MA 50: Joint Session "Spincaloric Transport" (jointly with TT)

Time: Friday 9:30–11:30 Location: EB 301

MA 50.1 Fri 9:30 EB 301

Magneto-Seebeck Effect in Magnetic Tunnel Junctions — •Marvin Walter[1], Jakob Walowski[1], Vladyslav Zbarsky[1], Markus Münzenberg[1], Markus Schäfers[2], Daniel Ebke[2], Günter Reiss[2], Andy Thomas[2], Patrick Peretzki[3], Michael Seibt[3], Michael Czerner[4], Michael Bachmann[4], and Christian Heiliger[4] — [1]I. Phys. Inst., Uni Göttingen, Germany — [2]Dept. of Physics, Bielefeld University, Germany — [3]IV. Phys. Inst., Uni Göttingen, Germany — [4]I. Phys. Inst., Uni Giessen, Germany

We present the observation of a magneto Seebeck effect in CoFeB/MgO/CoFeB magnetic tunnel junctions (MTJs). The effects could be used for thermal spin-injection and thermally driven spin-transfer torque. The samples presented in this work consist of a minimal pseudo-spin-valve stack with sputtered Ta and CoFeB layers and an e-beam evaporated MgO barrier. The MTJs are heated by either a diode laser or a Ti:Sa femtosecond laser for higher powers. The laser is focused onto the sample in a confocal microscope setup. The heating is simulated by finite element methods and the experimental results are compared with ab-initio calculations of the magneto-thermoelectric power and of the spin-Seebeck coefficient. A magneto-Seebeck effect of up to 40% is found for higher laser powers and a theoretically predicted sign change of the thermal voltage is observed. The experimental data and the temperature simulations are in good agreement with the ab-initio calculations. In addition, time-resolved reflectivity and autocorrelation measurements in a pump-probe setup are carried out.

MA 50.2 Fri 9:45 EB 301

Anisotropy of the Seebeck effect and anomalous Nernst effect from Kubo linear response formalism — •S Wimmer, D Ködderitzsch, and H Ebert — Universität München, Department Chemie, Butenandtstr. 5-13, D-81377 München, Germany

Employing the linear response Kubo formalism [1] implemented using the relativistic multiple scattering Korringa-Kohn-Rostoker technique we study the anisotropy of the Seebeck effect (ASE) and the anomalous Nernst effect (ANE) in ferromagnetic cubic transition-metal alloys. The diagonal and off-diagonal elements of the thermoelectric tensor, Seebeck and Nernst coefficients, respectively, are derived from Kubo-Greenwood transport calculations by use of Mott's formula for the thermopower [2]. Results for the ASE are discussed in comparison to the corresponding electric field-driven effect, the anisotropic magneto-resistance (AMR). The ANE is analogously compared to calculations of its galvanomagnetic counterpart, the anomalous Hall effect (AHE). The chemical disorder of the investigated alloys is treated on the level of the coherent potential approximation (CPA). As will be shown, a corresponding description of the Spin Seebeck effect can be achieved by making use of a relativistic spin projection scheme [3].
[1] S. Lowitzer, D. Ködderitzsch and H. Ebert, PRL **105**, 266604 (2010). [2] N.F. Mott and H. Jones, *The Theory of the Porperties of Metals and Alloys*, (Oxford University Press, Oxford, 1936), chap. 7. [3] S. Lowitzer, D. Ködderitzsch and H. Ebert, PRB **82**, 140402(R) (2010).

MA 50.3 Fri 10:00 EB 301

Evidence for thermal spin transfer torque — •Haiming Yu[1,2,3], Simon Granville[1], Dapeng Yu[3], and Jean-Philippe Ansermet[1] — [1]Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland — [2]Technische Universität München, Garching b. München, Germany — [3]Peking University, Beijing, China

Spin caloritronics, i.e., the addition of thermal effects to the electrical and magnetic properties of nanostructures, has recently seen a rapid development. It has been predicted that a heat current can exert a spin torque on the magnetization in a nanostructure, analogous to the well-known spin-transfer torque induced by an electrical current. We provided the experimental evidence for this effect in spin valves, showing the switching field change with heat current.

We present measurements of the second harmonic voltage response of Co-Cu-Co pseudo-spin-valves deposited in the middle of Cu nanowires. We exploit the quasi-1D nature of the nanostructures to generate a heat current by asymmetric Joule heating in the Co layers. Both the magnitude of the second harmonic response of the spin valve and the field value of the maximum response are found to depend on the heat current. Both effects show that the magnetization dynamics of the pseudo-spin-valves is influenced by the heat current. The data provide a quantitative estimate of the thermal spin torque exerted on the magnetization of the Co layers.

MA 50.4 Fri 10:15 EB 301

Spin-wave propagation and transformation in a thermal gradient — •Björn Obry, Vitaliy I. Vasyuchka, Andrii V. Chumak, Alexander A. Serga, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

We study the influence of a thermal gradient on the propagation behavior of spin waves in an yttrium iron garnet (YIG) waveguide. It is shown that the propagation of externally excited spin waves in regions of varying temperature results in a modification of the spin-wave wavelength. In a special case also the reflection of spin waves in a thermal gradient is observed. These observations can be attributed to a continuous change of saturation magnetization depending on the local temperature. The presented results reveal the potential of thermal gradients for the controlled manipulation of spin-wave propagation in waveguides. Financial support by the Deutsche Forschungsgemeinschaft (DFG, VA 735/1-1) within Priority Program 1538 "Spin Caloric Transport" is gratefully acknowledged.

MA 50.5 Fri 10:30 EB 301

Spin dependent electronic-transport calculations of Co_2FeAl and Co_2FeSi — •Denis Comtesse[1], László Szunyogh[2], Heike C. Herper[1], and Peter Entel[1] — [1]Faculty of Physics, University of Duisburg-Essen, 47048 Duisburg, Germany — [2]Institute of Physics, Budapest University of Technology and Economics, Budafoki út 8, H1111 Budapest

We present *ab initio* calculations of the electronic-transport properties perpendicular to the planes of Co_2FeAl and Co_2FeSi with Pt contacts. We use a fully relativistic description of the electronic structure within the screened Korringa-Kohn-Rostoker (SKKR) [1] formalism. The Kubo-Greenwood formalism is employed to calculate the electronic-transport and the spin projection operator introduced by Lowitzer *et al.* [2] is used to evaluate the spin dependent contributions to the total current. In addition we investigate which regions of the two dimensional Brillouin zone give the main contributions to the transport of the two spin channels. It is found that only small characteristically distributed regions of the Brillouin zone contribute significantly to the current in Co_2FeAl and Co_2FeSi. Furthermore, we investigate how the transport properties change with increasing system size. Therefore, systems with different numbers of layers between the leads have been taken into account. Financial support by Deutsche Forschungsgemeinschaft within the priority program SPP 1538 is greatfully acknowleged.

MA 50.6 Fri 10:45 EB 301

Magnon mediated heat transport in a magnetic insulator — •Vitaliy I. Vasyuchka, Alexander A. Serga, Andrii V. Chumak, and Burkard Hillebrands — FB Physik and Landesforschungszentrum OPTIMAS, TU Kaiserslautern, 67663 Kaiserslautern, Germany

In a magnetic system thermal gradients can appear as a natural result of thermalization of artificially excited magnons. Detection and measurement of such gradients provides information about the heat transport by magnon currents. In our experiments, the temperature gradient created by coherent surface and volume magnons excited in a tangentially magnetized yttrium iron garnet (YIG) film was detected using an infrared thermography technique. In the case of volume magnons the temperature distribution along the YIG film was found symmetrical relative to the antenna, while the thermalization of the surface magnons results in an unsymmetrical distribution. Moreover, the shift of the temperature maximum apart from the antenna was registered in the case of surface magnons. The difference in the temperature profiles is understood as a result of a nonreciprocal propagation of surface magnons. The time dynamics of the magnon-induced thermal gradients was studied.

Financial support by the Deutsche Forschungsgemeinschaft (DFG, VA 735/1-1) within Priority Program 1538 "Spin Caloric Transport" is gratefully acknowledged.

MA 50.7 Fri 11:00 EB 301

Large scale *ab initio* calculations of Konbu phases using KKR*nano* — •Elias Rabel[1], Alexander Thiess[1], Tetsuya Fukushima[2], Nguyen D. Vu[2], Kazunori Sato[2], Hiroshi Katayama-Yoshida[2], Phivos Mavropoulos[1], Rudolf Zeller[1], Peter H. Dederichs[1], and Stefan Blügel[1] — [1]Peter Grünberg Institut and Institute for Advanced Simulation, Forschungszentrum Jülich and JARA, D-52425 Jülich — [2]Department of Materials Engineering Science, Graduate School of Engineering Science, Osaka University, 1-3 Machikaneyama, Toyonaka, Osaka 560-8531, Japan

Konbu phases are column-like structures grown by 2-dimensional spinodal nanodecomposition in various materials. Recent experiments have shown interesting effects such as giant Peltier cooling in a submicron-sized CuNi/Au junction, which are possibly related to the presence of these phases [1]. From a theoretical perspective an *ab initio* treatment of a few thousand atoms is the minimal requirement, which we are able to meet with the recently developed Korringa-Kohn-Rostoker Green-function program KKR*nano*. Motivated by the experimentally found spin-thermoelectric properties, we investigate the electronic and magnetic structure of Konbu phases in (Zn,Cr)Te and CuNi. Kinetic Monte-Carlo simulation results provide valuable insight into the spatial structure of these phases and serve as input for our *ab initio* calculations.

Funding by the DFG Priority Programme 1538 "Spin Caloric Transport" is gratefully acknowledged.

[1] A. Sugihara et al., Appl. Phys. Express **3**, 065204 (2010).

MA 50.8 Fri 11:15 EB 301

Domain Wall Motion by the Magnonic Spin Seebeck Effect — •Ulrike Ritzmann, Denise Hinzke, and Ulrich Nowak — Universität Konstanz

In the last years it was demonstrated that in ferromagnetic materials spatial temperature grandients can lead to spin accumulation [1], even in magnetic insulators [2]. In this context, it is important to note that in addition to a spin polarized charge current also a chargeless angular momentum current driven by spin waves can exist.

Here, we propose the existence of domain wall (DW) dynamics driven by magnonic spin currents due to temperature gradients. To get some insight into this effect we introduce two different approaches: the stochastic Landau-Lifshitz-Gilbert equation, applied to spin models, and the Landau-Lifshitz-Bloch equation describing the dynamics of the thermally averaged spin polarization on micromagnetic length scales. We show that these approaches describe this new type of DW motion, where chargeless spin currents following from a temperature gradient drag a DW into the hotter region [3]. Furthermore, for a better understanding of the relevant length scales, we investigate the propagation and frequency range of thermally induced magnons.

We acknowledge financial support by the Deutsche Forschungsgemeinschaft through Schwerpunktprogramm SpinCaT.

[1] K. Uchida et al., Nature **455**, 778 (2008).
[2] K. Uchida et al., Nat. Mater. **9**, 894(2010).
[3] D. Hinzke and U. Nowak, Phys. Rev. Lett. **107**, 027205(2011)