MA 30 Spin-Electronics II

Time: Thursday 15:15–16:15 Room: HSZ 103

MA 30.1 Thu 15:15 HSZ 103

Spin-resolved photoemission studies at the Fe(001)/MgO interface — •Martina Müller, Frank Matthes, and Claus M. Schneider — Institut für Festkörperforschung, Forschungszentrum Jülich

The epitaxial system Fe(001)/MgO/Fe represents one of the most interesting materials for studying the tunnel magnetoresistance effect (TMR). In order to explain discrepancies between experimental results and theoretical predictions for the height of TMR, our experiments focus on the properties of the interface between Fe(001)/MgO since its electronic structure strongly determines the interfacial coupling. We performed spin-resolved photoemission experiments at the Synchrotron DELTA (Dortmund) studying the Fe (3d) valence bands covered with an ultrathin MgO layer. The samples were produced by molecular beam epitaxy and characterized in-situ by Auger spectroscopy and low energy electron diffraction. The systematic variation of either oxidation and layer thickness of the on-top MgO covering reveals different processes: A spin dependent attenuation of the Fe (3d) minority channel is observed for varying MgO thickness whereas electrons of both spin directions are involved in the change of electronic structure when passing from an oxidic to a more metallic MgO capping layer. The analysis of the Fe spin polarization completes the investigations by uncovering the spin dependent bonding conditions at the Fe(001)/MgO interface.

MA 30.2 Thu 15:30 HSZ 103

Spin-dependent tunneling through antiferromagnets: Mn/Fe(001) — •Peter Bose[1], Jürgen Henk[2], Arthur Ernst[2], Ingrid Mertig[1], and Patrick Bruno[2] — [1]Martin-Luther-Universität, FB Physik, FG Theoretische Physik, 06099 Halle/S., Germany — [2]MPI für Mikrostrukturphysik, Abteilung Theorie, 06120 Halle/S., Germany

The size of the tunnel magnetoresistance (TMR) of a magnetic tunnel junction (MTJ) which includes an antiferromagnet (AFM) film is *a priori* not clear. On one hand, a large TMR can be expected due to the large spin polarization in the leads. On the other hand, the TMR is determined essentially by interface properties, suggesting a small TMR due to the interfaces of the antiferromagnet. Recent spin-resolved scanning tunneling microscopy (SR-STM) experiments [1] proved that the latter is true for layer-wise AFM Mn films on Fe(001) [2], hence stressing the importance of interface properties.

While model calculations corroborate the experimental findings [1], there appears need for sophisticated first-principles tunneling calculations, the latter being reported on in this contribution. The spin-dependent conductance of Fe/Mn/vacuum/Fe MTJs is computed within Landauer-Büttiker theory applying multiple-scattering theory (layer-KKR). By this means, the origin of the experimentally observed TMR is unequivocally determined. Further, the role of surfaces states which provide a contrast mechanism in SR-STM is investigated.

[1] U. Schlickum *et al*, submitted to Phys. Rev. Lett.
[2] A. Ernst, J. Henk, R.K. Thapa, J. Phys.: Cond. Matt. **17** (2005), 3269.

MA 30.3 Thu 15:45 HSZ 103

Large room temperature TMR effect in tunnel junctions based on magnetite — •Andrea Boger, Edwin Menzel, Suleman Qureshi, Daniel Reisinger, Wolfgang Kaiser, Sebastian T. B. Goennenwein, Matthias Opel, and Rudolf Gross — Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, Walther-Meissner-Str. 8, 85748 Garching

To realize magnetic tunnel junctions with high tunneling magnetoresistance (TMR) at room temperature, the ferromagnet magnetite (Fe_3O_4) is attractive. The Curie temperature T_C is 860 K, and it has been predicted to be a half-metal [1].
To experimentally determine the spin polarization, we have investigated properties of magnetic tunnel junctions (MTJs) with Fe_3O_4 as the bottem electrode, fabricated by pulsed laser deposition. Ni or Co served as counter electrodes, and AlO_x as the tunnel barrier.
The MTJs were patterned in different shapes and areas. Measurements of magnetotransport and dc magnetization were done between 150 K and 350 K. They show ideal switching behavior and match to each other. TMR effects up to 20 % for Fe_3O_4/AlO_x/Co and 11 % for Fe_3O_4/AlO_x/Ni could be reached at 300 K. From this follows a spin polarization of about 44 % for Fe_3O_4. In addition, the temperature and voltage dependence of the TMR has been studied. We also observed a large geometrically enhanced TMR of more than 1000 % at 300 K, which is due to an inhomogeneous current distribution in the MTJs.
This work is supported by the BMBF project 13N8279.
[1] Z. Zhang, and S. Satpathy, Phys. Rev. B **44**, 13319 (1991).

MA 30.4 Thu 16:00 HSZ 103

Tunnel junctions with the Heusler-electrode $Co_2Cr_{0.6}Fe_{0.4}Al$ — •Martin Jourdan, Andres Conca, Christian Herbort, Anna Gerken, and Hermann Adrian — Institut für Physik, Johannes Gutenberg Universität, 55099 Mainz, Germany

Due to the theoretically predicted half-metallicity of the Heusler compound $Co_2Cr_{0.6}Fe_{0.4}Al$ tunneling junctions employing this material as electrodes promise huge magnetoresistance effects. However, the control and understanding of the influence of the interface and tunneling barrier properties on the tunneling magnetoresistance (TMR) poses a challenge. Recently we were able to prepare well ordered (B2 structure) epitaxial thin films of $Co_2Cr_{0.6}Fe_{0.4}Al$ which serve as a base electrode of $Co_2Cr_{0.6}Fe_{0.4}Al$-AlO_x-Co-CoO junctions. The dependence of the TMR-effect on the deposition temperature of the Heusler-electrode and the parameters of barrier preparation is presented. The electrode-barrier interface is characterized by in situ STM and RHEED as well as TEM. The relation between the bulk properties of the $Co_2Cr_{0.6}Fe_{0.4}Al$ electrode and the tunneling magnetoresistance of the junctions is investigated.