DS 10: Layers with Magnetic Properties

Time: Monday 17:15–19:00 Location: H34

DS 10.1 Mon 17:15 H34

Thermal stability of Py/Cu and Co/Cu giant magnetoresistance (GMR) systems — •Vitaliy Vovk[1], Guido Schmitz[1], and Andreas Hütten[2] — [1]Institute of material physics, WWU Münster, Münster, Germany — [2]Institute of nanotechnology, Forschungszentrum Karlsruhe, Karlsruhe, Germany

The long-term thermal stability in thin film functional materials often becomes a critical restriction regarding the technical application. GMR multilayer (ML) systems (Co/Cu and Py/Cu) are studied in this aspect since their automotive application requires operation in hot environments.

Tomographic atom probe analysis of Py/Cu system [1] conducted in our group has shown the minor broadening of the layer interfaces to be the most probable reason for the GMR degradation. Comparable results are observed in Co/Cu system using wide angle atom probe tomography (WATAP), though the systems have rather different thermodynamics. Besides the atomic transport, another important transformation takes place at elevated temperatures. The broad <111>-changes to sharp <200>-texture during the recrystallization process. It is shown that this texture reorientation is due to the anisotropic energy terms competition in the multilayer system. Since the RKKY coupling length depends among other parameters on the crystallographic orientation of the system, the thermal stability of the GMR effect can be significantly improved by the control of texture reorientation.

[1] C. Ene, G. Schmitz, R. Kirchheim, A. Hütten, Acta Materialia **53**, 3383, 2005.

DS 10.2 Mon 17:30 H34

Structural and magnetic characterization of Heusler multilayers — •Miriana Vadala[1], Alessio Lamperti[2], Alexei Nefedov[1], Gregor Nowak[1], Kurt Westerholt[1], Maximillian Wolff[1], and Hartmut Zabel[1] — [1]Experimentalphysik/Festkörperphysik, Ruhr-Universität Bochum, Germany — [2]Departement of Physics, University of Durham, United Kingdom

Heusler alloys are attractive candidates for application in spin dependent electron transport devices such as Giant Magneto Resistance (GMR), and in magnetic high performing devices. - We have grown by rf-sputtering multilayers of Heusler phase Co_2MnGe on Al_2O_3 and MgO substrates. We performed hard X-rays measurements to determine the chemical density profile and the epitaxial orientation inside these systems and polarized neutron reflectivity to study the magnetization profile of thin Co_2MnGe/Al_2O_3 and Co_2MnGe/MgO thin multilayers. X-ray scattering both at small and high angles showed intense Bragg peaks, respectively indicating high interface sharpness and crystallinity of the Heusler phase. Neutron maps, taken at room temperature and 10 K, both in saturated and remanence magnetization, evidenced a sharp magnetisation profile at the Heusler/Oxide interfaces with Bragg peaks detected up to the 4^{th} order; the absence of diffuse scattering indicates that the magnetic roughness is very small.

Financial support provided through the EU RTN "ULTRA-SMOOTH", as well as the partial support by SFB 491 and by BMBF 03ZA6BC1 is acknowledged.

DS 10.3 Mon 17:45 H34

Geometry and magnetic structure of epitaxial metallic layers on substrates with a large misfit — •Stephan Schönecker, Carsten Neise, Manuel Richter, Klaus Koepernik, and Helmut Eschrig — IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany

Modern electronic theory has provided a reliable theoretical procedure for finding total energies of crystalline materials for any configuration of atoms in the unit cell. Hence, we can look at epitaxial layers on substrats and perform total energy calculations for different geometries of layers in order to find metastable phases, that are locally stable against small perturbations.

Our calculations were done with the scalarrelativistic version of the full-potential local-orbital code FPLO. The method of fixed spin moment (FSM) was used to detect a possible magnetic ground state. We limit our discussion to crystals with body centered tetragonal (bct) Bravais lattice, and present results for palladium and cobalt. Both metals can be grown in a metastable but stress-free state on substrates, with a large misfit of up to 12 %.

DS 10.4 Mon 18:00 H34

Multilayered Polycrystalline Iron Garnet Structure of $Bi_3Fe_5O_{12}$ and $Y_3Fe_5O_{12}$ grown on SiO_2 substrates by pulsed laser deposition — •Timo Körner[1], Andreas Heinrich[1], Stephan Leitenmeier[1], Michael Herbort[1], Bernd Stritzker[1], Jürgen Simon[2], and Werner Mader[2] — [1]Universität Augsburg, EPIV, 86135 Augsburg — [2]Universität Bonn, Institut für Anorganische Chemie, 53117 Bonn

Iron Garnet single crystals like $Y_3Fe_5O_{12}$ (YIG) are important ceramic systems with extensive applications in structural ceramics and opto-electronics. Currently, it is desirable to integrate such macroscopic components on a single chip (e.g. Si, SiO_2, . . .) as in the case of microelectronics (integrated optics). High quality magnetooptical (MO) active garnet films with high Faraday rotation are also needed for MO imaging and microscopy. In our work we studied the influence of parameters during the deposition of YIG films and developed a new way to grow polycrystalline $Bi_3Fe_5O_{12}$ (BIG) thin films on different SiO_2 substrates using the pulsed laser deposition (PLD) method. Therefore we deposited a YIG buffer which was annealed above 1000°C in order to form a polycrystalline phase. On top of this buffer layer we deposited a thermodynamical unstable BIG layer. We measured the Faraday rotation of the films and studied them with x-ray diffraction (XRD), Rutherford backscattering spectroscopy (RBS), Environmental Scanning Electron Microscopy (ESEM) and high-resolution transmission electron spectroscopy (HRTEM). Their Faraday rotation can be compared with epitaxial BIG films grown on garnet substrates.

DS 10.5 Mon 18:15 H34

Pulsed Laser Deposition and Growth Studies of $Bi_3Fe_5O_{12}$ on $Gd_3Ga_5O_{12}$ — •Andreas Heinrich[1], Timo Körner[1], Stephan Leitenmeier[1], Michael Herbort[1], Bernd Stritzker[1], Jürgen Simon[2], and Werner Mader[2] — [1]Universität Augsburg, EP IV, 86135 Augsburg — [2]Universität Bonn, Inst. f. Anorganische Chemie

Magneto-optical garnets stand out because they exhibit a high Faraday rotation and low optical losses in the near infrared region. In this spectral range garnets are the only materials discussed in optical communications to realize nonreciprocal devices such as optical isolators. Such isolators are necessary to prevent reflected light caused by e.g. cable splices from irregularly entering optical components and hence to reduce the noise signal. Nowadays one wants to integrate such macroscopic optical components on a single chip leading to integrated optics. In order to achieve this, it is necessary to understand the principle growth mechanism, so that one can deposit high quality thin films of the optical active materials. We deposited $Bi_3Fe_5O_{12}$ on (100), (110) and (111) $Gd_3Ga_5O_{12}$ by Pulsed Laser Deposition. Here we want to give details on the growth and preferential growth direction of the films. Our investigations have been carried out by utilizing an Environmental Scanning Electron Microscopy, Energy Dispersive X-ray Analysis, Rutherford Backscattering Spectroscopy, and X-ray Diffraction. We also report on the Faraday rotation of the films, which has been determined in a special setup polarization microscope.

DS 10.6 Mon 18:30 H34

Magnetization in homogenous ferrofluidic films — •Birgit Graf[1], George Tzvetkov[1], Jörg Raabe[2], Konstantin Petukhov[3], and Rainer Fink[1] — [1]Universität Erlangen-Nürnberg, Lehrstuhl für Physikalische Chemie II, Erlangen, Germany — [2]Paul Scherrer Institut, Villigen, Switzerland — [3]Universität Erlangen-Nürnberg, Physikalisches Institut III, Erlangen, Germany

Ferrofluids are comprised of microscopic ferromagnetic nanoparticles, usually magnetite (Fe_3O_4), hematite (Fe_2O_3) or some other compound containing Fe^{2+} or Fe^{3+} suspended in a carrier fluid. The nanoparticles are typically of order 1-10 nm. Therefore and because of the fact that they are usually coated with a surfactant, most of the ferrofluids are stable. Since they do not retain magnetization in the absence of an externally-applied field they do not display macroscopic ferromagnetism.

As a model substance, we investigated thin films of APG L23 (from FerroTec, Nürtingen), which were prepared by spin-coating of the low viscous material. This material consists mainly of 10 nm magnetite particles. Using scanning transmission x-ray microscopy (STXM) at

the SLS PolLux beamline we could monitor small inhomogeneities within the films, which show distinct variations in the Fe L-Edge spectra. These variations may be due to phase separated species with different oxidation states. Using XMCD spectra and SQUID measurements, we derive the magnetic properties of differently prepared films (funded by the BMBF, contract 05 KS4 WE1/6).

DS 10.7 Mon 18:45 H34

LCMO Films Deposited on (100) and (111) STO Substrates — •Gulgun Hamide Aydogdu[1], Yener Kuru[2], and Hanns Ulrich Habermeier[1] — [1]Max Planck Institut für Festkörperforschung Heisenbergstraße 1, D-70569 Stuttgart, Germany — [2]Max Planck Institut für Metallforschung Heisenbergstraße 3, D-70569 Stuttgart, Germany

Epitaxial LCMO thin films of various thicknesses were grown on (100) and (111) STO substrates by pulse laser deposition technique (PLD). Determination of epitaxial relationship between the film and the substrate, phase analysis were carried out by X-ray diffraction (XRD). It is understood by pole figures that films on (111) STO display three-fold symmetry however, four-fold symmetry is observed for the ones on (100) STO. Surface morphologies and roughnesses of the films were characterized by atomic force microscopy (AFM). Electrical resistivities and magnetization of the samples were measured within a temperature range between 5 K and 300 K. Films on (100) STO were found to behave as an insulator for all thicknesses while the films on (111) STO show metallic behavior when film thickness exceeds 145 nm. Structural variations induced by the (111) STO substrate cause the increase of the Mn-O-Mn angle and the equatorial Mn-O distances. Consequently, double exchange mechanism is enhanced and the Jahn-Teller distortion is decreased. This study is an example that shows how the substrate material can be used to modify the electronic and magnetic properties of the LCMO films although chemical compositions and the thicknesses of films remain unchanged.