MA 54: Magnetic Coupling Phenomena

Time: Friday 9:30–11:15 Location: EB 301

MA 54.1 Fri 9:30 EB 301

Role of antiferromagnetic spin configuration in dual exchange biased structure in $[Pt/Co]_6/CoO/[Co/Pd]_8$ system — •Sri Sai Phani Kanth Arekapudi[1], Dmitriy Mitin[2], and Manfred Albrecht[2] — [1]Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz, Germany — [2]Institut für Physik, Universität Augsburg, D-86159 Augsburg, Germany

The exchange bias effect and magnetic reversal processes in the dual exchange bias structure, $[Pt/Co]_6/CoO/[Co/Pd]_8$ trilayer with an easy axis magnetization out-of-plane were studied. The individual reversal of the ferromagnetic multilayers was achieved by fine-tuning the switching field, and the exchange coupling was studied by observing the independent magnetic reversal processes, which was explicitly contemplated via minor loops. This allows us to set the trilayer system in two different magnetic cooling configurations. Where the net magnetic moment in the ferromagnetic layers were aligned either parallel or antiparallel to each other. After field cooling the samples from room temperature to below the blocking temperature of the antiferromagnet, we were able to probe the exchange interaction between two biased systems through a common antiferromagnetic interface. The dependence of exchange bias field on the thickness of the antiferromagnetic spacer (CoO) layer as well as the measurement temperature were systematically analyzed. Furthermore, the exchange bias field tends to decrease with increase in the thickness of the antiferromagnet and can be attributed to modification of the bulk spin structure and the domain walls of the AF layer ultimately influencing the exchange bias field.

MA 54.2 Fri 9:45 EB 301

Large exchange bias in epitaxial MnN/CoFe bilayers — Jan Balluff, Mareike Dunz, and •Markus Meinert — Center for Spinelectronic Materials and Devices, Physics Department, Bielefeld University, Germany

MnN is an antiferromagnet with a high Neel temperature and thus seems promising for exchange bias applications [1]. We investigated epitaxial MnN/CoFe film stacks grown on MgO(001) for their magnetic properties. We observed large exchange bias reaching up to 1000 Oe at room temperature. MnN film thickness, working pressure and deposition temperature dependencies of the exchange bias and the coercive field were studied in detail. Our results suggest that the MnN/CoFe system may become a substitute for the common IrMn or PtMn based exchange bias systems.

[1] Suzuki, K., Yamaguchi, Y., Kaneko, T., Yoshida, H., Obi, Y., Fujimori, H., and Morita, H. (2001). Journal of the Physical Society of Japan, 70(4), 1084-1089.

MA 54.3 Fri 10:00 EB 301

Light-ion bombardment induced magnetic patterning (IBMP) of exchange bias layer systems by He-ion microscope — •Alexander Gaul[1], Daniel Emmrich[2], André Beyer[2], Johanna Hackl[3], Hatice Doganay[3], Timo Kuschel[4], Andreas Hütten[4], Günter Reiss[4], Slavo Nemsak[3], Armin Gölzhäuser[2], and Arno Ehresmann[1] — [1]Department of Physics & CINSaT, University of Kassel — [2]Physics of Supramolecular Systems and Surfaces, University of Bielefeld — [3]PGI-6, FZ-Jülich — [4]Thin Films & Physics of Nanostructures, University of Bielefeld

Light-ion bombardment induced magnetic patterning (IBMP) of exchange bias (EB) bilayer systems by Helium ion bombardment through a shadow mask is a well known technique to tailor the magnetic anisotropy locally on the micrometer scale. Here we show the use of a Helium ion microscope (HIM) to create complex magnetic patterns in EB systems without masks. In this way lateral dimensions of the magnetic patterns down to a few tenths of a nanometer become feasible and experimetns to investigate the ultimate resolution limit of IBMP are at hand. Therefore designed patterns were written by a He-ion beam of 10~nm diameter in the EB layer. The influence of size and shape on magnetic domain walls within one sample has been analyzed by magnetic force microscopy (MFM) to detect changes in the domain wall charge distribution and by x-ray magnetic circular dichroism photoemission electron microscopy (XMCD-PEEM) to get a detailed information about the magnetization orientation within the domains and domain walls.

MA 54.4 Fri 10:15 EB 301

Unusual ferromagnetic $YMnO_3$ phase in $YMnO_3/La_{2/3}Sr_{1/3}MnO_3$ heterostructures — •Carmine Autieri and Biplab Sanyal — Department of Physics and Astronomy, Uppsala University, Box-516, SE-75120 Uppsala, Sweden

By means of ab-initio density functional calculations in the Hubbard model framework, we have studied the structural, magnetic and electronic properties of $YMnO_3/La_{2/3}Sr_{1/3}MnO_3$ heterostructures. Although in the bulk the ground state of $YMnO_3$ is a ferroelectric antiferromagnet, the $YMnO_3/La_{2/3}Sr_{1/3}MnO_3$ heterostructure stabilizes the ferromagnetic phase in $YMnO_3$ in the interface region. The hypothetical ferromagnetic phase of bulk $YMnO_3$ is dielectric and due to substantial differences between the lattice constants in the ab plane, a strong magnetocrystalline anisotropy is present. This anisotropy produces a high coercivity of the unusual ferromagnetic $YMnO_3$ that can explain the large vertical shift in the hysteresis loops observed in recent experiments. The correlation between weak exchange bias and vertical shift in hysteresis loops is proposed, which calls for reinvestigation of various systems showing vertical shifts.

MA 54.5 Fri 10:30 EB 301

Room temperature antiferromagnetism and exchange bias in $BiFeO_3$ / CoFe — •Christian Sterwerf, Jan-Michael Schmalhorst, and Günter Reiss — Center for Spinelectronic Materials and Devices, Physics Department, Bielefeld University, Germany

In this work we report room temperature exchange bias in bilayers of antiferromagnetic $BiFeO_3$ and ferromagnetic CoFe.

Epitaxial $BiFeO_3$ thin films were grown by reactive DC and RF magnetron co-sputter deposition on $SrTiO_3$ (100) substrates. Additional ferromagnetic CoFe layers with varying thicknesses were deposited to investigate the magnetic coupling between the films.

The crystallographic properties of the films are determined by means of x-ray diffraction and x-ray reflectivity. The amplitude of the exchange bias is investigated by the magneto-optical Kerr effect (MOKE) and the temperature dependent anisotropic magnetoresistance.

We found an exchange bias of more than H_{ex} = 75 Oe at room temperature accompanied by an increase of the coercive field of the CoFe layers to H_c=60 Oe.

MA 54.6 Fri 10:45 EB 301

Room temperature ferromagnetism in CoO/Co3O4 nanocrystals — •Zi-An Li[1], Nerio Fontaíña-Troitiño[2], András Kovács[3], Sara Liébana-Viñas[1], Marina Spasova[1], Rafal E. Dunin-Borkowski3[3], Markus Müller[4], David Doennig[4], Rossitza Pentcheva[1,4], Michael Farle[1], and Veronica Salgueiriño[2] — [1]Faculty of Physics and Center for Nanointegration (CENIDE), University Duisburg-Essen,Germany — [2]Departamento de FísicaAplicada, Universidade de Vigo, Spain — [3]Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons and Peter Grünberg Institute, Research Centre Jülich, Germany — [4]Department of Earth and Environmental Sciences, Section Crystallography, LMU Munich, Munich, Germany

Hetero-interfaces formed between oxide perovskite structures can exhibit novel functionality that is not available in the bulk constituents. Here, we present a detailed high-resolution transmission electron microscopy and quantitative magnetometry study of a robust (above room temperature) environmentally-stable ferromagnetically-coupled interface layer, which forms between the antiferromagnetic rocksalt CoO cores and the surrounding 2-4 nm-thick antiferromagnetic spinel Co3O4 surface layers of octahedral nanocrystals [1, 2]. The origin of the experimentally observed ferromagnetic phase is discussed based on density functional theory calculations including a Hubbard U term.

References 1. N. Fontaina-Troitino et al. Nano Letters 14, 640 (2014) 2. Financial support by the European Research Council Grant *IMAGINE* and SFB/TR80 is gratefully acknowledged.

MA 54.7 Fri 11:00 EB 301

Comparison of magnetic properties in amorphous and crystalline Fe/Fe-O core/shell nanoparticles — •Anil Kumar P.[1,2], Gurvinder Singh[3], Wilhelm R Glomm[4], Davide Peddis[5], Erik Wahlstrom[6], and Roland Mathieu[1] — [1]Department of Engineering Sciences, Uppsala University, Box 534, 751 21 Uppsala,Sweden

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Fe and Fe-O nanoparticles form an important part of several biomedical and technological applications. We report on the magnetic properties of amorphous Fe/Fe-O core/shell nanoparticles compared to those of a reference system with crystalline Fe/Fe-O core/shell nanoparticles. These nanoparticles are prepared by thermal decomposition and the nature of particles, amorphous or crystalline, is controlled by the choice of the ligand/surfactant. The crystalline Fe/Fe-O nanoparticles remain blocked until room temperature and exhibit small exchange bias effect. However, the amorphous Fe/Fe-O nanoparticles show substantial exchange bias and collective magnetic behavior with features of magnetic frustration and disorder reminiscent of spin/superspin glass systems. We discuss the origin of these effects.*Conference attendance supported by the EU-project NU-MATHIMO.