O 48: Oxide and Insulator Surfaces: Structure, Epitaxy and Growth

Time: Tuesday 18:30–20:30 Location: P1A

O 48.1 Tue 18:30 P1A

Epitaxy of Fe_3O_4/CoO bilayers and formation of cobalt ferrite on $SrTiO_3$(001) — •Jannis Thien, Jari Rodewald, Martin Hoppe, Karsten Küpper, and Joachim Wollschläger — Fachbereich Physik, Universität Osnabrück, Barbarastr. 7, 49069 Osnabrück, Germany

Thermoelectric generation using magnetic insulators such as ferrites has recently turned into a field of interest. In these materials the thermoelectric generation is initiated by a heat-mediated pure-spin-current, called the spin-Seebeck effect [1]. Furthermore, ferrites are of large interest for spin filters due their spin-dependent band gap [2].

One approach of preparing the ferrite $CoFe_2O_4$ is the interdiffusion of Fe_3O_4/CoO bilayers. Hence, Fe_3O_4/CoO bilayers were grown by reactive molecular beam epitaxy (RMBE) on $SrTiO_3$(001) consecutively. Afterwards the samples were post-annealed to start the diffusion process. The structural characterization of the surface was realised by low energy electron diffraction (LEED). X-ray photoelectron spectroscopy (XPS) was used to examine the chemical composition. Additionally, hard x-ray photoelectron spectroscopy (HAXPES) was carried out to be more sensitive to the bulk and interface composition. Further investigations of magnetic properties by vibrating sample magnetometry (VSM) are going to be performed.

[1] T. Niizeki et al., AIP Advances 5, 053603 (2015)
[2] J.-B. Moussy, J. Phys. D: Appl. Phys. 46, 143001 (2013)

O 48.2 Tue 18:30 P1A

NiO growth on Ag(001): A layer-by-layer vibrational study — •Florian O. Schumann[1], Krasimir L. Kostov[2], Sebastian Polzin[1], and Wolf Widdra[1,3] — [1]Institute of Physics, Martin-Luther-Universität Halle-Wittenberg, 06120 Halle, Germany — [2]Institute of General and Inorganic Chemistry, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria — [3]Max Planck Institute for Microstructure Physics, 06120 Halle, Germany

The vibrational properties of NiO(001) films on Ag(001) with thicknesses up to 50 monolayers (ML) are characterized with high-resolution electron energy loss spectroscopy (HREELS). The film-thickness-dependent Fuchs-Kliewer (FK) phonon frequency shifts and intensity changes are identified from the NiO monolayer to bulklike thick films. Characteristic changes of the vibrational properties are analyzed to resolve restructuring processes during annealing and thermal decomposition of NiO films. A quantitative comparison of the experimental data with the calculated loss function based on dielectric theory reveals an excellent agreement between the bulk and the NiO phonon properties for film thicknesses above 15 ML. In contrast, a strong FK phonon softening is observed for thin films below 5 ML that cannot be explained by dielectric theory nor phonon standing waves. This softening is attributed to the presence of surface stress, which results from the -2 % lattice mismatch between NiO and Ag. Furthermore the dispersion of six different phonon branches in the $\overline{\Gamma}\,\overline{X}$ direction for a fully relaxed 25 ML and a pseudomorphically 4 ML film will be compared.

O 48.3 Tue 18:30 P1A

High quality surfaces of perovskite oxides for photoemission spectroscopy — •Marten Düvel, Marius Keunecke, Sabine Steil, Daniel Steil, Vasily Moshnyaga, and Stefan Mathias — Georg-August-Universität Göttingen

In correlated materials, e.g., perovskite oxides, the overall behavior is governed by the interaction between charge, spin, orbit and lattice degrees of freedom. We plan to follow energy conversion processes in perovskite oxides, after optical excitation, using different time-resolved spectroscopy techniques. As a first step, $La_{0,3}Sr_{0,7}MnO_3$ thin films were prepared by metalorganic aerosol deposition (MAD) technique on $SrTiO_3$ (001) substrates and characterized by XRR, XRD, AFM, STM, SQUID, PPMS and SEM. From these oxide materials, we evaluate different methods to obtain high quality surfaces under ultra-high vacuum conditions, suitable for surface-sensitive methods like low-energy electron diffraction (LEED) and spin-,time- and angle-resolved photoemission spectroscopy (trARPES). Financial support of the SFB 1073 (TPB07) is acknowledged.

O 48.4 Tue 18:30 P1A

First stages of growth of SrxLa(1-x)MnO3 on SrTiO3(110) by PLD — •Giada Franceschi, Michele Riva, Ulrike Diebold, and Michael Schmid — IAP, TU Wien

Among energy conversion devices, solid-oxide fuel-cells (SOFCs) are attracting worldwide interest, being extremely efficient and environmentally friendly. Electricity is generated through electrochemical oxidation of fuels, which is initiated by incorporating oxygen at the cathode surface of the device. The state-of-the-art cathode material is strontium-doped lanthanum manganite (LSM), and current research on SOFCs aims at understanding the mechanisms behind the oxygen incorporation at its surface. As recently demonstrated, the latter must be addressed through atomic scale investigation, but to do so, a well-defined single-crystalline model system needs to be established in advance: within our project, we aimed at obtaining such a single-crystalline model system in the form of thin, atomically flat LSM films, grown by pulsed laser deposition onto SrTiO3(110) substrates. First, we home-prepared and characterized the target for pulsed laser deposition growth. After the optimization of the growth parameters, we incrementally grew LSM on different SrTiO3(110) substrates, and investigated the first stages of growth by employing in-situ STM, LEED, and XPS. For a proper set of growth parameters, LSM realized an ordered growth, resulting in atomically flat surfaces. We observed a changing periodicity with the film thickness, related to some non-trivial interaction mechanisms with the substrate. Atomic scale investigations were used to study the morphology of the grown films.

O 48.5 Tue 18:30 P1A

Electric field induced desorption of oxygen adatoms from the MoO_{2+x}/Mo(110) surface — •Killian Walshe[1], Sergey I. Bozhko[2], Olaf Lübben[1], Brian Walls[1], Barry E. Murphy[1], and Igor V. Shvets[1] — [1]Trinity College Dublin, Dublin, Ireland — [2]Institute of Solid State Physics, Russian Academy of Sciences, Chernogolovka, Moscow District 142432, Russia

Nanoscale writing on the MoO_{2+x}/Mo(110) surface has been demonstrated previously by Krasnikov *et al.* [1]. Pulsing with the scanning tunneling microscopy (STM) tip leads to the removal of oxygen adatoms. Here, in the zero tunneling current regime, STM measurements illustrate how the resolution of the nanoscale writing depends on the applied bias voltage and tip-surface distance. STM measurements and the theoretical modelling (COMSOL Multiphysics) of the electric field generated between the STM tip and metallic surface provides insight into the mechanism behind this process; the electric field generated by a negatively biased STM tip leads to anion oxygen adatoms penetrating the surface. The energetic barrier for this process has been estimated to be 0.45 eV. Density functional theory (DFT) calculations [1] demonstrate that the oxygen adatoms locally deform the underlying molybdenum oxide structure. It is suggested that this deformation, which leaves a gap below the oxygen adatom, reduces the barrier for the adatom to penetrate the surface.

1. A. Krasnikov *et al.*, *Nano Res.* **2013**, 6(12), 929-937

O 48.6 Tue 18:30 P1A

Single-crystalline growth of EuO on Cu (001) — •Tristan Heider[1], Timm Gerber[1], Patrick Lömker[1], Claus Michael Schneider[1,2], Lukasz Plucinski[1,2], and Martina Müller[1,2] — [1]Peter Grünberg Institut (PGI-6), Forschungszentrum Jülich GmbH, 52428 Jülich, Germany — [2]Fakultät für Physik and CENIDE, Universität Duisburg-Essen, 47048 Duisburg, Germany

The ferromagnetic insulator EuO shows very high spin polarization exceeding 90% which makes this material a prototype candidate for research in the field of spintronics. We studied MBE growth of EuO on Cu(001), because Cu is both a very good electrical and thermal conductor. Thus, Cu is also ideally suited as a substrate for photoemission experiments at low temperatures. Since the magnetic properties of EuO are strongly influenced by strain [1] Cu is an ideal substrate because it allows for nearly strain-free heteroepitaxy of EuO films, with the orientation EuO(100)||Cu(110) .

We systematically studied the growth of EuO on Cu(001) by performing synthesis in (a) temperature and (b) oxygen pressure series. We could restrict the EuO synthesis to a very small parameter window, in which single-crystalline growth is mastered. The crystalline quality was confirmed in situ by RHEED and LEED, while the chemical com-

position was analyzed by in situ XPS. An additional Eu capping layer was found to be a good protection from overoxidization of the highly reactive EuO film during vacuum transfer to the ARPES chamber, where high resolution spin-ARPES measurements are performed.

Reference: [1] Ingle et al. Phys. Rev. B 77, 121202(R) (2008)