DS 37: Thin Film Characterisation: Structure Analyse and Composition (XRD, TEM, XPS, SIMS, RBS, ...) II

Time: Thursday 11:15–12:45 Location: H8

DS 37.1 Thu 11:15 H8

Rare-Earth-Oxide Ultrathin Films — •Maraike Ahlf[1], Marvin Zöllner[1], Mareike Ahlers[2], Mathias Wickleder[2], and Katharina Al-Shamery[1] — [1]University of Oldenburg, Physical Chemistry 1 — [2]University of Oldenburg, Inorganic Chemistry, Germany

Increasing speed of development in microelectronics as well as in catalysis leads to the need of high performance thinfilm materials e.g. as gate-oxides in MOSFETs, new OLED applications or thinfilm coatings on catalysts. Especially in semiconductor industries the miniaturization of the microelectronic components requires new materials having higher dielectric constants and larger band gaps than conventionally used SiO_2 as gate-oxide to avoid quantummechanical tunneling with concomitant high leakage and high heat diffusion rates. Conventionally used methods for thinfilm deposition (e.g. PVD, CVD) suffer from problems such as carbon impurities within the deposited layers and formation of interfacial layers. Rare-earth oxides are potential candidates to replace SiO_2 as gate-oxide due to their electrical properties. Alternatively they are good candidates for OLED applications due to their luminescence. A radically new approach using new rare-earth based inorganic designer precursors which may easily be realized and incorporated into device production will be presented. In and ex UHV-Experiments have been done to study the constitution of the thin films, the crystallization process and the decomposition mechanism of the precursors on the surface using XPS, STM, AFM, SEM, TPD, TGA and TEM analyses. The precursors are expected to decompose carbonfree to form the oxide and gaseous decomposition products.

DS 37.2 Thu 11:30 H8

GIXRF in the soft X-Ray range used for the characterization of ultra shallow junctions — •Burkhard Beckhoff[1], Philipp Hönicke[1], Damiano Giubertoni[2], and Giancarlo Pepponi[2] — [1]Physikalisch-Technische Bundesanstalt, Abbestr. 2-12, 10587 Berlin, Germany — [2]Fondazione Bruno Kessler, via Sommarive 18, 38100 Povo, Trento, Italy

Grazing Incidence X-Ray Fluorescence (GIXRF) analysis in the soft X-ray range provides excellent conditions for exciting B-K and As-$L_{iii,ii}$ shells. The X-ray Standing Wave field (XSW) associated with GIXRF on flat samples is used as a tunable depth sensor to gain information about the implantation profile. This technique is very sensitive to near surface layers. It is therefore well suited for the study of ultra shallow dopant distributions. Arsenic implanted (implantation energies between 0.5 keV and 5.0 keV) and Boron implanted (implantation energies between 0.2 keV and 3.0 keV) Si wafers have been used to compare SIMS analysis with GIXRF analysis.

The measurements have been carried out at the electron storage ring BESSY II using monochromatized undulator radiation of well-known radiant power and spectral purity. The use of an absolutely calibrated energy-dispersive detector for the registration of the B-Kα and As-Lα fluorescence radiation allows for the absolute determination of the retained dose. An estimate of the concentration profile has been obtained by fitting the measurements with profiles derived by simulation of the implantation process. A good match among the total retained dose measured with the different techniques has been observed.

DS 37.3 Thu 11:45 H8

Advanced species depth-profiling with a photon-in photon-out method — •Beatrix Pollakowski and Burkhard Beckhoff — Physikalisch-Technische Bundesanstalt, Abbestr. 2-12, 10587 Berlin

Characterizing multi-layered systems with layer thicknesses of up to 10 nm, which is beyond conventional electron information depths and sensitivity, only spectroscopic method based on photon excitation and detection may provide information without any destructive modifications of the specimens. The presented photon-in photon-out method GIXRF-NEXAFS [1] allows for a non-destructive analysis with respect to the chemical bonds of deeply buried single layers. Considering the investigation of buried interfaces or gradient layers this approach may gain in importance as alternative method. The intensity of the X-ray standing wave (XSW) field determining GIXRF characteristics is utilized as a tunable marker to keep the mean penetration depth constant in the respective layer of interest.

The multi-layered 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 absolutely calibrated instrumentation was employed. GIXRF-NEXAFS measurements at the Ti-$L_{iii,ii}$ absorption edges with angular correction based upon prior XSW simulation demonstrate the high potential of the approach for analyzing novel materials and may provide access to buried interfaces by a differential approach.

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

DS 37.4 Thu 12:00 H8

Oberflächenanalyse von hocheffizienten Cu(In,Ga)Se_2 Solarzellenabsorberschichten — •J. Lehmann, S. Lehmann, S. Sadewasser, C.A. Kaufmann, T. Rissom, R. Caballero, A. Grimm, I. Lauermann und M.Ch. Lux-Steiner — Helmholtz-Zentrum Berlin für Materialien und Energie, Deutschland

Dünnschichtsolarzellen, basierend auf polykristallinen p-Typ Cu(In,Ga)Se_2 (CIGSe) Absorbern, weisen besonders hohe Wirkungsgrade (20%) auf. Durch intensive oberflächensensitive Charakterisierung wird gegenwärtig versucht, ein besseres Verständnis über Grenzflächen (z.B. Oberflächen, Korngrenzen) in diesen Solarzellen zu gewinnen. Verunreinigungen und Oxidation können dabei jedoch die Messergebnisse stark beeinflussen und teilweise verfälschen. Daher ist es wichtig, reproduzierbare und bezüglich Komposition und Kontamination definierte Oberflächen herstellen zu können. Hierzu wurden polykristalline CIGSe-Schichten definiert oxidiert und anschließend in basischen Lösungen (KCN bzw. NH_3) nasschemisch behandelt. Die Stöchiometrie sowie der Grad der Oxidation wurden mit Hilfe der Photoelektronenspektroskopie (XPS sowie UPS) oberflächensensitiv analysiert. Es zeigt sich, dass aufgrund der unterschiedlichen Affinitäten der Elemente zur Oxidation, die Oberflächenstöchiometrie der Probe verändert wird. Weiterhin konnte gezeigt werden, dass die Oberflächenbehandlung mit KCN in Bezug auf die Beseitigung der Oxide effektiver ist, als die Behandlung in ammoniakalischer Lösung. Die KCN-behandelte Oberfläche ist in seiner chemischen Struktur einer nicht an Sauerstoff ausgesetzten Oberfläche nahezu identisch.

DS 37.5 Thu 12:15 H8

Kationenordnung in $LaSrCoO_{3-x}$ Schichten auf $SrTiO_3$ — •Wolfgang Donner[1], Allan Jacobson[2] und Chonglin Chen[3] — [1]TU Darmstadt, Materialwissenschaften — [2]University of Houston, Chemistry — [3]University of Texas at San Antonio, Physics

Wir berichten über Synchrotronmessungen an dünnen epitaktischen $LaSrCo_{3-x}$ Schichten auf $SrTiO_3$. In Schichten, die *in situ* bei 400 Grad Celsius im Vakuum untersucht wurden, finden wir eine extrem grosse Ausdehnung (5.7%) in senkrechter Richtung gegenüber dem Zustand bei Normalbedingungen. Diese Ausdehnung wird durch die Ausbildung geordneter Sauerstoffleerstellen in Ebenen parallel zur Oberfläche verursacht. Wir finden dass diese Sauerstoffleerstellenordnung von einer Ordnung der La und Sr Kationen auf den A-Plätzen der Perowskitstruktur begleitet wird. Diese Kationenordnung tritt im Volumenmaterial nicht auf und ist durch die epitaktische Spannung verursacht.

DS 37.6 Thu 12:30 H8

Coincident Doppler Broadening measurement on embedded thin layers of different materials with a positron beam of variable energy — •Philip Pikart[1,2], Christoph Hugenschmidt[1,2], and Klaus Schreckenbach[1,2] — [1]ZWE FRM II, Lichtenbergstraße 1, 85747 Garching — [2]Technische Universität München, Physik Department E21, James-Franck Straße, 85748 Garching

Coincident Doppler Broadening (CDB) is particularly suited to study thin layers in a non-destructive way. Further, CDB is outstanding in its sensitivity to defects and precipitates, because the positron is used as a "nanoprobe". It diffuses thermally inside the sample, can be localized at a defect and then annihilates with an electron by the emission of gamma-radiation. The shape of the annihilation line is characteristic for chemical elements and defect types. Defects have a highly attractive potential for the diffusing positron, which leads to trapping in open volume defects. But also the trapping at precipitates and small clusters of a different material is possible. The aim of the

presented experiment is to study the trapping at interfaces and thin layers. For this purpose, samples consisting of aluminum are grown with an embedded layer of gold, copper and chrome. These materials cover a wide range of positron affinities, so the trapping probability of a positron at the layer depends on the material and the layer thickness. CDBS-results of these samples are presented and explained by a one-dimension potential well model.