DS 6 Thin film analysis III

Time: Monday 14:00–15:45 Room: GER 38

Invited Talk

DS 6.1 Mon 14:00 GER 38

Direct observation of substrate-dependent organic layer growth — •Eberhard Umbach[1], Thomas Schmidt[1], Achim Schöll[1], Helder Marchetto[2], Hans-Joachim Freund[2], and Rainer Fink[3] — [1]Experimental Physics II, University of Würzburg, D-97074 Würzburg, Germany — [2]Fritz-Haber-Institute, Max-Planck-Gesellschaft, D-14195 Berlin, Germany — [3]Physical Chemistry, University of Erlangen, D-91058 Erlangen, Germany

The growth of highly ordered or even epitaxial organic thin films on inorganic substrates very much depends on the preparation parameters like temperature and deposition rate as well as on the molecular properties, interface bonding, and substrate morphology. Various high resolution surface sensitive techniques are successfully applied to get a deeper understanding of the substrate bonding, intermolecular interaction, and electronic properties of interface and organic thin film. A novel spectro-microscope with aberration correction and energy filtering allows the direct observation of layer growth and the spectroscopic study of nano-objects like organic crystallites. With this instrument called SMART structural, chemical, and electronic properties as well as their dynamic development can be investigated with down to 2 nm spatial, $<$ 100 meV electron energy, and 10 to 50 meV photon energy resolution. The SMART is briefly introduced, and several examples of organic layer growth are discussed. These show the transition from Stranski-Krastanov to Franck-van der Merwe growth, the influence of substrate steps and step bunches, and the dependence of the growth properties on temperature and molecule. (Funded by BMBF, contract 05KS4WWB/4)

DS 6.2 Mon 14:45 GER 38

High Resolution Rutherford Backscattering Spectrometer — •Martin Schnell, Michael Uhrmacher, Carsten Ronning, and Hans Hofsäss — II. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen

A standard Rutherford Backscattering (RBS) set-up is equipped with silicon charged-particle detectors, which posess an energy resolution of 10 to 15 keV. This results in a limited depth resolution of about 5 to 10nm for stoichiometry analysis of thin films.

In this work, we describe a RBS set-up, which has been connected to the 500 keV heavy ion accelerator IONAS at the University of Göttingen. Using up to 1 MeV He^{2+} or 500 keV H^+ as incident ion beams, the backscattered ions are now analyzed in a cylindrically shaped electrostatic analyzer with 30 cm radius and 6 mm electrode separation. As detector we will use segmented channelplate detectors or silicon strip detectors, providing about 1 mm position resolution, corresponding to an excellent energy resolution of 1 keV. The expected depth resolution is about 1 nm for an analyzing depth up to 100 nm.

We will discuss the feasibility of this method for the "non destructive"investigation of nanoscale multilayer thin films, interface and surface reactions. First experimental results will be presented.

DS 6.3 Mon 15:00 GER 38

Ionenstrahlmikroskopische Untersuchungen an synthetischen Kylindrit-Mikrostrukturen mit hohem Aspektverhältnis und verschiedenen Grundflächen — •Christoph Meinecke[1], Ronny Kaden[2], Jürgen Vogt[1], Klaus Bente[2], and Tilman Butz[1] — [1]Institut für Experimentelle Physik II, Universität Leipzig; Linnéstraße 5; 04103 Leipzig — [2]Institut für Mineralogie Kristallographie und Materialforschung, Universität Leipzig; Scharnhorststr. 20; 04275 Leipzig

Das Mineral Kylindrit gehört zu den Sulfosalzen und besitzt in der natürlichen Form die Stöchiometrie $FeSn_4Bb_3Sb_2S_{14}$. Neben einer komplexen Chemie sind auch die physikalische Eigenschaften des Kylindrites, wie para- bzw. ferromagnetisches Verhalten und die Bandlücke von ca. 0.7 eV "narrow band gap" interessant. Ziel dieser Arbeit war es an synthetisch, mittels CVT, erzeugtem Kylindrit die Stöchiometrie zu bestimmen. Dafür wurden Kylindrit-Mikrostäbe mit runder und rechteckiger Grundfläche, ionenstrahlanalytisch an der Ionenstrahl-Nanosonde LIPSION (Universität Leipzig) untersucht. Vorteil dieser Analysemethode ist, dass die Mikrostrukturen im Ganzen analysiert wurden und danach für weitere physikalische Untersuchungen, wie z.B. Messung der elektrische Leitfähigkeit und des Halleffektes, zur Verfügung standen. Dazu musste bei der Auswertung der PIXE und RBS Spektren die Morphologie der Mikrostruktur berücksichtigt werden. Diesbezüglich wird hier vorgestellt, wie diese Techniken, die sonst zur Dünnschichtanalyse benutzt werden, zur Analyse von Mikrostrukturen modifiziert werden können und welche Auswirkungen die Morphologie der Probe auf die Spektrenform hat.

DS 6.4 Mon 15:15 GER 38

Characterization of nanostructures by conducting AFM — •Andrei Andreev, Yue Hou, and Christian Teichert — Institute of Physics, University of Leoben, Franz-Josef-Str. 18, A-8700 Leoben, Austria

The Conducting Atomic-Force Microscope (C-AFM) is a conventional AFM working in contact mode, where the usual AFM tip is replaced by a conductive tip. Between the tip and the sample a voltage is applied and the resulting current is measured using a special amplification circuit. The C-AFM is well known as a valuable tool for nanometer scale characterization of electric and topographic properties of very thin oxide layers [1,2].

In this work, we focus on the capabilities of C-AFM technique for spatially resolved investigations of various nanostructures like hybrid organic-inorganic structures, metallic nanowires or light emitting organic nanofibers. Here, the applicability of C-AFM, in particular of two-dimensional current mapping, for the characterization of such nanostructures is presented.

[1] S. Kremmer, et al., Mat. Sci. Eng. B102 (2003), 88
[2] S. Kremmer, et al., J. Appl. Phys. 97 (2005), 074315

DS 6.5 Mon 15:30 GER 38

Inhomogeneities in film properties deposited in large area magnetron sputter devices — •Ronny Kleinhempel, Benjamin Graffel, Gunar Kaune, Hartmut Kupfer, Walter Hoyer, and Frank Richter — Chemnitz University of Technology, Institute of Physics, D-09107 Chemnitz

An industrial application of thin films requires optimized functional film properties as well as a lateral homogeneity of these parameters. Especially by using large area deposition devices like rectangular magnetron sources it is necessary to keep the process parameters constant at each substrate point. We deposited indium tin oxide (ITO) films using a dual magnetron powered by a sine-wave generator at a frequency of 70 kHz and constant power of 4 kW. The films were deposited by reactive sputtering from rectangular (130x400 mm^2) alloy targets (In-90/Sn-10) in an Ar/O_2 gas mixture. The substrates were either moved (dynamic deposition) or kept at a fixed position in front of the targets. For a high deposition rate and a low electrical resistivity it is preferable to work in the transition mode at set-points close the metallic target mode. This includes the risk that a small decrease of oxygen partial pressure causes a lower film transparency. This fact does not appear in a homogeneous way, but it appears always at the same substrate position. These lateral inhomogeneities are reflected in film properties like electrical resistivity, average grain size and residual stress as well. Discussing the film properties and the results of plasma measurements reveals that low transparency is connected to a smaller charge carrier density in the plasma. The reduced charge carrier density results in a lower residual stress.