

DS 12: Thin Film Characterisation: Structure Analyse and Composition (XRD, TEM, XPS, SIMS, RBS, ...)

Time: Tuesday 11:45–13:30

Location: H 2013

DS 12.1 Tue 11:45 H 2013

Experimental determination of the IMPF of electrons in organic molecular solids — •TINA GRABER, STEFAN KRAUSE, ACHIM SCHÖLL, and FRIEDRICH TH. REINERT — Universität Würzburg, Experimentelle Physik II, Am Hubland, 97074 Würzburg

A precise knowledge of the inelastic mean free path (IMPF) of electrons in matter is of crucial interest in many respects. If electron spectroscopic techniques are applied in surface and interface science the attenuation length of the involved electrons has to be well-known in order to gain information on, e.g., adsorbate film thickness or growth modes. The IMPF certainly depends on the respective material and on the electron kinetic energy. Whereas some experimental information is available for inorganic compounds the data is very scarce for organic materials. Moreover, there is not yet a uniform theoretical description of the IMPF and the loss mechanisms of electrons in organic films, although some calculations have been performed [1]. In this work we present a systematic experimental study on the IMPF of electrons in condensed PTCDA films by means of photo electron spectroscopy (PES) and applying the overlayer method. Since the control of the adlayer growth mode it is mandatory for a precise determination, the attenuation length PTCDA/Ag(111) was chosen as a model system. The results indicate a significant deviation of the experimental IMPF values from the universal curve, which is generally utilized as a zeroth order approximation for the electron mean free path, particularly for low electron energies. [1] Tanuma, S., Powell, C. J., Penn, D. R., Surf. Int. Anal. 21, 165, 1993

DS 12.2 Tue 12:00 H 2013

Zeitaufgelöste Studien zum Transport von Alkali-Ionen durch dünne Polymerfilme — •THOMAS KOLLING, ANDREAS SCHLEMMER und KARL-MICHAEL WEITZEL — Fachbereich Chemie, Philipps Universität Marburg

Dünne Filmschichten und Membrane spielen in Forschung und Technik eine grosse Rolle, z. B. in der Mikroelektronik, Medizintechnik aber auch allgemein in der Oberflächenbearbeitung und -veredelung. Ausgehend von Studien zum integralen Transport von Caesium-Ionen durch dünne PPX - (Poly-Para-Xylene) Membrane beschreiben wir hier erste zeitaufgelöste Studien zum Transport einzelner Ionen durch eine entsprechende Membran. Dazu wurden dünne PPX-Membrane variabler Dicke (100 nm bis 2 μ m) durch Plasma-Dampfabscheidung (CVD) präpariert. So erzeugte Membrane wurden anschließend in einer Ultrahochvakuumkammer "freistehend" positioniert und mit gepulsten Ionenstrahlen verschiedener Alkali-Ionen, z.B. Cs⁺ und K⁺ beschossen. Durch die Membran hindurchtretende Teilchen wurden mit einem Mikrokanalplattendetektor zeitaufgelöst nachgewiesen und bezüglich ihrer kinetischen Energie analysiert. Gegenwärtig kann die Pulsdauer des Ionenstrahls vom μ s-Bereich bis zu 100 ns variiert werden. Bei den kürzesten Pulsdauern finden wir deutliche Hinweise auf Energiedissipation im Zuge diffusiven Transports.

DS 12.3 Tue 12:15 H 2013

Surface sensitive analysis of YBCO thin films — •TETYANA SHAPOVAL, SEBASTIAN ENGEL, ELKE BACKEN, DAGMAR MEIER, MARINA GRÜNDLICH, ULRIKE WOLFF, VOLKER NEU, BERNHARD HOLZAPFEL, and LUDWIG SCHULTZ — IFW Dresden, Institute for Metallic Materials, P.O. Box 270116, D-01171 Dresden, Germany

Successful cleaning and polishing of a set of YBa₂Cu₃O_{7- δ} (YBCO) thin films prepared by Pulsed Laser Deposition (PLD) and Chemical Solution Deposition (CSD) have been performed. The roughness of the films was reduced to a value of less than 5 nm, which opens a way to apply local surface sensitive techniques even on formerly very rough samples (some hundred nm peak-to-valley) such as CSD YBCO films. As one application flux lines of YBCO films were imaged with the Omicron Cryogenic SFM in MFM mode.

The knowledge about geometry and distribution of artificial nanodefects in the interior of the film is crucial for further improvement of superconducting properties of these materials. The above mentioned polishing procedure has been further developed to prepare smooth low angle wedges of such samples. This offers the possibility to obtain depth dependent information with different surface sensitive scanning

techniques. A high resolution electron backscattered diffraction image on the polished wedge of CSD YBCO sample reveals the homogeneous distribution of non superconducting BaHfO₃ nanoparticles in the whole volume of the film.

DS 12.4 Tue 12:30 H 2013

Depth Resolved Doppler Broadening Measurement of Layered Al-Sn-Samples — •PHILIP PIKART^{1,2}, MARTIN STADLBAUER^{1,2}, KLAUS SCHRECKENBACH^{1,2}, and CHRISTOPH HUGENSCHMIDT^{1,2} — ¹TU Munich, Department of Physics E21, James-Franck-Strasse, 85478 Garching — ²TU Munich, ZWE FRM II, Lichtenbergstrasse 1, 85748 Garching

The accumulation of positrons in a 2-dimensional layer of tin embedded in aluminum is examined by Doppler Broadening Spectroscopy (DBS). For this purpose samples are grown out of high purity materials consisting of a step-shaped layer (0.1 to 200 nm) of tin on a substrate of aluminum and covered by an aluminum layer of constant thickness (200 nm). The positron implantation profile is varied by different positron acceleration energies of up to 15 keV. The pre-thermal implantation profile of the monoenergetic positron beam is examined since the effect of thermal positron diffusion is less significant at tin layers thicker than 50 nm. At thin layers (< 50 nm), the positrons greatly accumulate either at the aluminum-tin interface or in the tin layer due to its higher positron affinity compared to aluminum. Thus a very high sensitivity of the measurement for low densities of tin is observed. Consequently from the experimental results, a sensitivity threshold for the detection of a low amount of tin in an aluminum matrix with DBS is determined. The DB results are compared to theory by an approximation for pre-thermal implantation in layered materials.

DS 12.5 Tue 12:45 H 2013

Growth of ultrathin Ni-Al alloyed layers on Ni(111): evidence for NiAl formation over a critical thickness of Ni3Al — •SÉVERINE LE MOAL¹, DIDIER SCHMAUS², and CAMILLE COHEN² — ¹Institut für Physikalische und Theoretische Chemie, Universität Bonn, Wegelerstr. 12, 53115 Bonn, Germany — ²Institut des NanoSciences de Paris, 140 rue de Lourmel, 75015 Paris, France

Ni-Al alloys are of great technological interest because of their mechanical and thermal properties (high hardness, high melting point). They also are resistant to corrosion, this latter property being due to the formation at their surface of a passive film of aluminium oxide that acts as a diffusion barrier. Ultrathin epitaxial oxides are also used as convenient supports for model catalysts. We have studied in detail the alloying process of thin Al layers deposited on Ni(111), under ultrahigh vacuum conditions, as a function of the deposited Al amount, the deposition and annealing temperatures and the annealing time. The use of many complementary techniques, either in situ in the UHV chamber connected to a Van de Graaff accelerator (Rutherford Backscattering Spectrometry, Ion Channelling, Nuclear Resonance Profiling, Low Energy Electron Diffraction, Auger Electron Spectroscopy), or ex situ (X-Ray Diffraction, Atomic Force Microscopy) enabled us to have detailed information on the morphology, the composition and the crystallographic structure of both the surface and the bulk of the alloyed layer. A transition in the alloying process has been evidenced: the formation of Ni3Al (fcc-L12) for Al deposits thinner than 5 ML is followed by the formation of NiAl (cc-B2) over this critical thickness.

DS 12.6 Tue 13:00 H 2013

Texture analysis on CrSi₂: Combining statistical and microscopical information — •HERBERT SCHLETTER¹, STEFFEN SCHULZE¹, MICHAEL HIETSCHOLD¹, KOEN DE KEYSER², CHRISTOPHE DETAVERNIER², GUNTER BEDDIES¹, and MEIKEN FALKE¹ — ¹Institute of Physics, University of Technology, 09107 Chemnitz, Germany — ²Department of Solid State Physics, Ghent University, Belgium 9000

Thin films of CrSi₂ on Si(001) were investigated with regard to their texture. Besides the various known epitaxial relations, another type of texture, the so-called axiotaxy, was found. The latter one is characterized by a texture axis with a fixed orientation relative to the substrate common to all crystallites, while there is a rotational degree of freedom around this axis. In contrast to the well-known fiber texture, in case of axiotaxy this texture axis is inclined with respect to the substrate

normal leading to a parallel arrangement of low-index planes across the interface. In case of CrSi_2 , planes of $\{100\}$ -type are parallel to $\text{Si}\{110\}$ planes, generating an interface structure with one-dimensional periodicity. Due to the energetic advantage resulting thereof, this kind of texture is believed to be a common feature in thin films. In order to reveal the texture of the thin films, electron backscatter diffraction (EBSD) was used. Statistical information on the orientation distribution were obtained and visualized in pole figures. On the other hand, because the measurement is carried out in an SEM, it is possible to assign the orientation to every point on the sample. Thus, information about the correlation between orientation of a crystal and its size and shape are available.

DS 12.7 Tue 13:15 H 2013

Thermal Stability of Cs Fullerides — •DANIEL LÖFFLER, PATRICK WEIS, SHARALI MALIK, ARTUR BÖTTCHER, and MANFRED KAPPES — Institut für Physikalische Chemie, Universität Karlsruhe, 76131 Karlsruhe, Germany

Thermal stability of solid Cs fullerides fabricated under ultra high vacuum conditions has been investigated by means of thermal desorption spectroscopy, ultraviolet photoelectron spectroscopy and secondary electron microscopy. The incorporation of Cs atoms proceeds by the formation of Cs_xC_{60} grains. The stability of Cs_xC_{60} depends on the doping degree x , $1 \leq x \leq 6$. Weakly doped phases, $\text{Cs}_{x < 4}\text{C}_{60}$, decompose in three channels manifested by C_{60} sublimation peaks, α at 570 K, β at 660-720 K and γ at 820-900 K. Channel α reveals the sublimation of C_{60} molecules from sample regions not involved in the formation of fulleride grains. Sublimation channel β represents thermal desorption of C_{60} molecules terminating Cs_xC_{60} grains, $x=1-3$. The latter result from the phase segregation $n\text{C}_{60}^{m-} \longleftrightarrow \text{C}_{60} + m\text{C}_{60}^{n-}$, $m=2,3$, $n=m+1$ as activated during heating the sample [1]. The binding energy of C_{60} cages to the grain surface has been found to vary slightly with x in the range from 1.75 eV up to 1.95 eV. Saturated Cs_xC_{60} , $4 \leq x \leq 6$, phases decompose only via channel γ by sublimation of Cs_xC_{60} cages.

[1] G. Klupp et al., Phys. Rev. B, 74 (2006) 195402