TT 97: Spincaloric Transport I (organized by MA)

Time: Thursday 16:45–18:45 Location: HSZ 403

TT 97.1 Thu 16:45 HSZ 403

Spin Hall magnetoresistance in ferromagnetic insulator/normal metal hybrids — •M. Althammer[1], S. Meyer[1], S. Geprägs[1], M. Opel[1], R. Gross[1,2], and S. T. B. Goennenwein[1] — [1]Walther-Meißner-Institut, BAdW, Germany — [2]Physik-Department, Technische Universität München, Germany

Pure spin currents, i.e. the net flow of spin angular momentum without an accompanying charge current, represent a new paradigm for spin transport and spintronics. We have experimentally studied a new type of magnetoresistance effect, which arises from the interaction of charge and spin current flows in ferromagnetic insulator/normal metal hybrid structures. In more detail, we measured the resistance of yttrium iron garnet(YIG)/Pt, YIG/nonferromagnet/Pt, nickel ferrite/Pt, and magnetite/Pt hybrid structures as a function of the magnitude and the orientation of an external magnetic field. The resistance changes observed can be quantitatively traced back to the combined action of spin Hall and inverse spin Hall effect in the Pt metal layer, and are thus termed spin Hall magnetoresistance (SMR) [1, 2]. We show that the SMR is qualitatively different from the conventional anisotropic magnetoresistance effect arising in magnetic metals and is not due to a static proximity magnetization in Pt, as proposed by Huang et al. [3]. Financial support by the DFG via SPP 1538 (project no. GO 944/4) and the Nanoinitiative Munich (NIM) is gratefully acknowledged.

[1] Nakayama et al., PRL, **110**, 206601 (2013)
[2] Althammer et al., PRB, **87**, 224401 (2013)
[3] Huang et al., PRL, **109**, 107204 (2012)

TT 97.2 Thu 17:00 HSZ 403

Cooling nanodevices via spin-polarized currents — •Jochen Brüggemann[1], Stephan Weiss[2], Peter Nalbach[1], and Michael Thorwart[1] — [1]1. Institut für theoretische Physik, Universität Hamburg, Jungiusstrasse 9, 20355 Hamburg — [2]Theoretische Physik, Universität Duisburg-Essen & CENICE, 47048 Duisburg

We investigate a non-equilibrium cooling scheme for nanodevices utilizing spin-polarized currents inspired by the demagnetization cooling for macroscopic systems. A minimal model is employed including the following parts: First, a quantum dot coupled to ferromagnetic leads via electron tunneling, second, a localized magnetic moment on the dot interacting with the electron spins via exchange interaction and, finally, a single phonon mode coupled to both electric and spin degrees of freedom. By deriving and solving a quantum master equation for the reduced density matrix in the sequential tunneling limit, we are able to determine both spin and phonon dynamics. Due to the combination of spin-polarized currents and spin-phonon interaction we achieve an increase of the ground state population of the localized moment and thus, subsequently, of the phonon mode compared to its initial preparation.

TT 97.3 Thu 17:15 HSZ 403

Magneto-thermopower and Magnetoresistance of single Co-Ni alloy Nanowires — •Tim Böhnert[1], Victor Vega[2], Ann-Kathrin Michel[1], Victor M. Prida[2], and Kornelius Nielsch[1] — [1]Universität Hamburg, Hamburg, Germany — [2]Universidad de Oviedo, Oviedo, Spain

The magneto-thermopower is measured and correlated to the anisotropic magnetoresistance of Co-Ni alloyed nanowires with varying composition. The highest absolute and relative variation of the Seebeck coefficient in perpendicularly applied magnetic fields at room temperature are determined to be $1.5\,\mu\mathrm{VK}^{-1}$ for $Co_{0.24}Ni_{0.76}$ and 8.1 % for $Co_{0.39}Ni_{0.61}$ nanowires. Power factors of $3.7\,\mathrm{mW/mK}^2$ have been achieved, which is competitive with common thermoelectric materials like Bi_2Te_3. For Co-Ni nanowires containing up to 39 % Co a linear relationship between the magnetic field dependent change of the Seebeck coefficient and the electrical conductivity is found.

TT 97.4 Thu 17:30 HSZ 403

Magneto-thermopower on FeNi and FeCo thin films — •Sasmita Srichandan, Maximilian Schmid, Michael Vogel, Christoph Strunk, and Christian Back — Institute of Experimental and Applied Physics, University of Regensburg, 93040 Regensburg, Germany

We present measurements on the magneto-thermoelectric effects of 20 nm thick ferromagnetic films of permalloy (Py) [1] and FeCo alloy. The Py has been deposited on bulk MgO and GaAs substrates as well as on 100 nm thick SiN membranes. The dominant contribution to these effects turns out to be planar Nernst effect (PNE). For bulk substrate samples, the out of the plane temperature gradient gives rise to the anomalous Nernst effect (ANE). No ANE or transverse spin Seebeck effect (TSSE) signals are detected for the membrane samples. The observed TSSE for Py on bulk substrates is at least two orders of magnitude smaller than in earlier experiments [2].

In addition we study thermoelectric effects for FeCo alloy of various compositions deposited on the membrane. The advantage with FeCo is that the Fermi energy can be tuned throughout the band structure [3]. The domain walls in our samples are clearly visible in the TEM images. We present preliminary results of the effect of the domains on the thermoelectric effects.

[1] M. Schmid, S. Srichandan et.al PRL **111**,187201(2013).
[2] K. Uchida et.al Nature **455**,778(2008).
[3] K. Schwarz et.al J. Phys. F **14**,2659(1984).

TT 97.5 Thu 17:45 HSZ 403

Magneto-Thermopower and Giant Magnetoresistance measurements on single multilayered Co-Ni/Cu nanowires — •Anna Niemann[1], Tim Böhnert[1], Ann-Katrin Michel[1], Svenja Bässler[1], Johannes Gooth[1], Katalin Neurohr[2], Bence Tóth[2], László Péter[2], Imre Bakonyi[2], and Kornelius Nielsch[1] — [1]Institute of Applied Physics, Universität Hamburg, Hamburg, Germany — [2]Wigner Institute, Budapest, Hungary

The magneto-thermopower (MTP) is linked to the giant magnetoresistance (GMR) of individual multilayered Co-Ni/Cu nanowires with varying Cu thickness. Both magneto effects are studied temperature dependent in perpendicular magnetic fields leading to cross plane GMR effects of up to 15 % at RT. This is a typical effect size for electrodeposited nanowires. A linear dependence between thermopower S and conductivity σ of the nanowires–with the magnetic field as an implicit variable–is found at a wide temperature range (50 K to 325 K). This observation is in agreement with the Mott formula with an additional thermopower offset, which allows the estimation of the absolute Seebeck coefficient of the contact material.

The linear behavior–S vs. σ–and the Mott formula are used to calculate the energy derivative of the resistivity, which can be further correlated to the transmission function serving as a starting point in theoretical models. Magneto-thermal conductance measurements are planned to complete the characterization of the spin-caloritronic properties, in particular to validate the Wiedemann-Franz law in cross-plane GMR structures.

TT 97.6 Thu 18:00 HSZ 403

The anomalous Nernst effect in the triplet superconductor Sr_2RuO_4 — •Martin Gradhand[1], Karol I. Wysokinski[2], and James F. Annett[1] — [1]H . H. Wills Physics Laboratory, University of Bristol, Tyndall Ave, BS8-1TL, UK — [2]Institute of Physics, M. Curie-Skłodowska University, Radziszewskiego 10, PL-20-031 Lublin, Poland

The existence of the time reversal symmetry breaking in the superconducting state of Sr_2RuO_4 is crucial for the understanding of the pairing mechanism in this material. It is believed to show triplet p-wave pairing with a finite orbital and spin momentum. The measured optical Kerr effect [1] in its superconducting state caused enormous theoretical effort with different possible explanations. [2]

Another way to proof or disproof the existence of the time reversal symmetry breaking would be highly desirable. Here we present, two routes strongly related to each other. On one hand we address the existence and magnitude of the orbital magnetic moment relying on the Berry curvature expression for periodic crystals. On the other hand we will discuss the possibility of a superconducting current induced by temperature gradients - the anomalous Nernst effect.

[1] J. Xia, et al. Phys. Rev. Lett. **97**, 167002 (2006)
[2] V. M. Yakovenko Phys. Rev. Lett.**98** 087003 (2007), V. P. Mineev Phys. Rev. B **76** 212501 (2007), E. Taylor C. Kallin Phys. Rev. Lett. **108** 157001 (2012), M. Gradhand et al. Phys. Rev. B **88**, 094504 (2013)

TT 97.7 Thu 18:15 HSZ 403

Magnetic field dependence of the thermal conductivity of LCMO — •Christoph Euler, Paulina Holuj, Tino Jäger, Christian Mix, and Gerhard Jakob — University of Mainz, Germany

We measured the low-temperature out-of-plane thermal conductivity of LCMO using the differential 3-omega technique and found substantial magnetic field dependence between 100 K and room temperature. The effect is observed to be largest in the vicinity of the metal-insulator transition, since the enhancement in thermal conductivity is caused by the colossal magnetoresistance effect increasing the electronic contribution to the thermal conductivity. Our measurements allow a discussion of the Wiedemann-Franz law in the framework of strong electron-lattice coupling.

TT 97.8 Thu 18:30 HSZ 403

Magnon Hall effect and topology in kagomé lattices: A theoretical investigation — •Alexander Mook[1], Jürgen Henk[2], and Ingrid Mertig[1,2] — [1]Max-Planck-Institut für Mikrostrukturphysik, D-06120 Halle — [2]Institut für Physik, Martin-Luther-Universität, D-06120 Halle

Ferromagnetic insulators with Dzyaloshinskii-Moriya interaction show the magnon Hall effect, i. e., a transverse heat current upon application of a temperature gradient [1,2]. In our theoretical investigation we establish a close connection of the magnon Hall effect in two-dimensional kagomé lattices with the topology of their magnon dispersion relation. From the topological phase diagram we predict systems which show a change of sign in the heat current in dependence of the temperature. Furthermore, we derive a high-temperature limit of the thermal Hall conductivity; this quantity provides a figure of merit for the strength of the magnon Hall effect. Eventually, we compare the temperature dependence of the magnon Hall conductivity of the three-dimensional pyrochlore $Lu_2V_2O_7$ with experiment.

[1] Y. Onose et al., Science **329**, 297 (2010).
[2] R. Matsumoto, S. Murakami, Phys. Rev. B **84**, 184406 (2011).