DS 30: Thin film characterization: structure analysis and composition (TEM, LEED, PAS)

Time: Thursday 9:30–11:00 Location: H 0111

DS 30.1 Thu 9:30 H 0111

TEM investigation of magnetically exchange coupled FeTb/[Co/Pt]$_n$ films — •Herbert Schletter, Christian Schubert, Birgit Hebler, Manfred Albrecht, and Michael Hietschold — Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz

The coupling phenomena between different magnetic materials are of interest for fundamental research as well as for applications. Interesting magnetic behaviour is reported for the coupling of a ferrimagnetic (FI) amorphous FeTb layer to ferromagnetic (FM) [Co/Pt]$_n$ multilayers [1]. For our studies, such two-component systems were deposited by room temperature sputtering onto SiO_2/Si substrates. In contrast to [1], magnetic characterization by means of SQUID revealed an unexpectedly strong exchange coupling even when a 3 nm thick Pt spacer layer was introduced between FM and FI.

Since the exchange coupling strongly depends on the interface morphology, TEM was used to gather structural information of the sample. The investigation showed, that parts of the FM layer possess high roughness caused by deep trenches between the crystallites. As a result, the spacer layer might be discontinuous and therefore its decoupling effect would be hindered.

As a further step, FeTb layers (identical to the ones in the two-component systems) were deposited onto prepatterned substrates. The structural changes caused by the substrate patterns were studied by TEM and correlated with changes in the magnetic properties.

[1] S. Manging et al., Phys. Rev. B **78**, 024424 (2008)

DS 30.2 Thu 9:45 H 0111

Structural investigations of ferecrystals [(SnSe)$_{1+x}$]$_m$[TaSe$_2$]$_1$ by transmission electron microscopy — •Corinna Grosse[1], Ryan Atkins[2], Holm Kirmse[1], Wolfgang Neumann[2], and David C. Johnson[2] — [1]AG TEM, Humboldt-Universität zu Berlin, 10099 Berlin, Germany — [2]Department of Chemistry, University of Oregon, Eugene OR 97401-3753, USA

Ferecrystals are a new kind of layered materials with an unusual, turbostratically disordered structure. Layered materials can have structural and physical properties which differ from those of bulk compounds. Structural investigations of the materials are necessary to gain an insight into the mechanisms which can influence their physical properties. The new family of ferecrystals [(SnSe)$_{1+x}$]$_m$[TaSe$_2$]$_1$ with m = 1, 3, and 6 was investigated by various methods of transmission and scanning transmission electron microscopy (TEM/STEM), including selected area electron diffraction (SAED) and energy-dispersive X-ray spectroscopy (EDXS). The high-resolution TEM and STEM images show in-plane crystallinity, atomically abrupt interfaces and turbostratic disorder in the [(SnSe)$_{1+x}$]$_m$[TaSe$_2$]$_1$ ferecrystals. Certain layer-to-layer orientations appear prevalently, suggesting local ordering between the different types of layers in parts of the ferecrystals. The SAED patterns show an increase in ordering with increasing index m. The chemical composition of the layers was determined by means of EDXS.

DS 30.3 Thu 10:00 H 0111

Quantification of LEED measurements. I. Systematic Errors — •Falko Sojka, Matthias Meissner, Marco Gruenewald, Roman Forker, and Torsten Fritz — University of Jena, Institute of Solid State Physics, Max-Wien-Platz 1, 07743 Jena, Germany

Low energy electron diffraction (LEED) on epitaxial layers is a powerful tool to examine long-range ordering at the interface. However, due to limitations like distortion of the LEED images, often additional efforts have to be made in order to derive precise epitaxial relations.

We developed and implemented an algorithm to determine and correct systematic distortions in LEED-images. The procedure is independent of the design of the device (MCP-LEED vs. conventional LEED). Therefore, only a calibration sample with a well-known structure and a suitably high number of diffraction spots, i.e. Si(111)-7x7, is required. The algorithm provides a correction matrix which can be used to rectify all further measurements generated with the same device. In detail, we distinguish between a radial and an asymmetric distortion. Additionally, we found an axial distortion which occurs due to a tilted sample surface during the measurement. We will show that this axial distortion can be described theoretically with the Ewald Construction, and that it is thus possible to correct those measurements, too. After all, a relative accuracy of the lattice parameter determination better than 1 % can be achieved.

DS 30.4 Thu 10:15 H 0111

Quantification of LEED measurements. II. Application to epitaxial organic films — •Matthias Meissner, Falko Sojka, Marco Gruenewald, Roman Forker, and Torsten Fritz — University of Jena, Institute of Solid State Physics, Max-Wien-Platz 1, 07743 Jena, Germany

Low energy electron diffraction (LEED) on epitaxial layers is a powerful tool to examine long-range ordering at the interface. However, due to limitations like distortion of the LEED images, often additional efforts have to be made in order to derive precise epitaxial relations.

Based on LEED images corrected for their distortion and calibrated by means of a Si(111)-7x7 diffraction pattern (cf. talk by Falko Sojka), a home-made algorithm finds the LEED spots belonging to a certain structure and fits a lattice to all those spots simultaneously. This provides us with absolute lattice parameters within a small error margin. Additionally, in the case of organic-inorganic epitaxy, measurements at higher energies can be used to relate the adsorbate lattice to the substrate lattice and derive the epitaxy matrix. The precision of this procedure will be evaluated on the basis of two systems: (a) 3,4,9,10-perylenetetracarboxylic dianhydride (PTCDA) on epitaxial graphene, featuring two different PTCDA phases, one known, the other not; (b) Tin-phthalocyanine (SnPc) on Au(111), not being described in literature yet.

DS 30.5 Thu 10:30 H 0111

Interdiffusion in Au/Cu thin films studied by depth dependent CDBS — •Markus Reiner[1], Philip Pikart[1,2], and Christoph Hugenschmidt[1,2] — [1]TU München, Physik-Department, Lehrstuhl E21 — [2]TU München, ZWE FRM II

The non-destructive positron annihilation spectroscopy (PAS) with the monoenergetic positron beam at NEPOMUC allows the investigation of thin film samples. As model system, a couple of a vapor deposited Au film (180 nm) on top of a Cu film (480 nm) on a Si substrate was studied by coincident Doppler broadening spectroscopy (CDBS), which is sensitive to the chemical vicinity of the annihilation site on an atomic scale. Depth dependent and time-resolved measurements showed that the experimentally observed signature of the gold film completely vanished after a heating cycle of several hours (maximum temperature of 415 °C). Ab-initio calculations of various AuCu-alloys confirmed the interpretation that a homogeneous AuCu layer was formed on top of the Cu film.

DS 30.6 Thu 10:45 H 0111

Structural characterization of lead sheets for organ pipes by Positron Annihilation Spectroscopy — •Maik Butterling — Helmholtz-Zentrum Dresden-Rossendorf

An important issue when restaurating organ pipes made from lead alloys is the engineering of such material by mechanical hammering to increase the density. Microscopic effects of work-hardening on the surface near layers of lead sheets were investigated by depth resolving Doppler Broadening Spectroscopy measurements using the slow positron beam SPONSOR [1] of the Helmholtz-Zentrum Dresden-Rossendorf. The influence of small differences in the chemical composition of the samples is also discussed.

[1] W. Anwand, H.-R. Kissener, G. Brauer, Acta Phys. Polonica A 88, 7-11 (1995).