MA 22: Magnetic Semiconductors (jointly with HL)

Time: Tuesday 14:00–15:15 Location: H31

MA 22.1 Tue 14:00 H31

Magnetic Semiconductor (Ga,Mn)As Studied by Fluctuation Spectroscopy — •Martin Lonsky[1], Jan Teschabai-Oglu[1], Klaus Pierz[2], Hans Werner Schumacher[2], and Jens Müller[1] — [1]Physikalisches Institut, Goethe-Universität, Frankfurt (M), Germany — [2]Physikalisch-Technische Bundesanstalt, 38116 Braunschweig, Germany

In spintronics, both charge and spin degrees of freedom of the electronic transport properties are utilized. Recent studies on diluted magnetic semiconductors (DMS), as for instance (Ga,Mn)As, raised hopes of applications combining the logic operations of semiconductor devices with the information storage capabilities of magnetic elements. However, ferromagnetism at room temperature has not yet been achieved in DMS, and the underlying mechanism is still subject of investigation. In this context, theoretical studies have discussed the percolation of magnetic polarons as a possible origin of spontaneous magnetization [1]. Motivated by recent results of a diverging $1/f$-noise magnitude in the ferromagnetic semimetal EuB_6, where the existence of percolating nanoscale magnetic clusters has been demonstrated [2], we apply fluctuation spectroscopy to (Ga,Mn)As in order to gain a better understanding of the coupling between charge transport and magnetism. Systematic (magneto-)transport studies are conducted on epitaxial thin films of (Ga,Mn)As [3] with different growth parameters.

[1] A. Kaminski and S. Das Sarma, Phys. Rev. Lett. 88, 247202 (2002)
[2] P. Das et al., Phys. Rev. B 86, 184425 (2012)
[3] A. B. Hamida et al., Phys. Stat. Solidi B 251, 1652 (2014)

MA 22.2 Tue 14:15 H31

Defect induced magnetism in SiC — •Shengqiang Zhou — Helmholtz-Zentrum Dresden Rossendorf, Institute of Ion Beam Physics and Materials Research, Bautzner Landstrasse 400, D-01328 Dresden, Germany

Defect-induced magnetism is attracting intensive research interest. It not only challenges the traditional opinions about magnetism, but also has some potential applications in spin-electronics. SiC is a new candidate for the investigation of defect-induced ferromagnetism after graphitic materials and oxides due to its high material purity and crystalline quality [1, 2]. In this contribution, I will review our comprehensive investigation on the structural and magnetic properties of ion implanted and neutron irradiated SiC sample.

The magnetization in ion irradiated SiC can be decomposed into paramagnetic, superparamagnetic and ferromagnetic contributions [3,4]. The ferromagnetic contribution persists well above room temperature and exhibits a pronounced magnetic anisotropy. By combining X-ray magnetic circular dichroism and first-principles calculations, we clarify that p-electrons of the nearest-neighbor carbon atoms around divacancies are mainly responsible for the long-range ferromagnetic coupling [5]. Thus, we provide a correlation between the collective magnetic phenomena and the specific electrons/orbitals.

[1] APL 98, 222508 (2011); [2] PRB 90, 214435 (2014); [3] PRB 89, 014417 (2014); [4] PRB, 92, 174409 (2015); [5] Sci. Rep., 5, 8999 (2015).

MA 22.3 Tue 14:30 H31

Spin-lattice-relaxation of Bismut doped Silicons slabs in air - a DFT approach. — •Johannes Gugler and Peter Mohn — Center for Computational Materials Science, Vienna, Austria

ESR experiments show that Bismuth doped Silicon exhibits a relaxation-time up to 1 ms at 10 K. These huge values are obtained due to the electron-spin-free surrounding in a Silicon crystal. The absence of electron-spins makes spin-lattice-relaxation a process of interest, when it comes to quantum dots. We present a DFT-investigation of the crystalographic structure, the DOS, the phonon spectra and the configuration of Bismuth doped (100)- and (111)-Silicon surfaces in air. We evaluate the influence of different position of the Bismuth atom inside the silicon slab on the spin-lattice-relaxation mechanisms.

MA 22.4 Tue 14:45 H31

Interface control of electronic transport across the magnetic phase transition in SrRuO3/SrTiO3 heterointerface — •Carmine Autieri[1], Saurabh Roy[2], Biplab Sanyal[1], and Tamalika Banerjee[2] — [1]Department of Physics and Astronomy, Uppsala University, Box-516, 75120 Uppsala, Sweden — [2]Physics of Nanodevices, Zernike Institute for Advanced Materials, University of Groningen, Groningen 9747 AG,The Netherlands

The emerging material class of complex-oxides, where manipulation of physical properties lead to new functionalities at their heterointerfaces, is expected to open new frontiers in Spintronics. For example, SrRuO3 is a promising material where external stimuli like strain, temperature and structural distortions control the stability of electronic and magnetic states, across its magnetic phase transition, useful for Spintronics. Despite this, not much has been studied to understand such correlations in SrRuO3. Here we explore the influence of electron-lattice correlation to electron-transport, at interfaces between SrRuO3 and Nb:SrTiO3 across its ferromagnetic transition, using a nanoscale transport probe and first-principles calculations. We find that the geometrical reconstructions at the interface and hence modifications in electronic structures dominate the transmission across its ferromagnetic transition, eventually flipping the charge-transport length-scale in SrRuO3. This approach can be easily extended to other devices where competing ground states can lead to different functional properties across their heterointerfaces.

MA 22.5 Tue 15:00 H31

Transport effects in $LaCo_5$ and YCo_5 upon electronic topological phase transitions — •Jürgen Weischenberg and Hongbin Zhang — Materialwissenschaft, TU Darmstadt Alarich-Weiss-Straße 2, 64287 Darmstadt, Germany

It is an interesting phenomenon that in $RECo_5$ (RE = La, Y) strong pressure can lead to a Lifshitz transition, which is manifested by an isomorphic lattice collapse. As the lattice collapses and the distance between the atoms decreases, the overlap of their orbitals becomes larger and leads to an alteration of the Fermi surface topology, i.e., an electronic topological phase transition (ETT). Transport properties can be utilized to characterize the ETT, since they are determined by the details of the electronic structure at the Fermi energy level. In this work, to understand recent experiments in $LaCo_5$ [1], we carry out first principle calculations of various transport properties using the full-potential linearized augmented plane-wave method (FLAPW) within density functional theory. In particular, we consider both the intrinsic and the side-jump contribution to the anomalous Hall effect which can be computed directly from the electronic structure of the pristine crystal alone [2]. The impact of the Fermi surface topologies on the electric- as well as on the thermoelectric transport properties in $LaCo_5$ and YCo_5 is discussed. Financial support by German federal state of Hessen through its excellence program LOEWE RESPONSE is gratefully acknowledged.

[1] R. L. Stillwell *et al.*, Phys. Rev. B **92**, 174421 (2015)
[2] J. Weischenberg *et al.*, PRL 107, 106601 (2011)