DS 8: Thin Film Characterisation: Structure Analysis and Composition (XRD, TEM, XPS, SIMS, RBS, ...) I

Time: Monday 10:15–11:45 Location: GER 38

DS 8.1 Mon 10:15 GER 38

Oberflächennahe Analytik mit Kleinwinkelröntgenstreuung im Labor — •Jörg Wiesmann[1], Peter Siffalovic[2], Jozef Keckes[3] und Günther Maier[3] — [1]Incoatec GmbH, Geesthacht, Deutschland — [2]Slovak Academy of Sciences, Bratislava, Slowakei — [3]Erich Schmid Institut für Materialwissensch., Leoben, Österreich

Kleinwinkelstreuung mit Röntgenstrahlung (SAXS) ermöglicht die Untersuchung von Materialien im Nanometermaßstab. Aussagen zu Teilchengrößen und -verteilung sind möglich. Die Eindringtiefe der Röntgenstrahlung ermöglicht zudem Informationen aus der Probentiefe ohne Zerstörung der Proben. In den letzten Jahren wurde SAXS vorwiegend am Synchrotron verwendet. Durch Entwicklung neuer Hochleistungsquellen können nun viele Fragestellungen auch im Labor gelöst werden. In unserem Beitrag stellen wir die hochbrillante Mikrofokus Röntgenquelle IμS vor, beschreiben ihre Verwendung in typischen Labor-SAXS Instrumenten und zeigen Messergebnisse an dünnen Multilayer-Strukturen und nanoskaligen Proben. Die IμS besteht aus einer 30W luftgekühlten Röhre, die charakteristische Ag, Cu, Cr, oder Mo Strahlung liefert. Sie wird verbunden mit 2D strahlformenden Multilayer-Röntgenoptiken. Dadurch entsteht ein kollimierter Strahl von <0.5mm mit einer Divergenz von 1mrad oder kleiner. In Kombination mit 2D Detektoren können damit im Labor Messungen durchgeführt werden wie sie sonst nur am Synchrotron möglich sind. Wir zeigen das Potential von Laborgeräten für SAXS und GISAXS (GI steht für streifenden Einfall) anhand von Beispielen aus der Dünnfilmtechnik (Multilayer als Röntgenoptiken).

DS 8.2 Mon 10:30 GER 38

BioRef - a versatile time-of-flight reflectometer for soft matter applications at Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin — •Markus Strobl[1], Roland Steitz[1], Martin Kreuzer[1,2], Reiner Dahint[2], and Michael Grunze[2] — [1]Helmholtz Zentrum Berlin für Materialien und Energie, Hahn-Meitner Platz 1, 14109 Berlin — [2]Universität Heidelberg, Im Neuenheimer Feld 229, 69120 Heidelberg

BioRef is a versatile novel time-of-flight (TOF) reflectometer at the reactor neutron source BER II of the Helmholtz Centre Berlin (HZB) featuring an infrared spectrometer for complementary in-situ ATR-FTIR measurements. The instrument has recently undergone commissioning and is now available for specular and off-specular neutron reflectivity measurements. BioRef is especially dedicated to the investigation of soft matter systems and studies at the solid liquid interface. Due to flexible resolution modes and variable utilized wavelength bands that allow for focusing onto a selected q-range BioRef enables a broad range of surface and interface investigations and even kinetic studies with sub-second time resolution. The instrumental conditions can be tailored to the specific requirements of a wide range of applications. The performance is demonstrated by several reference measurements and the unique option of in-situ on-board infrared spectroscopy is introduced by the example of a phase transition study in a lipid multilayer film.

DS 8.3 Mon 10:45 GER 38

Comparison of quantitative X-Ray Fluorescence Spectrometry under normal and grazing incidence condition by means of buried nanolayers — •Rainer Unterumsberger[1], Beatrix Pollakowski[1], Matthias Müller[1], Burkhard Beckhoff[1], Wolfgang Ensinger[2], Peter Hoffmann[2], Tobias Adler[2], and Andreas Klein[2] — [1]Physikalisch-Technische Bundesanstalt, Abbestr. 2-12, 10587 Berlin, Germany — [2]Institute of Materials Science, Technische Universität Darmstadt, Petersenstr. 32, 64287 Darmstadt, Germany

Non-destructive thickness determination of nanolayer and thin films becomes more and more important. The quantitative X-Ray Fluorescence Spectrometry (XRF) with synchrotron radiation is a well-established method for thickness determination of thin layers. Under grazing incidence condition (GIXRF), due to total reflection of the incidence beam the x-ray standing wave (XSW) field occurs. That enables near surface quantification of lowest depositions and the possibility of buried nanolayer quantification. In this work quantitative XRF and GIXRF will be compared and the advantages and limits of both methods will be demonstrated. Within a project of the German Science Foundation (DFG), a special sample system was investigated. It consists of buried borcarbide nanolayers varying in thickness deposited on 10 nm titanium and covered with 2.5 nm silicon dioxide. All layered structures are deposited on silicon-wafers. The measurements were carried out in the PTB laboratory at BESSY II. The result of the buried nanolayer thicknesses matches in both methods.

DS 8.4 Mon 11:00 GER 38

X-ray Reflectivity and Grazing Incidence X-ray Diffraction — •Markus Meyl[1], Bogdan Szymański[2], Arno Ehresmann[1], and Feliks Stobiecki[2] — [1]University of Kassel, Heinrich-Plett-Str. 40, 34132 Kassel, Germany — [2]Institute of Molecular Physics, Polish Academy of Sciences, Mariana Smoluchowskiego 17, 60-179 Poznań, Poland

X-ray Reflectivity and Grazing Incidence X-ray Diffraction in Bragg-Brentano-Geometry and by the Guinier-Process for the investigation of thin films will be discussed. The Guinier-Process as compared to the Seemann-Bohlin-Geometry includes the use of a monochromator between the X-ray tube and the sample for achieving strictly monochromatic incident X-rays as well as its very small angle of incidence. As a result the diffraction spectra have less background signal and higher intensities. Furthermore the structural information which can be received by these methods will be mentioned. From the spectra measured with the Bragg-Brentano-Geometry the layer thicknesses, the interface roughness's and the densities of the thin films can be determined. In addition the diffraction spectrum obtained with the Guinier-Process provides e.g. information about the lattice parameter, the lattice type and the crystallite sizes. In the last part exemplary results of thin films on a silicon substrate will be presented.

DS 8.5 Mon 11:15 GER 38

Nucleation Mechanisms In High Energy Ion Beam Induced Dewetting — •Michael Haag, Daniel Garmatter, Redi Ferhati, Sankarakumar Amirthapandian, and Wolfgang Bolse — Institut für Halbleiteroptik und Funktionelle Grenzflächen, Universität Stuttgart

Solid coatings, when heated above their melting points, often break up by forming small round holes, which then grow, coalesce and finally turn the initially contiguous film into a pattern of isolated droplets. Such dewetting has been intensively studied using thin polymer films on Si [1]. Three different hole nucleation mechanisms were discovered: homogeneous (spontaneous) nucleation, heterogeneous nucleation at defects, and spinodal dewetting by self-amplifying capillary waves. We have recently found that swift heavy ion (SHI) irradiation of thin oxide films on Si results in similar dewetting patterns, even though the films were kept far below their melting points [2]. Using our new in-situ SEM at the UNILAC accelerator of GSI [3], we were now able to identify the mechanisms behind this SHI induced dewetting phenomenon. By varying the film thickness and introducing defects at the interface, we can directly address the hole nucleation processes. Besides homogeneous and heterogeneous nucleation, we also found a process, which very much resembles the spinodal mechanism found for liquid polymers, although in the present case the instable wavy surface is not generated by capillary waves, but by ion beam induced stresses. [1] S. Herminghaus, et al., Science 282 (1998), [2] T. Bolse, et al., Nucl.Instr.Meth. 245 (2006), [3] S. Amirthapandian, et al., Rev.Sci.Instr. 81, (2010)

DS 8.6 Mon 11:30 GER 38

Sophisticated analysis of the PDA of thin praseodymia films at temperatures up to 300°C — •Sebastian Gevers[1], Daniel Bruns[1], Alessandro Giussani[2], Thomas Schröder[2], and Joachim Wollschläger[1] — [1]Fachbereich Physik, Universitaet Osnabrueck, Barbarastr. 7, 49069 Osnabrueck, Germany — [2]IHP, Im Technologiepark 25, 15236 Frankfurt (Oder), Germany

High quality praseodymia films are discussed as insulating buffer material, e.g. to form high-functional Germanium On Insulator (GeOI) heterostructures on the dominating Si wafer platform. For this purpose, thermal treatment of the oxide buffer layers is necessary to grow high quality Ge films with low defect densities. To control and to improve the quality of the GeOI structures, it is crucial to understand

the behavior of preaseodymia films regarding structure and defect formation during these annealing processes.

Therfore, thin heteroepitaxial praseodymia films with fluorite structure on Si(111) were annealed under UHV conditions at temperatures up to 300°C. Afterwards, investigations by X-ray diffraction (XRD), grazing incidence X-ray diffraction (GIXRD) and X-ray reflectometry (XRR) were performed to obtain information about structural changes of the film during the annealing process. Analyzing the XRD measurements within the kinematic diffraction theory leads to a detailed view on structural changes of the oxide films, e.g. separation into different crystalline phases.