MA 11: ThyssenKrupp Electrical Steel Dissertationspreis 2013 der AG Magnetismus

Ziel dieses jährlich durch die Thyssen-Krupp Electrical Steel Ag unterstützten Preises ist die Anerkennung herausragender Forschung im Fachverband Magnetismus im Rahmen einer Doktorarbeit und deren exzellente Vermittlung in Wort und Schrift. Nominiert wurden wissenschaftlich herausragende Dissertationen auf dem Fachgebiet Magnetismus in Theorie, Grundlagen und/oder Anwendungen, die im Jahr 2011 oder 2012 an einer deutschen Hochschule abgeschlossen wurden.

Auswahlverfahren: Ein von der AG Magnetismus eingesetztes Preiskomitee ermittelte unter den Einsendungen bis zu vier Finalisten, die hier in dieser Sitzung einen 20 min. Vortrag mit Diskussion über ihre Arbeit halten. Unmittelbar nach dem Symposium wählt das Preiskomitee den (die) Sieger(in), der (die) noch auf der Tagung bekannt gegeben wird. Das Preisgeld beträgt 1.000 EUR.

Aus den eingegangenen Vorschlägen wurden die folgenden Kandidaten in die engere Wahl genommen.

Time: Monday 12:15–13:55 Location: H3

MA 11.1 Mon 12:15 H3

Direct measurement of the spin polarization by tunneling spectroscopy with superconducting electrodes — •Oliver Schebaum — Thin Films and Physics of Nanostructures, Physics Department, Bielefeld University, Germany

Spinelectronics utilize the spin degree of freedom of electrons, which is neglected by conventional electronics. One promising spinelectronic device is the magnetic tunnel junction (MTJ). The spin polarization of the tunneling current in an MTJ can be altered by the magnetic electrodes as well as the incorporated tunnel barrier material. Tunnel junctions with a unified layer stack were prepared for three different barriers. In these systems, the tunnel magnetoresistance (TMR)ratios at optimum annealing temperatures were found to be 65% for Al2O3, 173% for MgO, and 78% for MgO-Al2O3 composite tunnel barriers. The similar TMR ratios of the tunnel junctions containing alumina provide evidence that coherent tunneling is suppressed by the alumina layer in the composite tunnel barrier [1]. Furthermore, we prepared tunnel junctions with one ferromagnetic and one superconducting Al-Si electrode. Pure cobalt electrodes were compared with a Co-Fe-B alloy and the Heusler compound Co2FeAl. The polarization of the tunneling electrons was determined using the Maki-Fulde-model and is discussed along with the spin-orbit scattering and the total pair-breaking parameters. The junctions were postannealed at different temperatures to investigate the symmetry filtering mechanism responsible for the giant TMR ratios in Co-Fe-B/MgO/Co-Fe-B junctions.[2,3]

[1] O. Schebaum, V. Drewello, A. Auge, G. Reiss, M. Münzenberg,H. Schuhmann, M. Seibt and A. Thomas, J. Magn. Magn. Mat. 323 (2011) 1525-1528

[2] O. Schebaum, D. Ebke, A. Niemeyer, G. Reiss, J.S. Moodera and A. Thomas, J. Appl. Phys. 107 (2010) 09C717

[3] O. Schebaum, S. Fabretti, J.S. Moodera and A. Thomas, New J. Phys. 14 (2012) 033023

MA 11.2 Mon 12:40 H3

Tailoring the magnetic vortex nucleation conditions in soft magnetic disks by means of introducing a — •Norbert Martin — Helmholtz-Zentrum Dresden-Rossendorf, 01099 Dresden

N. Martin Magnetic vortex structures are a promising candidate for magnetic data storage hence two bits can be stored per vortex, that is the chirality of the in plane magnetization and the orientation of the vortex core. This allows a higher data storage density. There are, however, lower limits in the size of magnetic elements in which a vortex can nucleate. One issue is thereby the magnetic field which is necessary in order to nucleate a vortex.

In the presented work a method is developed in order to decrease the nucleation field in a defined way by means of introducing a geometric asymmetry in the out of plane direction. The so caused decrease in the nucleation field is shown by micromagnetic modeling and experiments.

The asymmetry is introduced experimentally by masking a Permalloy thin film with a closely packed monolayer of nanospheres and subsequently irradiating the masked film with ions. The formation of magnetic vortices in such structures is proved by magneto-optic investigations and magnetic force microscopy. According to this dense arrays of small disks with magnetic vortices can be formed, which opens a way to higher data storage density.

MA 11.3 Mon 13:05 H3

Magnetoelectric coupling at metal surfaces — •Lukas Gerhard — Institute of Nanotechnology, Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

Magnetoelectric coupling offers the possibility to change the magnetic state of a material by an applied electric field. In the past, research in this field has focused on insulating materials such as complex multiferroic oxides because in bulk metallic systems, any external electric field is screened by the formation of a surface charge. In the topmost atomic layer of a metallic surface, however, this surface charge leads to small vertical displacements of the atomic cores. In thin films, this change of the interlayer distance in turn may lead to a modification of the magnetic order. In the framework of this thesis, we demonstrated electric-field induced reproducible switching of the magnetic order of a metallic system between two metastable states [1]. Strong magnetoelectric coupling on a few square nanometers was demonstrated at the surface of iron nanoislands on a copper substrate using the electric field of a scanning tunneling microscope. Electric-field induced phase transitions observed in two other systems show that magnetoelectric coupling is a fundamental effect in metallic magnetic thin films that may lead to the development of high-density non-volatile information storage devices made of metals.

[1] Magnetoelectric coupling at metal surfaces, L. Gerhard et al, Nature Nanotechnology 5 (2010)792-797

MA 11.4 Mon 13:30 H3

Spin-Resolved Studies of Individual Adsorbed Molecules with Sub*molecular Spatial Resolution — •Jens Brede — Institute of Applied Physics, University of Hamburg

We have investigated the spin- and energy-dependent tunneling through single molecules adsorbed on ferromagnetic thin films, spatially resolved at a sub-molecular level by low temperature spin-polarized scanning tunneling microscopy (SPSTM). In the case of cobalt coordinated Pc (CoPc) molecules the metal ion as well as the organic ligand exhibit a significant energy and spin dependence of STM images: Interestingly, the spin-majority dominated current flow from the organic periphery is in contrast to the spin-minority dominated tunneling current flow from the surrounding ferromagnetic Fe film. The observed inversion of the local spin polarization can explain the puzzling negative GMR values, which have been observed and controversially discussed in the field of molecular spin valves [1,2]. Thereby, our work tackles central aspects which are essential for understanding and designing new molecular spintronic devices.

More recently, phthalocyanine based single-molecule magnets (SMMs) were studied on ferromagnetic nanostructures by SPSTM as promising model systems for spintronic devices, quantum computing, and data storage at the nanoscale. In particular, we revealed the spin-dependent properties of SMMs with the highest reported blocking temperature bis(phthalocyaninato)terbium(III) (TbPC2). Individual spin split molecular orbitals were resolved for the first time with sub-molecular spatial resolution and the magnitude of the substrate induced exchange splitting was determined by spin-resolved tunneling spectroscopy. The unique insight offered by our SPSTM experiments highlights the importance of resolving spin-dependent molecular properties in atomically well-defined environments on a submolecular scale.
[1] Xiong et al., Nature 427, 821 (2004) [2] Jiang et al., Phys. Rev. B 77, 035303 (2008)