronics investigates the combined transport of spin, charge and heat. The corresponding currents are coupled to thermal and electric gradients via linear transport coefficients [1,2]. We calculate the extrinsic contribution to these coefficients caused by skew-scattering. For this purpose we use a fully relativistic KKR-Green's function method and solve the semiclassical Boltzmann equation [3,4]. We present temperature-dependent results for thermopower, spin Nernst angle and efficiency for Cu-based dilute alloys [5]. In case of Au defects we introduce an improved integration method to reduce computational effort and enhance accuracy. We compare results of both procedures for various thermoelectric quantities.

[1] Boona *et al.*, Energy Environ. Sci. **7**, 885 (2014); [2] Bauer *et al.*, Nat. Mater. **11**, 391 (2012); [3] Gradhand *et al.*, PRB **80**, 224413 (2009); [4] Gradhand *et al.*, Phys. Rev. Lett. **104**, 186403 (2010); [5] Tauber *et al.*, Phys. Rev. Lett. **109**, 026601 (2012).

MA 52.29 Thu 15:00 Poster C

Direct Measurements of the Magneto-Caloric Effect of MnFe4Si3 in Pulsed Magnetic Fields — •Nour Maraytta[1], Yurii Skourski[2], Jörg Voigt[1], Karen Friese[1], Jörg Persson[1], Salman Salman[3], and Thomas Brückel[1] — [1]Jülich Centre for Neutron Science JCNS-2 and Peter Grünberg Institute PGI-4, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany — [2]Dresden High Magnetic Field Laboratory HLD, Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden. — [3]Physics Department, Al-Quds University, Abu Dis, Palestine

Magnetocaloric Effect forms the basis of magnetocaloric refrigeration technology which is an energy-efficient and environmentally friendly method for cooling [1]. A large single crystal of MnFe4Si3 was grown; this allows one to determine the crystal and magnetic structure of the compound reliably [2].

In this contribution, we will present the direct measurements of ΔTad in pulsed magnetic fields up to 50T using a home-built experimental set-up from HLD [3]. This technique provides nearly adiabatic conditions during the measurements. The results show that the material can by reversibly cycled which is an important requirement for the applications. We will also compare the results to the ones obtained from magnetization measurements in static magnetic fields using PPMS.

[1] K.A. Gschneidner Jr. and V.K. Pecharsky, Int. J. Refrig. 2008, 31, 945 * 961. [2] P. Hering, K. Friese, J. Voigt et.al., Chem. Mat. 2015, 27, 7128-7136. [3] M. G. Zavareh, C. S. Mejía, A. K. Nayak, et.al., Appl. Phys. Lett. 2015, 106.

MA 52.30 Thu 15:00 Poster C

Influence of martensite intercalations on the thermal hysteresis in NiMn-based magnetic shape memory alloys — •Andreas Becker, Jan Peterhanwahr, Joris Swager, and Andreas Hütten — Bielefeld University, 33615 Bielefeld, Center for Spinelectronic and Materials

NiMnX (X=Al,Ga,Sn,In) magnetic shape memory Heusler alloys are considered as promising materials for magnetocaloric cooling applications due to their magnetoelastic coupling near room temperature[1]. However most of them show a very large thermal hysteresis, which can span over several hundreds of Kelvin, limiting their potential in future applications. Therefore efficient mechanisms to change the martensitic transformation behavior have to be found.

Our research showed that rigid substrates increase hysteresis width and residual austenite in NiCoMnAl thin films[2]. We concluded that thin martensite intercalations in those films should be the best available substrate for transforming films. Our aim is to reduce the thermal hysteresis in off-stoichiometric NiCoMnAl thin films, grown by sputter deposition, by preparing multilayer systems, which consist of alternatively grown martensite intercalations and active transforming layers. Stoichiometry of the layers is chosen in such a way that the martensite transformations do not overlap. The phase transition of the active layer is investigated by temperature dependent magnetic, electrical transport and x-ray diffraction measurements.

[1] Liu et al., Nature Materials 11, 7 (2012)
[2] M. Wodniok et al., AIP Advances 7, 056428 (2017)

MA 52.31 Thu 15:00 Poster C

Reversibility of minor hysteresis loops in magnetocaloric Heusler alloys — •T. Gottschall[1,2], E. Stern-Taulats[3], Ll. Mañosa[3], A. Planes[3], K. P. Skokov[1], O. Gutfleisch[1], Y. Skourski[2], and J. Wosnitza[2] — [1]TU Darmstadt, Institute of Material Science, Germany — [2]High Magnetic Field Laboratory (HLD-EMFL), Helmholtz-Zentrum Dresden-Rossendorf, Germany — [3]Departament de Fisica de la Materia Condensada, Facultat de Fisica, Universitat de Barcelona, Spain

The unavoidable existence of thermal hysteresis in these magnetocaloric materials is one of the central challenges limiting their implementation in cooling devices. Transforming the material in minor loops of the thermal hysteresis, however, allows achieving significant reversible effects even when the hysteresis is relatively large. In this work, we focus on the magnetocaloric properties of Heusler alloys under cycling. We compare thermometric measurements of the adiabatic temperature change in low magnetic fields and pulsed field experiments with calorimetric measurements of the isothermal entropy change when moving in minor hysteresis loops driven by magnetic fields [1, 2].

Support of DFG (SPP1599) is gratefully acknowledged.

[1] T. Gottschall et al., Phys. Rev. Applied 5 (2016) 024013.
[2] T. Gottschall et al., Appl. Phys. Lett. 110 (2017) 223904.

MA 52.32 Thu 15:00 Poster C

Magnetic properties of the $Fe_xNi_{8-x}Si_3$ materials, 0≤ x ≤8 — •Mohammed Ait Haddouch[1], Simone Gallus[2], Jörg Persson[1], Jörg Voigt[1], Karen Friese[1], and Andrzej Grzechnik[2] — [1]Jülich Centre for Neutron Science-2/Peter Grünberg Institut-4, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany — [2]Institute of Crystallography, RWTH Aachen University, Jägerstr. 17-19, 52066 Aachen, Germany

In this work, the magnetic properties of the system $Fe_xNi_{8-x}Si_3$ with 0≤ x ≤8 were investigated by DC magnetization measurements for 1≤ x ≤6 in the temperature range from 10 K to 900 K. The system features a large number of different crystallographic sites for the magnetic ions, which is a possible ingredient for good magnetocaloric materials. Within the ternary $Fe_xNi_{8-x}Si_3$ system, two different stability fields have been observed [1]. For the $Ni_{31}Si_{12}$ structure types samples with 0≤ x ≤4 we find magnetic transitions below 380 K evidenced by sudden changes in the slope of the M(T) curves. Even above these temperatures, the samples do not exhibit Curie-Weiss behavior, indicating the existence of another magnetically ordered phase. For 5≤ x ≤8 samples with the Fe_3Si structure type with compositions exhibit only one phase transition around 800 K. On the basis of our data, a magnetic phase diagram will be proposed over the full range of $Fe_xNi_{8-x}Si_3$ compositions between 0 K and 900 K. We will also derive the magnetic entropy change for the different magnetic transitions of these

compound, to check their magnetocaloric effect efficiency.

[1] Gallus et.al, submitted to Solid State Sciences, (2017)

MA 52.33 Thu 15:00 Poster C

Effect of high Mn-doping on magnetocaloric $La(FeSi)_{13}$-based compounds — •Alexandra Terwey[1], Benedikt Eggert[1], Daniela Trienes[1], Joachim Landers[1], Soma Salamon[1], Werner Keune[1], Katharina Ollefs[1], Iliya Radulov[2], Konstantin Skokov[2], Oliver Gutfleisch[2], and Heiko Wende[1] — [1]Faculty of Physics and Center for Nanointegration (CENIDE), University of Duisburg-Essen, Duisburg, Germany — [2]Functional Materials, TU Darmstadt, Darmstadt, Germany

By combining low temperature Mössbauer studies with and without applied magnetic fields and magnetometry, we investigated the effect of Mn-doping with increasing concentrations on $La(FeSi)_{13}$-based compounds and thereby analyzed the coupling of Mn to the Fe sublattices in the system. $La(FeSi)_{13}$-based materials have the potential use as magnetocaloric refrigerants due to a first-order magneto-structural phase transition near room temperature when additionally doped with hydrogen. Mn doping prevents hydrogen segregation. From our Mössbauer studies at low temperatures in applied external magnetic fields we find a decrease in the hyperfine fields with increasing Mn concentration as well as an increase in the spin frustration. This increase in spin frustration points towards a stronger AFM coupling between Fe and Mn and additionally results in a lowering of the saturation magnetization and of the local Fe moment as validated by magnetometry and extracted hyperfine magnetic fields. Funding by the DFG (SPP1599) is acknowledged.

MA 52.34 Thu 15:00 Poster C

Energy flow in the rare earth Dysprosium revealed by Ultrafast X-Ray diffraction — •Alexander von Reppert[1], Jan-Etienne Pudell[1], Azize Koc[2], Karine Dumesnil[3], Matthias Reinhardt[2], Flavio Zamponi[1], and Matias Bargheer[1,2] — [1]Institut für Physik und Astronomie, Universität Potsdam, Potsdam, Germany — [2]Helmholtz-Zentrum Berlin, Berlin, Germany — [3]Institut Jean Lamour (UMR CNRS 7198), Université Lorraine, Nancy, France

We present ultrafast x-ray diffraction (UXRD) measurements on nanolayered Dysprosium systems, that serves as a model for the class of heavy rare earth materials (Ho, Gd, Tb, ..), which exhibit large magnetostriction. We excite the material by femtosecond light pulses, which instantaneously heat up the electron gas. The coupling of the deposited energy to spin degrees of freedom and to phonons yields the lattice strain. The measured strain is a result of two stress components acting on the atoms: The stresses due to phonons and spins are proportional to the energies in the phonon and spin systems via effective Grüneisen constants which have opposite signs in these rare earths. By a careful analytic decomposition of the signals we can monitor the heat flow among spins and phonons and observe a long lasting non-equilibrium between the spin and phonon excitations that persists for many nanoseconds.

MA 52.35 Thu 15:00 Poster C

Studying the effect of anisotropy on lattice and magnetization dynamics in FePt — •Lisa Willig[1,3], Paul Haberjoh[1], Jan-Etienne Pudell[1], Olav Hellwig[2], Alexander von Reppert[1], and Matias Bargheer[1,3] — [1]Institut für Physik und Astronomie, Universität Potsdam, Potsdam, Germany — [2]Institut für Physik, Technische Universität Chemnitz, Chemnitz, Germany — [3]Helmholtz-Zentrum Berlin, Berlin, Germany

Here we compare the response of two nanoscopic FePt specimen: granular and continuous films of comparable size upon fs-laser excitation. The FePt particles of the granular film are embedded in carbon matrix and exhibit a much larger out of plane magnetic anisotropy, which is desirable for heat assisted magnetic recording. Ultrafast X-Ray diffraction with a 200 fs time-resolution is used to monitor the lattice dynamics and energy flow in both films. Marked differences appear in the initial strain buildup: The nanoscopic granular film exhibits a delayed onset and strongly reduced amplitude in the out of plane expansion compared to the immediate expansion of the homogeneously excited continuous film, where all in-plane stresses are intrinsically balanced. We complement our findings of the lattice dynamics with magnetization measurements via time-resolved MOKE to present lattice and magnetization of this technologically relevant material under comparable conditions.

MA 52.36 Thu 15:00 Poster C

Lattice response of $TbFe_2$ thin films to ultrashort laser pulse excitation studied by X-Ray diffraction — •Steffen Zeuschner[1], Azize Koc[2], Jan-Etienne Pudell[1], Karine Dumesnil[3], Matthias Reinhardt[2], Flavio Zamponi[1], Marc Herzog[1], Alexander von Reppert[1], and Matias Bargheer[1,2] — [1]Institut für Physik und Astronomie, Universität Potsdam, Potsdam, Germany — [2]Helmholtz-Zentrum Berlin, Berlin, Germany — [3]Institut Jean Lamour (UMR CNRS 7198), Université Lorraine, Nancy, France

We present ultrafast X-ray diffraction experiments that quantify the strain waves launched by femtosecond laser excitation. The spatio-temporal temperature and strain profiles suggest a non-linear fluence dependent non-equilibrium electronic heat transport on a picosecond timescale. $TbFe_2$ is a model system known for its giant magnetostriction. Its two constituents Tb and Fe contribute a high crystalline anisotropy, a large effective magnetic moment and a Curie temperature considerably above room temperature. In line with the concept of heat assisted magnetic recording we observe that switching the magnetization by external magnetic fields is facilitated upon laser heating.

MA 52.37 Thu 15:00 Poster C

Spin excitations in antiferromagnetic rare earths drive ultrafast negative thermal expansion — •Jan-Etienne Pudell[1], Alexander von Reppert[1], Flavio Zamponi[1], Matthias Rössle[1,2], Hartmut Zabel[3], Daniel Schick[2], and Matias Bargheer[1,2] — [1]Institut für Physik und Astronomie, Universität Potsdam, Potsdam, Germany — [2]Helmholtz-Zentrum Berlin, Berlin, Germany — [3]Institut für Experimentalphysik , Ruhr Universität Bochum, Bochum, Germany

We present ultrafast x-ray diffraction (UXRD) measurements on a nanolayer system of Holmium (Ho), Yttrium and Niobium layers. We excite the samples by femtosecond light pulses, which instantaneously heat up the electron gas. The coupling of this deposited energy to spin degrees of freedom and to phonons, which simultaneously measured in all constituting layers by x-ray diffraction of 200 femtosecond pulses derived from a laser based plasma source. In the helical antiferromagnetic phase of Ho the energy transferred from the electrons to the spin system leads to a pronounced lattice contraction, whereas heating the phonon system leads to a negative stress component. The sign of the measured ultrafast strain profiles changes upon cooling to the AFM phase, yielding direct evidence of the negative driving stress due to spin excitations. By modeling the generated coherent strain wave in the layers we can derive the spatio-temporal stress profiles generated by the phonon and spin contributions.

MA 52.38 Thu 15:00 Poster C

Magnetic skyrmions in metallic multilayers: investigation of the three dimensional magnetic texture and spin-orbit torque engineering — •Nicolas Reyren[1], William Legrand[1], Davide Maccariello[1], Jean-Yves Chauleau[1,2], Nicolas Jaouen[2], Vincent Cros[1], and Albert Fert[1] — [1]Unité Mixte de Physique CNRS/Thales, Univ. Paris-Sud, Université Paris-Saclay, Palaiseau, France — [2]Sychrotron SOLEIL, Gif-sur-Yvette, France

Magnetic multilayers made of repeated trilayers, *e.g.*,(Pt|Co|Ir) with thicknesses of each layer below about 1 nm, are designed to preserve a large effective Dzyaloshinskii-Moriya interaction (DMI) while increasing the total magnetic volume. In such samples, the volume increase is associated to an improved stability of the magnetic textures and, in particular, we showed that skyrmions could be stabilized at room temperature. However, in the case of numerous repetitions, typically above ten for our samples structure, the stray fields of the skyrmion core and the surrounding uniform magnetization which favour "Néel caps", overcome the DMI and lead to non-uniform magnetization along the thickness of the skyrmion. In each individual magnetic layer, the magnetic texture corresponds to a skyrmion, but the chirality of the top and bottom layers can differ. The chirality playing a crucial role for spin-orbit torque induced motion, the samples should be carefully designed in order to improve the skyrmion velocity by taking into account the specifics of the three-dimensional magnetic texture.

MA 52.39 Thu 15:00 Poster C

Effective Hamiltonian descriptions for skyrmion and antiskyrmion dynamics — •Benjamin F. McKeever[1,2], Davi R. Rodrigues[3,2], Matthias Sitte[1], Jairo Sinova[1,4], Artem Abanov[3], and Karin Everschor-Sitte[1] — [1]Institut für Physik, Johannes Gutenberg-Universität, Mainz 55128, Germany — [2]Graduate School Materials Science in Mainz, Mainz 55128, Germany — [3]Department of Physics & Astronomy, Texas A&M University, College

Station, Texas, USA — [4]Insitute of Physics ASCR, 162 53 Phraha 6, Czech Republic

The dynamics of magnetic textures described by the Landau-Lifshitz-Gilbert equation is complex. However, the description of the low energy physics often requires only a reduced set of effective variables. One route to such a description follows a generalization of the method by Thiele, originally introduced for the steady translational motion of rigid domains, involving direct manipulations of the Landau-Lifshitz-Gilbert equation. Here we exploit an alternative, equivalent method that is independent of microscopic details and derives a general effective Hamiltonian description from an action principle. The advantage of this formalism is that it can be extended to magnetic textures with soft internal modes and does not rely on the usual rigid texture approximation. We first present the general formalism and apply to it to the known example of the translational modes of rigid skyrmions. Then we study the circular internal modes of skyrmions and antiskyrmions that are stabilized by anisotropic Dzyaloshinskii-Moriya interactions, and finally the gyration modes of skyrmions and antiskyrmions.

MA 52.40 Thu 15:00 Poster C

Skyrmion bubbles generation with oblique magnetic field and electrical currents — Sören Nielsen[1], •Enno Lage[1], Christian Denker[2], Markus Münzenberg[2], and Jeffrey McCord[1] — [1]Nanoscale Magnetic Materials - Magnetic Domains, Institute for Materials Science, Universität Kiel, Germany — [2]Institut für Physik, Universität Greifswald, Germany

Room temperature magnetic skyrmion bubbles have been found in Ta/CoFeB/TaO_x and similar systems comprising heavy metal/ferromagnet/oxide layers. Ta/CoFeB/MgO is a promising system presumably allowing for successful skyrmion bubble generation and detection by magnetic tunnel junctions (MTJ) with high TMR ratios. In this work, typical MTJ bottom electrodes and barriers (5 nm Ta/x CoFeB/3 nm MgO) trilayers with an optional Ru capping, deposited by e-beam evaporation (MgO, Ru) and magnetron sputtering (Ta, CoFeB), were used for skyrmion generation. We will present our results on skyrmions. Skyrmions are observed by magneto-optically using magneto-optical Kerr effect microscopy. A transition from in-plane to out-of-plane magnetic anisotropy is found for a CoFeB thickness of $x \approx 1.4$ nm. The stability of skyrmion bubbles in proximity of the transitional regime was found to cover an increased field range with increasing film thicknesses. Paths for the enhanced generation of skyrmion bubbles in thinner magnetic films based on the application of combined out-of-plane bias fields and in-plane magnetic field pulses will be demonstrated. We will further discuss the interaction of skyrmion bubbles with electrical currents.

MA 52.41 Thu 15:00 Poster C

Current-Induced Skyrmion Generation Through Morphological Phase Transitions in Chiral Ferromagnetic Heterostructures — Ivan Lemesh[1], Kai Litzius[2,3,4], Pedram Bassirian[2], •Nico Kerber[2,3], Daniel Heinze[2], Jakub Zazvorka[2], Felix Büttner[1], Lucas Caretta[1], Max Mann[1], Markus Weigand[4], Simone Finizio[5], Jörg Raabe[5], Mi-Young Im[6,7], Mathias Kläui[2,3], and Geoffrey S. D. Beach[1] — [1]Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA — [2]Institut für Physik, Johannes Gutenberg-University, 55128 Mainz, Germany — [3]Graduate School of Excellence Materials Science in Mainz, 55128 Mainz, Germany — [4]Max Planck Institute for Intelligent Systems, 70569 Stuttgart, Germany — [5]Swiss Light Source, Paul Scherrer Institut, Villigen PSI CH-5232, Switzerland — [6]Center for X-ray Optics, Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA — [7]Department of Emerging Materials Science, DGIST, Daegu 42988, Korea

The creation and current driven motion of magnetic skyrmions at room temperature was recently observed [1], but the key formation mechanisms are poorly understood. Here we show that in thin films pulsed currents can drive morphological phase transitions. Using high-resolution x-ray microscopy, we image the evolution of the spin texture with temperature and magnetic field, and demonstrate that transient Joule heating can drive the system across the stripe-skyrmion phase boundary. [1] Litzius, K. et al. Nat. Phys. 13, 170-175 (2017)

MA 52.42 Thu 15:00 Poster C

Impact of transition metals clusters on the stability and dynamics of Skyrmions — •I Gede Arjana, Jonathan Chico, Imara L. Fernandes, and Samir Lounis — Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich & JARA, D-52425 Jülich, Germany

Owing to their topological properties, magnetic skyrmions are prime candidates for future spintronic devices. However, incorporating them as possible bits of information hinges on their interaction with inhomogenities present in any device. Recently, single skyrmions in Pd/Fe/Ir(111) were moved using a Co trimer deposited on the surface but not with a single Co adatom[1]. Following our previous works [2,3], we investigate the interaction of $3d$ and $4d$ clusters with a single magnetic skyrmion in Pd/Fe/Ir(111) and explore their electronic and magnetic properties with a full *ab initio* approach. The latter is used in conjunction with atomistic spin dynamics to study the complex motion of skyrmions going beyond the description based on the Thiele equation. This allows us to study the effect that different types of clusters have over the skyrmions dynamics, and how such defects can be used to engineer tracks and nucleations areas, which are of importance for spintronic devices. – Funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (ERC-consolidator grant 681405 - DYNASORE).

[1] C. Hanneken *et al.*, New J. of Physics, **18**, 055009 (2016).
[2] D. M. Crum *et al.*, Nat. Comms. **6**, 8541 (2015).
[3] I. L. Fernandes *et al.*, submitted (2017).

MA 52.43 Thu 15:00 Poster C

Thermal formation of skyrmion and antiskyrmion density — •Marie Böttcher[1,2,3], Stefan Heinze[2], Jairo Sinova[1,4], and Bertrand Dupé[1,2] — [1]Institut für Physik, Johannes Gutenberg Universität Mainz, 55099 Mainz, Germany — [2]Institute of Theoretical Physics and Astrophysics, University of Kiel, 24098 Kiel, Germany — [3]Graduate School Materials Science in Mainz, 55128 Mainz, Germany — [4]Institute of Physics, Academy of Sciences of the Czech Republic, Cukrovarnická 10, 162 53 Praha 6, Czech Republic

We use an atomistic extended Heisenberg model derived from density functional theory calculations [1] for the ultra-thin film system Pd/Fe/Ir(111) to show that temperature induces non-zero skyrmion and antiskyrmion densities. The parallel tempering Monte Carlo method is applied in order to reliably compute the B-T phase diagram in the presence of frustrated interactions and we introduce the topological susceptibility to evaluate the critical temperatures. The frustration of the exchange interaction turns out to have a crucial influence on the critical temperatures [2]. Here, we focus on the effect of the frustration of exchange interaction on the creation of skyrmions and antiskyrmions densities as a function of temperature and magnetic field.

[1] S. von Malottki *et al.*, Sci. Rep. **7**, 12299 (2017). [2] M. Böttcher *et al.*, *arXiv*:1707.01708 (2017).

MA 52.44 Thu 15:00 Poster C

Spin currents and triplet exciton condensate in magnetic field — •Dominique Geffroy[1,2], Atsushi Hariki[2], and Jan Kuneš[2,3] — [1]Department of Condensed Matter Physics, Faculty of Science, Masaryk University, Kolářská 2, 611 37 Brno, Czech Republic — [2]Institute of Solid State Physics, TU Wien, Wiedner Hauptstr . 8, 1020 Vienna, Austria — [3]Institute of Physics, the Czech Academy of Sciences, Na Slovance 2, 182 21 Praha 8, Czech Republic

We investigate spin-triplet exciton condensation in the two-orbital Hubbard model by means of dynamical mean-field theory. Employing an impurity solver that handles complex off-diagonal hybridization functions, we study the behavior of excitonic condensate in stoichiometric and doped systems subject to external magnetic field. We find a general tendency of the triplet order parameter to lay perpendicular to the applied field and identify exceptions from this rule. For solutions exhibiting odd-k spin textures, we discuss the Bloch theorem which, in the absence of spin-orbit coupling, forbids the appearance of spontaneous net spin current. We demonstrate that the Bloch theorem is not obeyed by the dynamical mean-field theory.

MA 52.45 Thu 15:00 Poster C

Towards understanding strong electron correlation in molecular complexes on surfaces — •Marc Philipp Bahlke and Carmen Herrmann — Institute for Inorganic and Applied Chemistry, University of Hamburg, Martin-Luther-King-Platz 6, 20146 Hamburg, Germany

The interaction of conduction band electrons with localized unpaired electrons can cause the formation of a singlet state at sufficiently low temperature. This effect is known as the Kondo effect and can be observed in many experimental setups such as break junctions and in scanning tunneling microscopy (STM) experiments.

Our goal is to understand the Kondo effect from a chemical perspective, to allow for a systematic manipulation of molecules (e.g. via ligand substitution) that in turn controls the Kondo effect. As a first step in this direction, we investigated a series of cobaltcarbonyl complexes adsorbed on Cu(100), as reported by P. Wahl *et al.* [1], concerning the Kondo effect in the scope of a combination of density functional theory and the single impurity Anderson model (DFT++).

We found that hybridization of the Co 3*d* shell strongly depends on the number of CO ligands attached to cobalt, which is potentially the reason for the increasing Kondo temperature with an increased number of Co ligands.

[1] P. Wahl, L. Diekhöner, G. Wittich, L. Vitali, M. A. Schneider, K. Kern, *Phys. Rev. Lett.* **95**, 166601 (2005).

MA 52.46 Thu 15:00 Poster C

Existence of noncollinear spin-spiral solutions of the Kohn-Sham equations for the homogeneous electron gas — •Maximilian Kulke and Arno Schindlmayr — Department Physik, Universität Paderborn, 33095 Paderborn, Germany

A spiral spin-density wave (SSDW) denotes a nonlinear magnetic configuration where the magnetization vector rotates helically around the spin-quantization axis. Such configurations are known to occur in the ground state of certain noncollinear magnetic materials, such as γ-Fe, but are also commonly studied in the frozen-magnon approximation for spin-wave excitations. Within spin-density-functional theory, SSDWs are occasionally difficult to identify due to the additional degrees of freedom, however. Here we study self-consistent spin-spiral solutions of the Kohn-Sham equations for the homogeneous electron gas with standard methods typically employed for real materials. The homogeneous electron gas allows a largely analytic treatment that avoids numerical inaccuracies affecting implementations for real materials. We use a local-spin-density functional and consider a variety of electron densities and wave vectors for the static planar helical variation of the magnetization. Our results show that noncollinear spin-spiral solutions do not exist for all parameter combinations but only for sufficiently small wave vectors, and that there are multiple solutions in some areas of the parameter space.

MA 52.47 Thu 15:00 Poster C

Magnetic Phases in Ni-Mn Heusler Alloys: A Case for Ab-initio Plus Structure Factor Calculations — •Marianne Schröter, Jan Büddefeld, Maurice Thomalzig, Alfred Hucht, and Anna Grünebohm — Universität Duisburg-Essen, Germany

Ni-Mn based magnetic Heusler alloys, which are among the candidates for environmentally friendly solid state cooling, show rich magnetic phase diagrams.[1] Competing ferromagnetic and anti-ferromagnetic interactions generate complicated spin structures, including different kinds of ferrimagnetic and helimagnetic ordering. To analyse these structures we augment the multi-step approach [2] (DFT and classical Heisenberg model with long-range magnetic interactions parametrized by DFT) by evaluating the magnetic structure factor.

We present temperature and concentration dependent magnetic phase diagrams for Ni(Co)Mn(Ga, Sn) alloys.

[1] T. Graf, et. al, Prog. Solid State Chem. 39, 1 (2011)
[2] D. Comtesse et .al., Eur. Phys. B 85, 343 (2012)

MA 52.48 Thu 15:00 Poster C

Growth of ferroelectric $BaTiO_3$ thin films on top of a ferromagnetic $La_{0.7}Sr_{0.3}MnO_3$ layer deposited on (001)-oriented $SrTiO_3$ substrate using pulsed laser deposition (PLD) — •Kevin Lancaster, Camillo Ballani, Christoph Hauser, Christian Eisenschmidt, and Georg Schmidt — Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, Von-Danckelmann-Platz 3, 06120 Halle

The investigation of the tunnelling anisotropic magnetoresistance (TAMR) demands well defined and homogeneous layers of a ferromagnet and a tunnelling barrier [1], ideally grown epitaxially on top of each other. A ferroelectric barrier like $BaTiO_3$ might add additional functionality to TAMR devices. Previous work [2] indicates the discrepancy between a decrease in surface roughness and in-plane tension for $BaTiO_3$ layers thicker than 5 nm on $La_{0.7}Sr_{0.3}MnO_3$ but an ideal tunnelling thickness of less than 4 nm. We present an optimization for thin film pulsed laser deposition of $BaTiO_3$ onto $La_{0.7}Sr_{0.3}MnO_3$ on (001)-oriented $SrTiO_3$ substrates and its characterization by the means of x-ray refraction and deflection, and conductive atomic force microscopy.

[1] J. D. Burton, E. Y. Tsymbal: "Tunneling anisotropic magnetoresistance in a magnetic tunnel junction with half-metallic electrodes", Phys. Rev. B93, 024419, 2016
[2] D. Hansen, R. Plunnecke: "Growth and Strain Relations in (001)-oriented Ferroelectric and Ferromagnetic Perovskite Oxide Thin Films", Institutt for elektronikk og telekommunikasjon, 2013

MA 52.49 Thu 15:00 Poster C

IrMnGa as candidate for a fully compensated ferrimagnet — •Johannes Kroder, Enke Liu, Gerhard H. Fecher, and Claudia Felser — Max Planck Institut CPfS, Dresden, Germany

Zero net magnetization and the absence of stray fields make antiferromagnets promising candidates for spintronics applications. Conventional antiferromagnets however have an identical electronic structure for both spin directions and therefore cannot carry any spin polarized current. An interesting alternative are fully compensated ferrimagnets (FC FiM) which consist of two antiferromagnetically coupled sublattices of different atomic species that cancel to a zero net magnetization. Due to the different sublattices FC FiM can be spin polarized, which was recently confirmed for Mn_2Ru_xGa [1] and for $Mn_{1.5}V_{0.5}FeAl$ [2].

In general, full- and half-Heusler compounds are a promising material class to search for new FC FiM since they often show half metallicity. Here we report on the cubic half-Heusler compound IrMnGa. Powder X-ray diffraction reveal a B32a-type structure where manganese occupies two different crystallographic sites which are coupled antiferromagnetically. VSM measurements and DFT calculations indicate that IrMnGa is not fully compensated but has a small residual moment. Moreover, we show that the magnetization can be significantly reduced by varying the composition which makes off-stoichiometric IrMnGa an interesting candidate as FC FiM.

[1] H. Kurt *et.al*, PRL **112**, 027201 (2014); [2] R. Stinshoff *et.al*, PRB **95**, 060410(R) (2017)

MA 52.50 Thu 15:00 Poster C

Electronic structure of high-TMR off-stoichiometric Co_2(Mn,Fe)Si Heusler thin films explored by hard X-ray photoelectron spectroscopy — •Siham Ouardi[1], Kidist Moges[2], Bing Hu[2], Gerhard H. Fecher[3], Masafumi Yamamoto[2], Tetsuya Uemura[2], Shigenori Ueda[4], and Claudia Felser[3] — [1]WPI Ad-vanced Institute for Materials Research, Tohoku University, Sendai 980-8577, Japan — [2]Graduate School of Information Science and Technology, Hokkaido University, Sapporo 060-0814, Japan — [3]Max Planck Institute for Chemical Physics of Solids, Dresden, Germany — [4]National Institute for Materials Science, SPring-8, Hyogo, Japan

The quaternary Heuslers alloy Co_2(Mn,Fe)Si are among the most promising half-metallic ferromagnets and suitable as a spin source for spintronic devices. A giant tunneling magnetoresistance (TMR) ratio up to 2610% at 4.2 K (429% at 290 K) was realized on Co_2(Mn,Fe)Si/MgO/Co_2(Mn,Fe)Si magnetic tunnel junctions (MTJs) with Mn-rich, lightly Fe-doped Co_2(Mn,Fe)Si electrodes [1]. This work reports on the investigation of the electronic states of off-stoichiometric Co_2(Mn,Fe)Si Heusler thin films by hard X-ray photoelectron spectroscopy in combination with band structure calculations. Co, Fe, and Mn states are probed by magnetic dichroism in angle-resolved photoelectron spectroscopy at the 2*p* core levels. The effect of the Fe doping, as well as the antisite disorder on the valence states at the Fermi edge will be discussed.

[1] K. Moges, et al. Phys. Rev. B 93, 134403 (2016).

MA 52.51 Thu 15:00 Poster C

Magnetism and electric transport in Heusler compounds $Co_2V_{1-x}Cr_xGa$ — •Jörn Bannies, Johannes Kroder, Gerhard H. Fecher, and Claudia Felser — Max Planck Institut CPfS, Dresden, Germany

During the last decades Heusler compounds have attracted much interest due to their huge variety of properties. Among them the half-metallic ferromagnetism has been intensively investigated. Characteristically the saturation magnetization in half-metallic ferromagnets such as Co_2 based Heusler compounds scales linearly with the valence electron count which is known as the Slater Pauling rule.

Recently Co_2 based Heusler compounds have been proposed to host Weyl fermions. The anomalous Hall effect is assumed to be maximized when the Weyl nodes reside at the Fermi level. Thus, shifting the Weyl nodes around the Fermi level can be used to verify this assumption. Due to the large compositional variability provided by Heusler compounds this is easily be achieved by substitutional alloying.

Here we report on the Heusler system $Co_2V_{1-x}Cr_xGa$. Substitution of V by Cr is intended to shift the Weyl nodes to higher energies passing through the Fermi level, thereby generating a maximum in the anomalous Hall conductivity. This is expected to occur at $x \approx 0.5$. Polycrystalline samples with x ranging from 0 to 1 were prepared by conventional arc melting technique. After annealing, the magnetisation followed obey the Slater Pauling rule which hints on their half-metallicity. Additionally temperature dependent measurements of the magnetoresistivity were carried out.

MA 52.52 Thu 15:00 Poster C

Growth, Structure, and Properties of La2MBO6 (M = Co, Ni, Mg, and Zn; B = Ru, Ir) Double Perovskite Single Crystals — •Ryan Morrow[1], Mihai Sturza[1], Laura T. Corredor[3], Michael Vogl[1], Anja Wolter-Giraud[1], Sabine Wurmehl[1,2], and Bernd Büchner[1,2] — [1]Leibniz Institute for Solid State and Materials Research Dresden IFW, Dresden D-01069, Germany — [2]Institute for Solid State Physics, Technische Universität Dresden, Dresden D-01069, Germany — [3]Universidade Federal do Rio Grande do Norte, Natal-RN 59078-970, Brazil

Double perovskites have received a great deal of attention in recent times due to their magnetic properties. However, the vast majority of experimental data thus far in this field has been generated with powder samples resulting in numerous open questions concerning the underlying principles governing the magnetic properties of these complex oxides. Here it is shown that, using a flux method, double perovskite iridate single crystals as large as 3 mm with formula La2MBO6 (M = Co, Ni, Mg, and Zn; B = Ru, Ir) have been grown. The structure and properties of the crystals are characterized and are in agreement with previous powder data. Therefore, future more detailed experiments will be possible on a variety of double perovskite single crystals with numerous electronic configurations.

MA 52.53 Thu 15:00 Poster C

Anti-site disorder induced diluted magnetism in semiconducting CoFeTiAl alloy — •tingting lin — Institute of Materials Science, TU Darmstadt, 64287 Darmstadt, Germany

The ordered CoFeTiAl Heusler compound shows a semiconducting character and has been synthesized. However, the detailed electronic structure and the effect of anti-site disorder, which prevails in such type of materials, are unclear. We investigated the effect of anti-site disorder on the electronic structure using the KKR-CPA method, and found that the Co-Ti and Fe-Ti anti-site disordering can induce diluted magnetism in CoFeTiAl alloy. For instance, the Fe-Ti anti-site disorder can induce a 100% spin polarization at the Fermi level within a specific range of disorder parameters. The Co-Fe anti-site disorder occurs more easily judging by the total energies, but has little effect on the semiconductor behavior in the electronic structure and magnetic properties. Detailed analysis reveals that the magnetism can be attributed to the contributions of Co, Fe, and Ti atoms on the anti-site disordered sites, i.e., the diluted magnetism in CoFeTiAl alloy is induced by the anti-site disorder rather than by introducing magnetic dopant elements. This makes the system interesting for future spintronic applications.

MA 52.54 Thu 15:00 Poster C

Magnetoelectronic structure of ultrathin Fe_3O_4/$SrTiO_3$ heterointerfaces — •Mai Hussein Hamed[1], Ronja Anika Heinen[1], Marek Wilhem[1], Patrick Lömker[1], Carolin Schmitz-Antoniak[1], Andrei Gloskovsky[2], Wolfgang Drube[2], Claus M. Schneider[1,3], and Martina Müller[1,4] — [1]Peter-Grünberg-Institut (PGI-6), Forschungszentrum Jülich GmbH, Germany. — [2]Photon Science, DESY, Hamburg, Germany. — [3]Fakultät für Physik, Universität Duisburg-Essen, Germany. — [4]Experimentelle Physik I, Technische Universität Dortmund, Germany.

Fe_3O_4/$SrTiO_3$ heterostructures are promising candidates for oxide spintronics, as their functionality depends strongly on the interface properties. For this purpose, we emphasized on the impact of reduces dimensionality on the magnetoelectronic and structural properties of ultrathin magnetite.

Magnetite thin films are grown epitaxially on Nb-$SrTiO_3$(001) substrates via pulsed laser deposition with varying thicknesses (d=2-38nm). By magnetic characterization, it is found for ultrathin Fe_3O_4 coverages (d=2nm) that the saturation magnetization M_S reduces to $1\mu_B$/f.u and the Verwey transition shifts towards lower value T_V=20K instead of $4\mu_B$/f.u and 120K for bulk Fe_3O_4 respectively. Using HAXPES and XMCD techniques provides complementary element-selective information of the surface and buried interface magnetoelectronic structure. Our results suggest the formation of a 2ML γ-Fe_2O_3 intralayer at the interfaces. Interfacial redox reaction or oxygen mobility could account for the formation of this intralayer phase.

MA 52.55 Thu 15:00 Poster C

MBE growth of I-Mn-V antiferromagnets — •Martin Brajer[1,2], Štěpán Svoboda[1], Richard Campion[3], and Vít Novák[1] — [1]Institute of Physics ASCR, v.v.i., Cukrovarnicka 10, 162 53 Praha, Czech Republic — [2]Faculty of Mathematics and Physics, Charles University in Prague, Ke Karlovu 3, 121 16 Prague, Czech Republic — [3]School of Physics and Astronomy, University of Nottingham, UK

We report on growth of two members of the I-Mn-V family of room-temperature antiferromagnets (AFs) by means of molecular beam epitaxy: tetragonal phase CuMnAs and LiMnAs. The former is an AF semimetal with broken inversion symmetry, allowing for current-induced switching of AF moments. It can be successfully grown on standard zinc-blende semiconductor substrates GaAs, GaP and Si. We study strain relaxation and surface morphology of the material depending on the type of the substrate used. The latter is tetragonal LiMnAs, an AF semiconductor with band-gap of 1.6 eV. It can be grown on a lattice-matched InAs substrate, which allows for a stable 2D growth, but hinders its basic transport characterization because of the high substrate conductivity. We attempt to overcome this problem by using a thin metamorphic (Ga,In)As layer on top of an insulating GaAs substrate. This approach brings about a problem of strain relaxation and related surface morphology degradation: the thinner the metamorphic layer (i.e. the lower its conductance), the higher the density of misfit dislocations, calling for a compromise between the suppression of the parasitic conductivity and enhanced surface roughness.

MA 52.56 Thu 15:00 Poster C

Band-gap evolution of thin ferromagnetic europium-oxide films at low temperatures — •Marcel Ney[1], Günther Prinz[1], Patrick Lömker[2], Martina Müller[2,3], and Axel Lorke[1] — [1]Faculty of Physics, Universität Duisburg-Essen, D-47048 Duisburg — [2]Peter Grünberg Institut, Forschungszentrum Jülich GmbH, D-52428 Jülich — [3]Faculty of Physics, TU Dortmund, D-44227 Dortmund

In spintronic research, materials with magnetic properties, which can be used as spin filters, are of particular interest. We are investigating EuO with a Curie temperature of T_C = 69K, as one candidate for this application. It is of interest to study how the ferromagnetic phase transition below T_C affects the optical band-gap of EuO.

Thin EuO-layers were grown by molecular-beam-epitaxy on YSZ substrates, with different thicknesses. A FTIR-spectrometer, was used to measure the transmission through the EuO thin films to determine the optical band-gap energy.

The EuO-films with thicknesses between 5nm and 30nm were investigated in a range of 293K down to 25K. At room temperature, we observe a dependence of the band-gap on the layer thickness due to the quantum confinement effect. When cooling a 20nm layer below the Curie temperature, we observe a red shift of the optical band-gap of about $E_a = 0.27 \pm 0.02$eV. This energy shift is in good agreement with theoretical and experimental values for EuO exchange splitting effects. For thin films first measurements show a different temperature dependent behavior upon cooling below T_C, which indicates that quantum size effects will influence the magnetic ordering of the material.

MA 52.57 Thu 15:00 Poster C

Synthesis, Structure and Magnetic Properties of the AB3Si2Sn7O16 Phases — •Morgan Allison[1,2,3], Siegbert Schmid[2], Tilo Söhnel[3], Glen Stewart[4], Christopher Ling[1], and Sabine Wurmehl[1] — [1]IFW, Dresden, Germany — [2]School of Chemistry, The University of Sydney, Sydney, Australia — [3]School of Chemistry, The University of Auckland, Auckland, New Zealand — [4]School of PEMS, UNSW@ADFA, Canberra, Australia

Layered oxide structures have been reported to exhibit several novel magnetic material properties. Transition metal oxide materials with mixtures of different elements have also been shown to exhibit several useful magnetic behaviours, many of which could be extremely beneficial for future technical devices. Fe4Si2Sn7O16 provides a novel situation in oxide compounds. It can be described as a composite of oxygen linked intermetallic (FeSn6) octahedra and (FeO6)/(SnO6) kagomé-oxide layers within the one structure. SiO4 tetrahedra separate these layers which leads to electronic isolation of the repeated layers by about 7 Å, resulting in a nearly perfectly 2D oxide system. In our investigation, doping experiments across a range of different transition metal chemistries were performed, refinements of the structures from X-ray and neutron powder diffraction patterns were used to determine the crystal structure and distribution of transition metals across both layers. In this presentation the results of different elemental substitution on the crystal and magnetic structures of this family of compounds will be discussed, additionally we will present some of the novel results from the spectroscopic and magnetic characterisation of these materials.

MA 52.58 Thu 15:00 Poster C

Inelastic electron tunneling spectroscopy at tunnel junctions with integrated topological material — •Denis Dyck[1], Robin-Pierre Klett[1], Andreas Becker[1], Jan Haskenhoff[1], Jan Krieft[1], Karsten Rott[1], Torsten Hübner[1], Gregor Mussler[2], Jan-Michael Schmalhorst[1], Andreas Hütten[1], and Günter Reiss[1] — [1]Center for Spinelectronic Materials and Devices, Physics Department, Bielefeld University, Bielefeld, Germany — [2]Forschungszentrum Jülich, Peter-Grünberg Institut, Jülich, Germany

The research on topological insulators is evolving rapidly. Within less than a decade, experimental effort led from fundamental material analysis to first real topological devices exploiting physics for future spintronic applications. However, all data were taken at planar devices. For technical integration into applicable information architecture, devices based on vertical transport are required to achieve, e.g., scalability and low power consumption. Here, the successful patterning and integration of tunnel junctions based on topological back electrodes are a necessary way to go. Furthermore, different classes of topological matter are investigated: topological crystalline insulators, represented by SnTe thin films, BiSbTe as a topological insulator and Co2TiSi as a magnetic Weyl semimetal. In this work we report on the realization of such tunnel junctions consisting of aforementioned materials and their characterization using inelastic electron tunneling spectroscopy (IETS). Different excitations for different topological materials can be identified.

MA 52.59 Thu 15:00 Poster C

Impact of ultrafast transport on the high-energy states of a photoexcited topological insulator — •Friedrich Freyse[1], Marco Battiato[2], Andrei Varykhalov[1], Oliver Rader[1], and Jaime Sánchez-Barriga[1] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie, Elektronenspeicherring BESSY II, Albert-Einstein-Str. 15, 12489 Berlin, Germany — [2]Institute of Solid State Physics, Vienna University of Technology, Vienna A-1040, Austria

Ultrafast dynamics in three-dimensional topological insulators (TIs) opens new routes for increasing the speed of information transport up to frequencies thousand times faster than in modern electronics. However, up to date, disentangling the exact contributions from bulk and surface transport in the subpicosecond dynamics of these materials remains a difficult challenge. Here, using time- and angle-resolved photoemission, we demonstrate that driving a TI into the bulk insulating regime opens new channels for ultrafast transport on the surface that unexpectedly persist up to high energies above the Fermi level. In particular, we show that the emergent transport channels are due to an ultrafast process of surface charge accumulation that is directly connected to the existence of a projected bulk band gap at high energy and the lack of available bulk states at the Fermi level. We further provide a qualitative description of the mechanisms responsible for the observed electron dynamics.

MA 52.60 Thu 15:00 Poster C

Characterizing Magnetoelectricity at the Local Scale — •Harsh Trivedi[1], Vladimir Shvartsman[1], Robert Pullar[2], Marco Medeiros[2], Pavel Zelenovskiy[3], Vladimir Shur[3], and Doru Lupascu[1] — [1]Institute for Materials Science and Centre for Nanointegration Duisburg-Essen (CeNIDE), University of Duisburg-Essen, 45141, Essen, Germany — [2]CICECO, University of Aveiro, 3810-193, Aveiro, Portugal — [3]School of Natural Sciences and Mathemaics, Ural Federal University, 620002, Ekaterinburg, Russia

A growing interest in studying local manifestations of macroscopic functionalities has led to a wide spread development in near-field microscopic techniques. Common examples of such studies include electrical conduction at ferroelectric/ferroelastic domain walls, polarization dynamics in ferroelectrics, study of ergodicity in relaxor-ferroelectrics, and the local magnetoelectric (ME) effect. The data in these studies are often captured in the form of sequence of images or spectroscopic responses over a 2D-grid. Theoretically, the effect under consideration can be characterized by local measurement of the induced parameters. However, there are certain instrumental challenges. In this poster we highlight these challenges by considering composite multiferroics as a case study. Here, we consider local measurements on various BaTiO3/Ferrite based composite systems. We have utilized techniques like Piezoresponse Force Microscopy (PFM), Confocal Raman Microscopy (CRM), Magnetic Force Microscopy (MFM) for the local measurements. To overcome the above-mentioned challenges, we propose a set of approximation methods based on machine-learning.

MA 52.61 Thu 15:00 Poster C

Impact of low temperature, high pressure and illumination wavelength on photo-induced effects in $BiFeO_3$ by means of optical spectroscopy — •Fabian Meggle[1], Jihaan Ebad Allah[1], Michel Viret[2], Jens Kreisel[3], and Christine Kuntscher[1] — [1]Experimentalphysik II, Universität Augsburg, D-86159 Augsburg, Germany — [2]Service de Physique de l'Etat Condensé, CEA Saclay, DSM/IRAMIS/SPEC, URA CNRS 2464, 91191 Gif-Sur-Yvette Cedex, France — [3]Materials Research and Technology Department, Luxembourg Institute of Science and Technology, L-4422 Belvaux, Luxembourg

Recently, it has been reported that during illumination with green light $BiFeO_3$ crystals show three absorption features in the optical spectrum between 1.0 and 2.2 eV [1]. We studied the impact of low temperature, high pressure, and illumination wavelength on this photo-induced effect by using optical spectroscopy. Our findings will be discussed in terms of the photostriction effect observed in $BiFeO_3$ [2].

[1] F. Burkert et al., Appl. Phys. Lett. **109**, 182903 (2016)
[2] B. Kundys et al., Nat. Mater. **9**, 803 (2010)

MA 52.62 Thu 15:00 Poster C

low-temperature magnetoelectric effect in multiferroic h-Yb1-xHoxMnO3 — •gang qiang[1], yifei fang[2], and jincang zhang[2] — [1]Experimentelle Physik 2, Technische Universitat Dortmund, 44221 Dortmund, Germany — [2]Materials Genome Institute and Department of Physics, Shanghai University, Shanghai 200444, China

Hexagonal RMnO3 as a group of important multiferroic materials, attracted much attention during the last few decades. Much work, by now, has been done on their magnetic structure, magnetic phase diagrams as well as the high temperature ferroelectric transition, but few investigation has been carried out to study the low-temperature ferroelectric properties nor its interaction with the magnetic transitions. In this work, we carried out a detailed study of the low-temperature ferroelectricity, magnetic property as well as the ME effect in bulk Yb1-xHoxMnO3 ($0<=x<=0.6$, $\Delta x=0.2$). In h-YbMnO3 (x=0), ferroelectric polarization is found around 43.5 K and is supposed to be closely related with the structure change, and defects in the material is supposed to be responsible for the asymmetry of the P-T curves under opposite poling filed. In the Ho-doped samples (x>0), two-dimensional antiferromagnetic (AFM) perturbation as well as the second AFM ordering are observed. Substitution of Yb by Ho atoms shows great influences on the electric property and the low-doping concentration tend to be more favorable for the enhancement of electric polarization.

MA 52.63 Thu 15:00 Poster C

Exchange coupling in multiferroics/ferromagnet heterostructures — •Sven Becker, Mehran Vafaee, Mathias Kläui, and Gerhard Jakob — Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The interface between the antiferromagnetic perovskite $BiFeO_3$ and a ferromagnet has been target of numerous research projects. The interlayer exchange coupling was often weak at room temperature[1] or died after some time because of oxidation of the interface[2]. Multiferroic $Bi_{1-x}Ba_xFeO_3$/ferromagnet (x=0, 0.15) as well as $TmFeO_3$/ferromagnet heterostructures have been fabricated using pulsed laser deposition (PLD). As ferromagnetic layers $La_{0.7}Sr_{0.3}MnO_3$ and ferrimagnetic Sr_2FeMoO_6 have been deposited. Single crystal growth has been confirmed using XRD. Ferroelectric properties of $Bi_{0.85}Ba_{0.15}FeO_3$ have been proven by piezoresponse force microscopy (PFM). Heterostructures have been investigated with regard to the exchange coupling using a SQUID magnetometer. [1] M. Vafaee Appl. Phys. Lett. **108**, 072401 (2016) [2] J. T. Heron, Nature **516**, 370 (2014)

MA 52.64 Thu 15:00 Poster C

Voltage control of magnetism in oxide heterostructures: A

combined scattering and electron microscopy investigation — •Tanvi Bhatnagar[1], Anirban Sarkar[1], Markus Waschk[1], Emmanuel Kentzinger[1], Andras Kovacs[2], Rafal Dunin-Borkowski[2], and Thomas Brückel[1,3] — [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 at MLZ, Lichtenbergstr. 1, 85784 Garching, Germany

The voltage control of magnetism in oxide heterostructures e.g. LaxSr1-xMnO3/BaTiO3 has drawn a considerable interest due to strong couplings between lattice, charge, spin and orbital degrees of freedom at the interfaces and for improving the functionality of future spintronic devices. Here, we use advanced deposition techniques (including oxide molecular beam epitaxy) and investigate the chemical and magnetic structure of the resulting interfaces as a function of electric field. For this investigation, we make use of a combination of advanced scattering (neutron and X-ray) methods and electron microscopy and spectroscopy (including off-axis electron holography and electron magnetic circular dichroism).

MA 52.65 Thu 15:00 Poster C

Exploring magnetoelectricity at the nanoscale in two-phase hetero-structured multiferroic thin films

— •Muhammad Naveed-Ul-Haq[1], Vladimir Shvartsman[1], Harsh Trivedi[1], Samira Webers[2], Heiko Wende[2], and Doru Lupascu[1] — [1]Institute for Materials Science and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg- Essen, Universitätsstraße 15, 45141 Essen, Germany. — [2]Faculty of Physics and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen, Lotharstraße 1, 47057 Duisburg, Germany.

High quality epitaxial bi-layered $CoFe_2O_4 - BaTiO_3$ thin films were prepared on $SrTiO_3 : Nb(100)$ and $SrTiO_3 : Nb(111)$ substrates using pulsed laser deposition. X-ray diffraction and transmission electron microscopy showed that the films are polycrystalline single-phase perovskite, free of additional phases. Piezoforce response microscopy revealed that the film on $SrTiO_3 : Nb(111)$ substrate shows strong lateral and vertical PFM responses. However, the film on $SrTiO_3 : Nb(100)$ shows good response only in the lateral direction. The magnetoelectric properties were studied by applying an in-plane magnetic field and measuring the piezoresponse and a subsequent analysis via the principal components analysis (PCA). It was discovered that the thin films grown on $SrTiO_3 : Nb(111)$ substrate show a better strain mediated coupling than those grown on $SrTiO_3 : Nb(100)$ substrate. Thus it is concluded that the substrate orientation has a strong influence on the local piezoelectric and magnetoelectric properties of films.

MA 52.66 Thu 15:00 Poster C

Electric field control of chiral correlations above the multiferroic phase transition in $Ni_3V_2O_8$

— •Sebastian Biesenkamp[1], Jonas Stein[1], Karin Schmalzl[2], Navid Qureshi[3], and Markus Braden[1] — [1]Institute of Physics II, University of Cologne, Germany — [2]JCNS at ILL, Grenoble, France — [3]ILL, Grenoble, France

Multiferroics allow one to control chiral magnetic order by an electric field. While this effect is well established in the long-range multiferroic phase, only recently it was observed that in $TbMnO_3$ and in $MnWO_4$ chiral correlations can be controlled even above the onset of long-range multiferroic order [1]. Here we report polarized neutron scattering experiments on $Ni_3V_2O_8$ that reveal the qualitatively same behavior in a region above the transition to the multiferroic phase. Time-resolved neutron scattering experiments have been executed in order to resolve the relaxation time τ of chiral domains in $Ni_3V_2O_8$ for different temperatures, while switching them with external fields of about 1kV/mm. With our time-resolved setup, it was possible to follow the relaxation of chiral domains over 5 orders of magnitude in time, yielding a simple activation law $\tau \propto \exp(E_A/k_BT)$.

[1]Stein et al. Phys. Rev. Lett. 119, 177201 (2017)

MA 52.67 Thu 15:00 Poster C

Structural and magnetic properties of Ba2Mg0.4Co1.6Fe12O22 hexaferrites

— •B. Georgieva[1], S. Kolev[1], K. Krezhov[2], Ch. Ghelev[1], B. Vertruyen[3], R. Closset[3], A. Mahmoud[3], R. Cloots[3], A. Zaleski[4], and T. Koutzarova[1] — [1]Institute of Electronics, Bulgarian Academy of Sciences, Sofia, Bulgaria — [2]Institute for Nuclear Research and Nuclear Energy, BAS, Sofia, Bulgaria — [3]Chemistry Department, University of Liege, Belgium — [4]Institute of Low Temperature and Structure Research, PAS, Wroclaw, Poland

In multiferroic materials, long-range magnetic and ferroelectric orders coexist resulting in a magnetoelectric effect. For example, Y-type hexaferrites, (as Ba2Mg2Fe12O22) have a relatively high temperature of magnetic transition (~200 K) to a spiral spin arrangement and an easy magnetization axis lying in a plane perpendicular to the c crystal axis. Multiferroicity exists without an external magnetic field, a longitudinal-conical spin arrangement arises below 50 K, and the direction of the electric polarization can be controlled by low magnetic fields (<0.02 T). We studied the effect of Co substitution in Ba2Mg2Fe12O22 on its structural and magnetic properties. Ba2Mg0.4Co1.6Fe12O22 powder was synthesized by sonochemical co-precipitation. Its XRD spectra had the characteristic peaks of the Y-type hexaferrite as a main phase. Less than 2% of CoFe2O4 appeared as a second phase; this was confirmed by Moessbauer spectroscopy. The magnetization at 50kOe was 30emu/g and 26.6emu/g at 4.2 K and 300 K. The ZFC and FC magnetization curves measured at 500 Oe showed a magnetic phase transition from a ferrimagnetic-to-helical spin order at 200 K.

MA 52.68 Thu 15:00 Poster C

Structural investigations on Erythrosiderite-type compounds

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Erythrosiderite-type compounds of the form $A_2[FeCl_5(H_2O)]$ were discovered as being magneto-electric. We investigate the crystal and magnetic structures of the compounds $(NH_4)_2[FeCl_5(H_2O)]$ and $Cs_2[FeCl_5(H_2O)]$. In contrast to the other erythrosiderite-type compounds, $(NH_4)_2[FeCl_5(H_2O)]$ is multiferroic. We studied a structural phase transition occurring in this material well above the onset of magnetic order by single-crystal neutron diffraction. The structural transition can be attributed to the ordering of the NH_4 groups. The compound $Cs_2[FeCl_5(H_2O)]$ plays an exceptional role in this material family: It differs from the other erythrosiderite-type compounds with respect to its crystal structure. While most erythrosiderite-type compounds crystallize in space group $Pnma$, this compound exhibits space group $Cmcm$ associated with a different arrangement of the $FeCl_5O$ octahedra. Again, there is a structural phase transition occuring well above the magnetic ordering that was neglected for most investigations so far. We investigated both compounds by neutron and X-ray diffraction and present an analysis of their low-temperature crystal structures and its consequences for the magneto-electric properties.

MA 52.69 Thu 15:00 Poster C

THz spectroscopy on chiral Ni_3TeO_6 in magnetic fields up to 8 T

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In the realm of multiferroicity, Ni_3TeO_6 stands out for the observation of non-hysteretic magnetic switching and the record linear magnetoelectric coupling constant in single-phase materials [1]. The structure of Ni_3TeO_6 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 optical activity (Faraday effect). However, one may also expect more exotic effects such as magneto chiral dichroism or quadrochroism [2]. Circularly polarised light is particularly well suited to address such effects. We study the optical properties of Ni_3TeO_6 in the THz range using circularly polarised light, high magnetic fields, and low temperatures.

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Single crystal growth, magnetic phase diagram and antiferromagnetic resonance modes in $MTiO_3$ (M=Co,Ni)

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Single crystals of layered $S = 1$ and $S = 3/2$ antiferromagnets $MTiO_3$ (M=Co,Ni) which both show pronounced magnetodielectric coupling have been grown by the optical floating-zone method. The single crystals have been studied by means of magnetometry up to 60 T and high-frequency electron spin resonance (HF-ESR). The magnetic phase diagrams are derived, including a broad field-induced anomaly indicative of spin-reorientation for $B||ab$-plane. For $NiTiO_3$, the reonance frequency vs. field diagram in the ordered state and the temperature dependence of the main resonance modes are presented. The antiferromagnetic resonance modes imply an easy plane-type anisotropy. Zero-field splitting of the out-of-plane modes amounts to 190 GHz and the gapped in-plane mode is consistent with the saturation field of $B_{ab} = 35$ T seen in the pulsed-field magnetisation studies. In $CoTiO_3$, the HF-ESR data are less clear but there is evidence for the easy-plane mode saturating at $B_{ab} = 16$ T with zero-field splitting well beyond the accessible frequency range of 1 THz.

MA 52.71 Thu 15:00 Poster C

Spin-wave transport and higher harmonic generation in Néel walls — •Kai Wagner[1,2], Olga Gladii[3], David Halley[3], Yves Henry[3], Matthieu Bailleul[3], Attila Kákay[1], and Helmut Schultheiss[1,2] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Institute of Ion Beam Physics and Materials Research, 01328 Dresden, Germany — [2]TU Dresden, 01307, Dresden, Germany — [3]Institut de physique et chimie des matériaux de Strasbourg, 67034 Strasbourg, France

Magnetic domain walls are promising candidates for flexible and reconfigurable waveguides in magnonic circuitry [1,2,3]. We investigate spin-wave transport along 90° Néel walls in microstructured thin-film elements made of Py as well as Fe [4] by μBLS [5] and via micromagnetic simulations [6]. The experiments cover the range from thermal excitation, through the linear regime up to non-linear excitation and higher harmonic generation associated with the excitation of previously not observed guided spin-wave modes. Additionally, first experimental observations of spin-wave transport along interconnected Néel walls in flux closure domain structures and along walls, which suddenly change their direction at the edge of the microstructure are presented.

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MA 52.72 Thu 15:00 Poster C

Current driven domain wall creation in ferromagnetic nano-wires — •Nils Sommer[1], Matthias Sitte[1], Davi Rohe Rodrigues[2], and Karin Everschor-Sitte[1] — [1]Institute of Physics, Johannes Gutenberg Universität, 55128 Mainz, Germany — [2]Department of Physics & Astronomy, Texas A&M University, College Station, Texas 77843-4242, USA

A central topic in spintronics is the manipulation of magnetic textures by currents.

In a recent work, it was predicted that magnetic domain walls can be generated in ferromagnetic nano-wires by means of an electric current once there is an inhomogeneity.

In this work, the focus is on a set-up where the magnetization of the ferromagnetic wire was mainly aligned along the wire. Only the magnetization at one end of the wire was fixed along a perpendicular direction. It has been shown that above a certain threshold current density domain walls are injected into the nano-wire with a period that is controlled by the current strength.

During my Bachelor research, we have analysed the influence of the orientation of the fixed magnetization at the end of the wire. We have shown that while reducing the tilting angle the threshold current above which domain walls are shedded is increasing. Decreasing the tilting angle to zero we were able to recover the ferromagnetic instability.

MA 52.73 Thu 15:00 Poster C

Interaction of Domain Walls and Skyrmions — •Venkata Krishna Bharadwaj, Kyoung-Whan Kim, and Karin Everschor Sitte — Johannes Gutenberg Universität

Magnetic domain walls and skyrmions are promising candidates for spintronics applications such as racetrack memory devices. Motivated by recent experiments [1-3], we study the interactions between domain walls and skyrmions and their interplay in the presence of inhomogeneous current distributions. In the first step, we perform numerical simulations with Micromagnum [4] with some software extensions to analyze the production of different magnetic textures and the possibility to form skyrmions upon the collision of domain walls. [1] W.Jiang et al., Science 349, 283 (2015), [2] S. Woo. Et al, Nature Materials 15, 501 (2016) [3] S.Woo et al., Nature Physics 13, 448 (2017) [4] Micromagnum, http://micromagnum.informatik.uni-hamburg.de/