DS 10: Thin Film Characterisation: Structure Analysis and Composition (XRD, TEM, XPS, SIMS, RBS, ...) III

Time: Monday 14:00–15:30 Location: GER 38

DS 10.1 Mon 14:00 GER 38

Structure and stability of laser deposited ZrO_2/Ti and ZrO_2/MgO multilayers — •Sarah Hoffmann, Benedikt Ernst, Tobias Liese, and Hans-Ulrich Krebs — Institut für Materialphysik, University of Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen

ZrO_2/Ti and ZrO_2/MgO thin multilayer systems have important applications in X-ray optics, especially in the 'water window' regime (wavelength: 2.3 - 4.4 nm) as X-ray mirrors and multilayer Laue lenses [1]. For this purpose the knowledge of the thermal stability of these multilayer systems is necessary. Thus, in this contribution the structure and stability of ZrO_2/Ti and ZrO_2/MgO multilayers is presented. The films were prepared on Si substrates using pulsed laser deposition (PLD) in ultra high vacuum. During heating the phase transformations of the components were studied using in-situ X-ray reflectometry (XRR) and in-situ X-ray diffraction (XRD). Furthermore, the changes in the structure were observed by in-situ transmission electron microscopy (TEM). The observed results are discussed with respect to the processes occuring during annealing of the multilayers (structural changes, crystallization of the amorphous oxides, changes in the oxygen content of the layers,...).

[1] T. Liese, V. Radisch, and H.U. Krebs, Rev. Sci. Instrum. 81 (2010) 073710.

DS 10.2 Mon 14:15 GER 38

Establishment of a structure zone model for the growth of reactively sputtered Titania thin films — •Azza Amin, Dominik Köhl, and Matthias Wuttig — I. Institute of Physics (IA), RWTH Aachen University, 52056 Aachen, Germany

TiO_2 thin films are applied in a wide range of applications e.g. in self-cleaning, antibacterial, antifogging or optical coatings. The physical properties exploited in these applications strongly depend on the crystal structure of the films. Crystalline TiO_2 thin films typically exhibit an anatase or a rutile phase. Therefore, it is desirable to develop a thorough understanding of the structure formation. This would allow it to tailor the film structure with the aim to improve the desired properties needed for a targeted application. Therefore, the structural evolution during growth of reactively sputtered TiO_2 films has been comprehensively investigated as a function of various parameters comprising oxygen partial pressure, energetic ion bombardment, target age and substrate temperature. Pronounced correlations have been found between the deposition conditions, the film thickness, the crystal structure and the morphology of the films. These correlations have been summarized in a structure zone model that explicitly links the basic characteristics of the deposition process with the properties of the films fabricated.

DS 10.3 Mon 14:30 GER 38

Non-destructive species depth profile of nanolayered systems — •Beatrix Pollakowski and Burkhard Beckhoff — Physikalisch-Technische Bundesanstalt, Berlin, Germany

Analyzing nanolayered samples with thicknesses larger than the mean free path of electrons, only spectroscopic methods based on photon detection may provide information without modifications of the specimens. The combination of X-ray absorption spectroscopy and X-ray fluorescence spectrometry under grazing incidence conditions (GIXRF-NEXAFS) has shown that a non-destructive analysis regarding the chemical bonds of deeply buried single layers is feasible [1]. Utilizing the intensity of x-ray standing wave (XSW) field, which is directly related to the grazing incidence, as a marker the penetration depth can be tuned to a certain depth.

The multilayer systems investigated consist of a titanium oxide and metallic titanium layer, separated from each other by a 2 nm C layer. For the respective experiment, well-characterized monochromatic synchrotron radiation of the electron storage ring BESSY II and calibrated instrumentation was employed. A species depth profile was derived by means of a differential approach. Two GIXRF-NEXAFS measurements at the Ti-$L_{iii,ii}$ absorption edges at different penetration depths are necessary to determine the entire system. The results demonstrate the high potential of the approach for analyzing novel materials and may provide access to interfaces.

[1] B. Pollakowski et al., Phys. Rev. B **77**, 235408 (2008)

DS 10.4 Mon 14:45 GER 38

Crystallization and Oxygen loading in pulsed laser deposited YSZ-Films — •Benedikt Ernst, Tobias Liese, Sarah Hoffmann, and Hans-Ulrich Krebs — Institut für Materialphysik, University of Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Yttria-stabilized zirconium dioxide (YSZ) as an oxygen ion conductor is widely used in technical applications, for example as solid oxide fuel cells. Thus, it is important studying the film stability at higher temperatures. In this contribution, amorphous YSZ films prepared by Pulsed Laser Deposition (PLD) at room temperature and annealed in argon/vacuum or oxygen atmosphere are presented. In a first thermal treatment in high vacuum up to temperatures of 800°C a loss of oxygen and crystallization of the film is achieved. Further heating in oxygen atmosphere leads to a reversible reloading of oxygen in the film. At this, changing the heating time and temperature enables to obtain different levels of oxygen in the samples. The weight change during outgasing and reloading was measured by thermal gravimetric analysis (TGA). The structure of different oxygen states and dynamics of crystallization was characterized by in-situ x-ray diffraction (XRD) and ellipsometry. This work is supported by the SFB755.

DS 10.5 Mon 15:00 GER 38

Hard X-ray photoelectron spectroscopy studies of newly designed charge transfer salts at PETRA III. — •Andrei Gloskovskii[1], Katerina Medjanik[2], Sebastian Thiess[3], Heiko Schulz-Ritter[3], Wolfgang Drube[3], Dennis Chercka[4], Martin Baumgarten[4], Klaus Müllen[4], Claudia Felser[1], and Gerd Schönhense[2] — [1]Institute of Inorganic and Analytical Chemistry, Johannes Gutenberg - University, Mainz — [2]Institute of Physics, Johannes Gutenberg - University, Mainz — [3]Hasylab/DESY, Hamburg — [4]Max Planck Institute for Polymer Research, Mainz

The undulator beamline P09 of the PETRA III storage ring is in user operation since September 2010. The hard X-Ray photoelectron spectroscopy (HAXPES) end station is located 95 m from the source. Photoelectrons with up to 15 keV kinetic energy can be measured in different experimental geometries by means of a SPECS Phoibos 225 HV analyser. Thin films and microcrystals of the organic charge-transfer compounds tetra- /hexamethoxypyrene - tetracyanoquinodimethane (TMP_x/HMP_x-$TCNQ_y$ in different stoichiometries) have been studied by HAXPES. The spectra of the HMP_x-$TCNQ_y$ compounds reveal two bonding states of oxygen, one of which stays fixed, but varies strongly in intensity and the other one is broadened and changes its energy position for x:y=2:1 microcrystals. This is an indication of the higher degree of charge transfer. The results correlate with previous investigations of the same systems using UPS/STS and NEXAFS. Funded by BMBF 05K10UMA, DFG/TR49, Graduate School of Excellence MAINZ, Centre of Complex Materials COMATT.

DS 10.6 Mon 15:15 GER 38

Transmission of ballistic electrons through metal–insulator–metal heterosystems — Johannes Hopster[1], Marika Schleberger[1], Lars Breuer[1], Andreas Wucher[1], Alexander Bernhart[1], Mark Kaspers[1], Christian Bobisch[1], Rolf Möller[1], and •Detlef Diesing[2] — [1]Institut für Experimentalphysik, Universität Duisburg-Essen — [2]Institut für Physikalische Chemie, Universität Duisburg-Essen

The transport of electrons through metal-insulator-metal heterosystems is determined by scattering processes in the metal layers and transport over or through the barrier in the insulator. We use an experimental setup combining a low energy electron gun with adjustable kinetic energy and a **b**allistic **e**lectron **e**mission **m**icroscope (BEEM). Electrons with excess energies of up to 5 eV are injected by a STM tip in the silver top electrode of a tantalum/tantalum–oxide/silver tunnel junction. The ratio of detected electrons in the tantalum back electrode and electrons injected into the silver top electrode depends exponentially on the tip voltage and thus, on the excess energy of the electrons in a wide range from 1.7 to 4.2 V. In experiments with an electron gun the transmission with primary energies from 20 eV to 600 eV was studied. With energies up to 600 eV the yield shows a

monotonous increase but the dependence on the energy turns from an exponential behavior to a linear behavior.