# MA 35: Magnetic Oxides and Shape Memory Alloys (jointly with MM)

Time: Thursday 9:30–11:45 Location: H23

MA 35.1 Thu 9:30 H23

**Magnetoelastic coupling and the formation of adaptive martensite in magnetic shape-memory alloys** — •Markus Ernst Gruner and Peter Entel — Faculty of Physics and CeNIDE, University of Duisburg-Essen, 47048 Duisburg

Efficient magnetic shape-memory alloys undergo a thermoelastic martensitic transformation which is frequently accompanied by structural premartensitic precursor phenomena. The premartensites evolve into modulated martensitic phases which can in several cases be interpreted as nanotwinned representations of the low-symmetry ground state with a more or less regular periodicity of the twin defects. Their presence is related to a pronounced shear anomaly in [110] direction. This is a common signature of magnetic shape memory systems as different as Ni-Mn-based Heusler systems and disordered fcc Fe-based alloys and can be ascribed to an electronic band-Jahn-Teller-type instability which affects the transversal acoustic phonons in [110] direction.

By means of large-scale first-principles total energy calculations, we will demonstrate at the example of Ni-Mn-based Heusler compounds and disordered Fe-Pd alloys, that the presence of a specific magnetic order is an important factor for the (de-)stabilization of nanotwinned or modulated martensites according to the inherently strong magnetoelastic coupling in these systems.

MA 35.2 Thu 9:45 H23

**First order ferromagnetic to antiferromagnetic transition in the Heusler compounds Fe2MnGa and Mn2PtGa** — •A. K. Nayak[1], C. Shekhar[1], T. Gasi[2], M. Nicklas[1], and C. Felser[1] — [1]Max Planck Institute for Chemical Physics of Solids, 01187 Dresden, Germany. — [2]Institut for Inorganic and Analytical Chemistry, Johannes Gutenberg University, 55099 Mainz, Germany

The discovery of ferromagnetism by Heusler in X2YZ based materials that consist of all nonmagnetic elements has led to finding of several new materials with distinguishable properties. However, the structural and magnetic properties of these materials are complex in nature due to the observation of various magnetic as well as structural ordering depending upon the nature of X, Y and Z atoms. The off-stoichiometry X2YZ based materials, where part of the Z atoms are replaced by Y atoms, show a structural transition with strong magneto-structural coupling. Here we will show the observation of first order magnetic to magnetic transition in the Heusler compounds Fe2MnGa and Mn2PtGa. Fe2MnGa crystallizes in a cubic structure with ferromagnetic (FM) ordering that shows large Curie temperature (TC) of 750K. It undergoes a first-order FM to antiferromagnetic(AFM) transition around the room temperature. Mn2PtGa, which crystallizes in tetragonal structure, undergoes a first-order FM to AFM transition around 150K, below the magnetic ordering temperature of 230K. The first-order FM to AFM transition leads to kinetic arrest of the FM to AFM transition. The observation of phase coexistence and field induced irreversibility results in a new phase termed as magnetic glass.

MA 35.3 Thu 10:00 H23

**Unusual magnetic anisotropy of the ferromagnetic shape-memory alloy $Ni_{50}Fe_{23}Ga_{27}$** — •Jin-Feng Qian[1,2], Wen-Hong Wang[1], Guang-Heng Wu[1], and Claudia Felser[2] — [1]Institute of Physics, Chinese Academy of Sciences, 100190, Beijing, China — [2]Max Planck Institute for Chemical Physics of Solids, 01187, Dresden, Germany

Unusual magnetic anisotropy of the ferromagnetic shape-memory alloy $Ni_{50}Fe_{23}Ga_{27}$ has been observed. The anisotropy of the austenite becomes very large, even larger than that of the martnsite in ribbon samples. Lowering the temperature from 300 K to 80 K, the saturation field of the austenite is dramatically increased from 200 Oe up to 6 kOe. This high-anisotropy clearly highlights the demagnetization effect of the martensitic transformation. The physical mechanism is attributed to a combined effect coming from the atomic disorder, the premartensitic transformation, and the off-stoichiometric Ga-rich composition of the alloys.

MA 35.4 Thu 10:15 H23

**Magnetic dichroism in angular resolved hard X-ray photoelectron spectroscopy from buried magnetic layers.** — •Carlos Eduardo Viol Barbosa, Siham Ouardi, Daniel Ebke, Gerhard H. Fecher, and Claudia Felser — Max Planck Institute for Chemical Physics of Solids

The high bulk sensitivity of hard X-ray photoelectron spectroscopy (HAXPES) in combination with circularly polarized radiation enables the investigation of the magnetic properties of buried layers. Angular distributions of high kinetic energy (7 to 8 keV) photoelectrons in a range of about 60° were recorded in parallel to the energy distribution. Depending on purpose, energy and angular resolutions of 150 to 250 meV and 0.17° to 2° can be accomplished simultaneously in such experiments. Experiments were performed on exchange-biased magnetic layers covered by thin oxide films. More specifically, the angular distribution of photoelectrons from the ferromagnetic layer $Co_2FeAl$ layer grown on MnIr exchange-biasing layer was investigated where the magnetic structure is buried beneath a MgO layer. Pronounced magnetic dichroism is found in the Co and Fe $2p$ states for all angles of emission. A slightly increased magnetic dichroism was observed for normal emission in agreement with theoretical considerations.

MA 35.5 Thu 10:30 H23

**Impact of oxygen vacancies on the magnetic properties of $SrCoO_{3-\delta}$** — •Martin Hoffmann[1,2], Vladislav S. Borisov[2], Igor V. Maznichenko[1], Sergey Ostanin[1], Ingrid Mertig[1], Wolfram Hergert[1], and Arthur Ernst[2] — [1]Institute of Physics, Martin Luther University Halle Wittenberg, Germany — [2]Max Planck Institute of Microstructure Physics, Halle, Germany

Experimental studies have shown that the perovskite $SrCoO_{3-\delta}$ with $\delta \leq 0.06$ is a ferromagnetic metal. Due to a small lattice mismatch, this material could be used as an electrode in functional multicomponent systems with $ABO_3$ structure. Magnetic properties such as the critical temperature and the magnetic moment obtained in several measurements vary between 210-305K and 1.5-3$\mu_B$, respectively. Former theoretical investigations of this material still lack a proper description of the magnetic properties of $SrCoO_{3-\delta}$. Furthermore, oxygen vacancies are not considered previously. We explain the experimental results from the *ab-initio* point of view using a Korringa-Kohn-Rostoker (KKR) Green function method.

By means of the coherent-potential approximation, we model different amounts of randomly distributed oxygen vacancies and investigate the behavior of the Curie temperature $T_C$. Although the absolute values for $T_C$ are too large, the gradient agrees well with experiments. To improve the absolute values, we considered the strongly correlated character of the $d$-orbitals of Co by applying the LDA+$U$ method.

MA 35.6 Thu 10:45 H23

**Designing magnetic functionality in spin filter oxides on silicon** — •Christian Caspers[1], Sebastian Flade[1], Mihaela Gorgoi[2], Andrei Gloskovski[3], Wolfgang Drube[3], Claus M. Schneider[1], and Martina Müller[1] — [1]Peter Grünberg Institut (PGI-6), Forschungszentrum Jülich — [2]BESSY II, Helmholtz-Zentrum Berlin — [3]DESY Photon Science, DESY Hamburg

Integrating the magnetic oxide functionality into spintronics devices is an appealing route for realizing highly efficient and conductance-matched spin filter contacts. Europium Oxide (EuO) is the only binary magnetic oxide (MO) predicted to be thermodynamically stable on silicon. We succeeded in integrating high-quality EuO thin films directly on Si(001). We performed a depth-sensitive hard x-ray photoemission (HAXPES) study to selectively probe the bulk EuO and EuO/Si interface electronic structure. A quantitative analysis of the Eu core-level photoemission spectra reveals a nearly ideal stoichoimetry of ultra-thin EuO/Si(001) films (d=4 nm) and a fully homogeneous cation distribution. A careful inspection of the Si2p core level provides insights into the chemical state of the EuO/Si interface. An in situ passivation of SiO2 in the monolayer regime reduces metallic silicides at the EuO/Si interface to less than 3 A. Moreover, an epitaxial growth is realized in these carefully designed MO/Si heterostructures. Our study demonstrates the successful integration of high-quality EuO thin films directly on silicon, paving the way for future spin injection applications.

MA 35.7 Thu 11:00 H23

**XAS Studies on All-Oxide Ferromagnetic/Ferroelectric Heterosystems: SrTiO3(001)/La0.7Sr0.3MnO3/BaTiO3** —

•Hatice Doganay[1], Ingo Krug[1], Jürgen Schubert[2], Daniel Gottlob[1], Florian Nickel[1], Stefan Cramm[1], and Claus M. Schneider[1] — [1]Peter Grünberg Institut (PGI-6) Forschungszentrum Jülich, 52425 Jülich, Germany — [2]Peter Grünberg Institut (PGI-8) Forschungszentrum Jülich, 52425 Jülich, Germany

It is predicted by ab-initio calculations, that there is a charge redistribution at the Fe/BaTiO3 (BTO) [Sahoo, S. et al. PRB 76 (2007) 092108] interface, which is induced by the ferroelectric polarization, changing the interfacial magnetization of the ferromagnet. Considering the theoretical predictions [Burton, J. D. and Tsymbal, E.Y., PRB 80 (2009) 174406], it is very important to improve our knowledge of the interface properties of these so called artificial multiferroics. To avoid uncontrolled oxidation of the metal layer, we use fully oxidic systems such as BTO/La0.7Sr0.3MnO3(LSMO) layered heterostructures. The present work represents an x- ray absorption spectroscopy study on the all-oxide ferromagnetic /ferroelectric heterosystem SrTiO3(001)/LSMO/BTO fabricated by pulsed laser deposition. To provide accurate information on differences in the electronic properties as a function of oxygen background pressure during BTO growth, XAS measurements with polarized x-rays have been performed.

MA 35.8 Thu 11:15 H23

**Interface reaction in LSMO-metal hybrid structures** — •Nico Homonnay[1], Christian Eisenschmidt[1], Martin Wahler[1], Jo Verbeeck[2], Gustav Van Tendeloo[2], and Georg Schmidt[1] — [1]Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany — [2]University of Antwerp, Antwerpen, Belgium

The ferromagnetic oxide $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) is expected to have a high spin polarization. It can thus be interesting for oxide-metal hybrid structures for spintronics applications [1]. In these structures, however, possible degradation of the crystalline LSMO at interfaces to metals can be of utmost importance for transport structures based on giant magnetoresistance or tunnelling magnetoresistance. Here we present a study of in-situ prepared interfaces between LSMO and various metals. LSMO films are grown by pulsed laser deposition. The samples are then transferred in UHV either into a sputtering chamber or into an evaporation system where a thin metal layer is deposited (gold, platinum, copper, tantalum, chromium or titanium). Structural characterization is done by X-ray diffraction and transmission electron microscopy, while the magnetic properties are determined using a SQUID VSM. For a number of metals we observe a strong degradation of the crystalline quality or even a complete loss of crystallinity. In these samples also the magnetization is lost almost completely. Only for noble metals like Au or Pt both magnetic and structural integrity is preserved. These interface reactions are not observed if the sample is left in air for several days prior to metal evaporation. This work was supported by the EU project IFOX. [1] Park et al., Nature 392 (1998)

MA 35.9 Thu 11:30 H23

**Photoinduced changes of the first and third harmonic voltage at the metal insulator transition** — •Christin Kalkert, Marvin Walter, Jakob Walowski, Manuel Mchalwat, Vasily Moshnyaga, Bernd Damaschke, Markus Münzenberg, and Konrad Samwer — I. Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Manganite compounds are well known for their sensitivity to different external stimuli such as magnetic and electric fields. This is manifested for example in the colossal magnetoresistance and the colossal electroresistance effect. Here we study the influence of laser light on the first and third harmonic voltage in the vicinity of the temperature dependent metal insulator transition. We prepared epitaxial $La_{1-x}Ba_xMnO_3$ films ($x = 0.2 \ldots 0.3$) on $SrTiO_3$ substrates by metalorganic aerosol depostion technique. The first and third harmonic voltages were measured as a function of temperature with and without the laser beam shining onto the manganite bridge. The setup includes two lasers, a continous wave laser (Toptica Photonics, $\lambda = 640$nm) and a femtosecond laser (Femtolaser Fusion, $\lambda \approx 800$nm). We observed a change of the first and third harmonic voltage close to the metal insulator transition under the influence of the laser light. For manganite systems the third harmonic voltage can be associated with the concentration of correlated polarons, hence the results are discussed in terms of a light induced change of the concentration of correlated polarons. Financial support by DFG via SFB 602, TPA2 and the Leibniz Program is acknowledged.