DÜNNE SCHICHTEN (DS)

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ÜBERSICHT DER HAUPTVORTRÄGE UND FACHSITZUNGEN

(Hörsäle TU H107, TU H110)

Hauptvorträge

DS 1.1	Fr	10:00	(TU H107)	**Not so amorphous silicon dioxide films on silicon**, Wolfgang Donner, M. Castro-Colin, S.C. Moss, Z. Islam, S.K. Sinha, R. Nemanich, H.T. Metzger, P. Boesecke, T. Schuelli
DS 3.1	Fr	12:00	(TU H107)	**X-ray absorption studies of hard coatings in the boron-carbon-nitrogen**, R. Gago, I. Jimenez
DS 6.1	Fr	14:00	(TU H110)	**Strukturierung von dünnen Schichtsystemen auf EUV Photolithograpiemasken**, Jan Hendrik Peters
DS 7.1	Sa	13:45	(TU H107)	**The role of ion irradiation induced viscous flow in thin film structuring: Hard matter going soft**, S.G. Mayr
DS 9.1	Sa	09:00	(TU EB301)	**Low-dimensional electrons at silicon surfaces**, Franz J. Himpsel
DS 12.1	Mo	10:45	(TU H107)	**Solid matter under extreme conditions - Electronic excitations by swift highly charged ions**, Gregor Schiwietz
DS 15.1	Mo	09:45	(TU EB301)	**Femtosecond dynamics of adsorbate-surface interactions studied by means of time-resolved photoelectron spectroscopy**, Vortrag des Gaede-Preisträgers Michael Bauer
DS 17.1	Mo	13:30	(TU H110)	**Mechanisms of mechanical deformation in artificial superlattices and self-organized nanostructured thin films**, Lars Hultman
DS 19.1	Di	13:45	(TU H107)	**In-situ-Charakterisierung der Schichtabscheidung mit gepulsten Magnetrons**, Thomas Welzel

FV-internes Symposium „Anorganische Dielektrika für die künftige Mikro- und Nanotechnologie“

DS 10.1	Sa	10:00	(TU H110)	**Atomic-scale properties of high-k dielectrics for CMOS: ab initio study for Pr-based materials**, Jarek Dabrowski, Andrzej Fleszar
DS 10.2	Sa	10:45	(TU H110)	**Epitaxial growth of oxide layers on silicon surfaces**, Wolfgang Moritz, Nicole Jeutter, Laure Libralesso, Jörg Zegenhagen
DS 10.3	Sa	11:30	(TU H110)	**The role of interfaces in nanosize ferroelectrics oxides**, Marin Alexe, Lucian Pintilie, Dietrich Hesse
DS 10.4	Sa	12:15	(TU H110)	**DRAM capacitor scaling**, M. Gutsche, T Hecht, S Jakschik, C Kapteyn, G Krautheim, S Kudelka, J Lützen, A Sänger, U Schröder, H Seidl, A Avellan, J Heitmann, G Hirt
DS 10.5	Sa	13:00	(TU H110)	**Advance MOSFET gate dielectrics for high-performance microprocessors: Materials selection and analytical challenges**, E. Zschech, H.-J. Engelmann, K. K Dittmar, S. Ohsiek, B. Tracy, E. Adem, A. Myers, S. Robie, M. Sidorov, J. Bernard

FV-internes Symposium „Optische Spektroskopie von dünnen Schichten und Grenzflächen“

DS 21.1	Di	09:45	(TU H110)	**Real-time optical diagnostics for epitaxial growth**, D. E. Aspnes
DS 21.2	Di	10:30	(TU H110)	**Ab-initio calculations of electronic and optical properties of surfaces**, Olivia Pulci
DS 21.3	Di	11:15	(TU H110)	**Optical analysis of monolayers at surfaces and interfaces**, V. Wagner
DS 21.4	Di	12:00	(TU H110)	**Biomolecular layers on silicon studied by optical spectroscopy**, Dietrich R.T. Zahn
DS 21.5	Di	12:45	(TU H110)	**Infrared ellipsometry for structure analysis of organic films**, Karsten Hinrichs, Michael Gensch, Katy Roodenko, Norbert Esser

Fachsitzungen

DS 1	**Dünnschichtanalytik I**	Fr	10:00–10:45	TU H107	DS 1.1–1.1
DS 2	**Elektrische und optische Schichteigenschaften**	Fr	10:45–12:00	TU H107	DS 2.1–2.5
DS 3	**Dünnschichtanalytik II**	Fr	12:00–12:45	TU H107	DS 3.1–3.1
DS 4	**Halbleitende, amorphe und organische Schichten**	Fr	14:45–15:45	TU H107	DS 4.1–4.4
DS 5	**Optische, metallische und magnetische Schichten**	Fr	10:45–12:00	TU H110	DS 5.1–5.5
DS 6	**Anwendung dünner Schichten**	Fr	14:00–15:45	TU H110	DS 6.1–6.5
DS 7	**Ionenstrahlverfahren I**	Sa	13:45–15:00	TU H107	DS 7.1–7.3
DS 8	**Ionen-Festkörper-Wechselwirkung I**	Sa	15:15–17:00	TU H107	DS 8.1–8.7
DS 9	**Elektronische Eigenschaften von Oberflächen**	Sa	09:00–09:45	TU EB301	DS 9.1–9.1
DS 10	**FV-internes Symposium „Anorganische Dielektrika für die künftige Mikro- und Nanotechnologie”**	Sa	10:00–13:45	TU H110	DS 10.1–10.5
DS 11	**Anorganische dielektrische Schichten**	Sa	14:30–15:45	TU H110	DS 11.1–11.5
DS 12	**Ionen-Festkörper-Wechselwirkung II**	Mo	10:45–12:45	TU H107	DS 12.1–12.6
DS 13	**Ionenstrahlverfahren II**	Mo	14:15–15:15	TU H107	DS 13.1–13.4
DS 14	**Schichtherstellung mit Laserverfahren**	Mo	15:15–16:45	TU H107	DS 14.1–14.6
DS 15	**Vortrag des Gaede-Preisträgers**	Mo	09:45–10:30	TU EB301	DS 15.1–15.1
DS 16	**Dünnschichtanalytik III**	Mo	10:45–13:00	TU H110	DS 16.1–16.9
DS 17	**Harte Schichten und mechanische Eigenschaften**	Mo	13:30–15:15	TU H110	DS 17.1–17.5
DS 18	**Optische Spektroskopie dünner Schichten I**	Mo	15:15–16:45	TU H110	DS 18.1–18.6
DS 19	**Schichtabscheidung**	Di	13:45–15:15	TU H107	DS 19.1–19.4
DS 20	**Schichtwachstum**	Di	15:15–16:30	TU H107	DS 20.1–20.5
DS 21	**FV-internes Symposium „Optische Spektroskopie von dünnen Schichten und Grenzflächen”**	Di	09:45–13:30	TU H110	DS 21.1–21.5
DS 22	**Optische Spektroskopie dünner Schichten II**	Di	14:30–16:45	TU H110	DS 22.1–22.9
DS 23	**Postersitzung I**	Fr	16:00–18:30	Poster TU B	DS 23.1–23.47
DS 24	**Postersitzung II**	Di	17:00–19:00	Poster TU B	DS 24.1–24.27

FV-übergreifende Symposien

- **Highlights in Synchrotron Radiation Research**, Sa, TU H3010, Details siehe SYSR

- **From quantisation in the gravitational field to correlated electron systems: Perspectives of research with neutrons**, Di, TU HE101, Details siehe SYRN

- **Nichtflüchtige Festkörperspeicher**, Sa, TU HE101, Details siehe SYFS

- **Organic Optoelectronics and Photonics**, Mo, TU HE101, Details siehe SYOO

- **Symposium des FV Oberflächenpysik ”Recent Progress in Scanning Probe Methods”**, Fr, 11:00, TU H3005

Mitgliederversammlung des Fachverbands Dünne Schichten

Mo 17:00–17:30 TU H107

Tagesordnung:

1. Bericht des Sprechers
2. Symposien und Hauptvorträge 2006
3. Verschiedenes

Im Anschluss an die Mitgliederversammlung des Fachverbandes findet um 17:30 Uhr im H 107 der TU die Mitgliederversammlung der Deutschen Vakuumgesellschaft statt.

Hinweis

Die Postersitzungen DS 23 am Freitag von 16:00 Uhr bis 18:30 Uhr und DS 24 am Dienstag von 17:00 bis 19:00 Uhr finden im Bereich vor dem Hörsaal H 107 im Hauptgebäude der TU Berlin statt.
Die Poster sollten ab 8:00 Uhr aufgehängt und erst nach der Postersitzung wieder entfernt werden.

Fachsitzungen

– Haupt-, Kurzvorträge und Posterbeiträge –

DS 1 Dünnschichtanalytik I

Zeit: Freitag 10:00–10:45 Raum: TU H107

Hauptvortrag

DS 1.1 Fr 10:00 TU H107

Not so amorphous silicon dioxide films on silicon — •Wolfgang Donner[1], M. Castro-Colin[1], S.C. Moss[1], Z. Islam[2], S.K. Sinha[3], R. Nemanich[4], H.T. Metzger[5], P. Boesecke[5], and T. Schuelli[5] — [1]Department of Physics, University of Houston, 4800 Calhoun, Houston TX 77204-5005, USA — [2]Advanced Photon Source, Argonne National Laboratory, Argonne IL 60439, USA — [3]Department of Physics, University of California San Diego, CA 92093-0354, USA — [4]Department of Physics, North Carolina State University, Raleigh NC 27695, USA — [5]European Synchrotron Radiation Facility, 38043 Grenoble, France

Thermally grown oxide films on silicon are still the most widely used gate oxides in integrated circuits. Its extremely smooth interfaces, good dielectric properties and the lack of grain boundaries, along which dopant diffusion would be possible, are unequalled. However, since an amorphous overlayer is being grown onto a well-defined crystalline substrate, it can be expected that the film-substrate interface would exhibit some degree of structural order. Numerous attempts have been made in the past two decades to characterize this technologically very important interface. A review of the structural results will be given, among which the detection of microcrystallites inside an amorphous matrix is now widely accepted. Results from a series of Synchrotron-based x-ray diffraction experiments will be presented that suggest a modulation of the amorphous structure of SiO_2 along the Si110 directions induced by the substrate.

DS 2 Elektrische und optische Schichteigenschaften

Zeit: Freitag 10:45–12:00 Raum: TU H107

DS 2.1 Fr 10:45 TU H107

ESR investigation of a donor-like state in epitaxial Si layers — •Kai Petter, Björn Rau, Klaus Lips und Walther Fuhs — Hahn-Meitner-Institut, Abteilung Silizium-Phovoltaik, Kekuléstr. 5, 12489 Berlin

Epitaxial silicon layers ($\sim 1\ \mu$m thick) grown by electron cyclotron resonance chemical vapour deposition (ECR-CVD) are investigated by Electron Spin Resonance (ESR). The ESR spectra are dominated by two resonances at g=2.006 and 1.999. Here, we investigate the resonance at g=1.999, a localised state near the conduction-band. The spin density of this resonance at 5K is approximately equal to the charge carrier concentration at room temperature. When the samples are excited by above-bandgap light, the ESR signal increases and saturates for high light intensities. The increase and the saturation light intensity are, however, different for different samples. These results can be explained in a model of an n-type semiconductor with different concentrations of compensating acceptors where the ESR resonance is caused by occupied donors. Based on this model we show to which degree our measurements can be used to determine the concentrations of donors and acceptors and therefore the level of compensation in our material. The limitations that arise from the fact that the concentrations of the occupied acceptors are not accessible by our measurements will also be discussed.

DS 2.2 Fr 11:00 TU H107

Photochromism in thin films of nitrospirobenzans — •Michael Karcher und Paul Fumagalli — Freie Universität Berlin

The photochromism of 1',3',3'-trimethyl-6-nitrospiro[2H-benzopyran - 2,2'-indoline] (NO_2BIPS) in solution has been extensively studied.[1-4] Now we have succeeded to create thin films (about 80 nm thick) of NO_2BIPS by evaporation of powder from a stainless steel crucible at 160°C in high vacuum at a base pressure of $2 \cdot 10^{-7}$ mbar. We observed photoswitching behaviour on irradiation of ultraviolet light in these films and compared it to the behaviour in solution using UV-VIS-spectroscopy.

[1] J. B. Flannery, Jr., *J. Amer. Chem. Soc.* **1968**, *90*, 5660-5671
[2] T. Bercovici, T. Heiligman-Rim, E. Fischer, *Mol. Photochem.* **1969**, *1*, 23
[3] A. K. Chibisov, H. Görner, *J. Phys. Chem. A* **1997**, *101*, 4305-4312
[4] H. Görner, *Phys. Chem. Chem. Phys.* **2001**, *3*, 416-423

DS 2.3 Fr 11:15 TU H107

Effect of hot landing at elevated temperature and metal concentration on the optical and electrical properties of teflon AF -noble metal composites — •Haile Takele, Ulrich Schürmann, Henry Greve, Vladimir Zaporojtchenko, and Franz Faupel — Lehrstuhl für Materialverbunde, Technische Fakultät der CAU Kiel, Kaiserstr. 2, 24143 Kiel, Germany

Metal-Polymer nanocomposite films with embedded gold and silver nanoparticles were prepared by a vapor phase co-deposition technique in a high vacuum system[1,2]. The effect of hot landing at elevated temperature during deposition on the microstructure of the composite films was investigated using top view and cross-sectional transmission electron microscopy. The resulting changes in the optical properties of the composites as function of the substrate temperatures were studied using UV-Visible spectroscopy. A large shift of the surface plasmon peak position and a sharp transition in the electrical properties of the composites from insulator to conductor near the percolation point were observed for samples having a metal volume fraction ranging from 0.15 to 0.75. The metal volume fraction was measured by using SEM/EDX. Photoelectron spectroscopy and Fourier transform infrared spectroscopy are also applied to study the chemical composition and structure of the composite.

[1] A. Biswas, O. C. Aktas, J. Kanzow, U. Saeed, T. Strunkus, V. Zaporojtchenko, F. Faupel, Materials Letters, 58, 1530 (2004).

[2] A. Biswas, O. C. Aktas, U. Schürmann, U. Saeed, V. Zaporojtchenko, and F. Faupel,Appled Physics Letters 84, 2655 (2004).

DS 2.4 Fr 11:30 TU H107

Elektromigration in (Nano)- Leiterbahnen mit Engstellen und Inseln — •Burkhard Stahlmecke und Günter Dumpich — Experimentalphysik, AG Farle, Universität Duisburg-Essen (Standort Duisburg), Lotharstrasse 1, 47057 Duisburg

Das Elektromigrationsverhalten von Gold-Nanoleiterbahnen mit vorgegebenen Engstellen und kreisförmigen Aussparungen wurde in-situ in einem hochauflösenden Rasterelektronenmikroskop (HRSEM) untersucht. Desweiteren wurden mit Goldstreifen beziehungsweise Inseln bedeckte Platinleiterbahnen hergestellt, um zu untersuchen, ob Elektromigration an den Goldstrukturen auftritt. Die Herstellung der Nanoleiterbahnen erfolgte mittels Elektronenstrahllithographie (EBL). Die Untersuchungen an Goldleiterbahnen (Länge l = 10 μm, Breite b = 1 μm, Schichtdicke t = 30 nm) mit Engstellen von 500 nm zeigen, dass Voidbildung vermehrt vor der Engstelle / Aussparung stattfindet. Dagegen bilden sich die zugehörigen Hillocks unmittelbar in der Engstelle, d.h. überraschenderweise im Gebiet mit höchster Stromdichte.

Gefördert durch die DFG im Rahmen des SFB 616.

DS 2.5 Fr 11:45 TU H107

Controlled syntheses of silver/polymer nanocomposite films by co-sputtering from two magnetron sources — •Ulrich Schürmann, Whitney Hartung, Haile Takele, Vladimir Zaporojtchenko, and Franz Faupel — Lehrstuhl für Materialverbunde, Technische Fakultät der CAU Kiel, Kaiserstr. 2, 24143 Kiel, Germany

We present a study of the physico-chemical properties of thin polymer films with embedded silver nanoparticles. These films were deposited by co-sputtering from two magnetron sources. The deposition rates were monitored by quartz crystal microbalances, which were calibrated by measuring film thickness after deposition with a profilometer. To study optical and electrical properties, nanocomposites with thickness of some hundred nanometers were deposited on different substrates. The metal volume fraction was monitored by SEM/EDX using a metal/polymer standard, which was calibrated gravimetrically. We characterized the chemical composition and the structure of the composites by using TEM, XRD, XPS and FTIR. Electrical properties of the composite material were studied at different metal filling factors and temperatures. We observe a sharp change in the resistivity over 10 orders of magnitude near the percolation threshold. Marked difference in the UV/Vis-spectra depending on metal concentration, particle size and density were observed. The optical absorption shows a red shift of the absorption peak from 405 nm to more than 500 nm at higher silver content.

DS 3 Dünnschichtanalytik II

Zeit: Freitag 12:00–12:45 Raum: TU H107

Hauptvortrag

DS 3.1 Fr 12:00 TU H107

X-ray absorption studies of hard coatings in the boron-carbon-nitrogen — •R. Gago[1] and I. Jimenez[2] — [1]Institut für Ionenstrahlphysik und Materialforschung, Forschungszentrum Rossendorf, 01314 Dresden (Germany) — [2]Instituto de Ciencia y Tecnologia de Polimeros (CSIC), 28006 Madrid (Spain)

X-ray absorption near edge spectroscopy (XANES) is a powerful characterisation technique that provides information about the density of unoccupied electronic states of molecules and solids. In the case of thin films, such electronic information can be correlated with the bonding structure and orientation of bonds, even in amorphous or nanostructured films. Particularly, in the electron or photon yield detection modes, XANES does not require special sample preparation procedures, making the measurements fast and easy. XANES is especially suited to study the bonding structure of compounds of light elements, as is the case of the boron-carbon-nitrogen (BCN) system since it gives distinct spectral signatures for sp^2 and sp^3 hybrids. In this work, we review our results during the last years regarding XANES studies of hard coatings within the BCN system, i.e. diamond, amorphous carbon (a-C), carbon nitride (CN_x) and ternary BCN compounds. Mainly, bonding structure (sp^2/sp^3) and phase segregation issues are addressed. Finally, it is shown that XANES is also sensitive to microstructural features like preferential orientation and curvature of basal planes, the latter referred commonly as fullerene-like arrangements.

DS 4 Halbleitende, amorphe und organische Schichten

Zeit: Freitag 14:45–15:45 Raum: TU H107

DS 4.1 Fr 14:45 TU H107

Präparation und Charakterisierung photokatalytisch aktiver Zinndioxid-Titandioxid-Komposite — •H. Stuhldreher[1], P. Meisterjahn[1], K.-H. Müller[2] und H. Paulus[3] — [1]HTW Südwestfalen, Iserlohn — [2]HTW Südwestfalen, Soest — [3]TWS, Soest

Bei der Photokatalyse an TiO_2 werden toxische Abwässer in Anwesenheit des halbleitenden Photokatalysators mit UV-Licht bestrahlt. Dabei können photogenerierte Ladungsträger in angrenzender Phase Redoxreaktionen ausführen oder es tritt unerwünschte Rekombination auf. Durch Verwendung von SnO_2-TiO_2-Kompositen kann die Rekombination inhibiert werden und so eine Steigerung der photokatalytischen Aktivität erzielt werden. Nach Applikation des Komposits auf optisch-transparente leitfähige Elektroden (OTE) und anodischer Polarisation lässt sich die photokatalytische Aktivität zusätzlich steigern.

Als OTE werden dotierte SnO_2-Schichten eingesetzt (R= 200Ω ;T= 85%). Oberflächenanlytische Untersuchungen (SNMS) zeigen, dass die dotierten Schichten eine homogene Elementverteilung aufweisen. Antimonanreicherung an Oberfläche oder Interface tritt nicht auf.

Zur Herstellung der Komposite werden kolloidale TiO_2-Nanopartikel in ein Zinn-Sol eingearbeitet und auf der OTE appliziert. Die Kompositschichten sind sowohl elektrisch leitfähig als auch photokatalytisch aktiv. An der Oberfläche sind sowohl SnO_2 als auch TiO_2 zu erwarten, was durch Schichtanalysen mit SNMS bestätigt wird. Die photokatalytische Aktivität wurde durch Mineralisierung von Modellschadstoffen nachgewiesen und durch den Einsatz des Kompositsystems und durch Anlegen einer anodischen Spannung an die OTE zusätzlich gesteigert.

DS 4.2 Fr 15:00 TU H107

Correlation of plasma parameters and diamond-like carbon films properties — •Oleksiy Filipov, Nicolas Wöhrl, Stephan Reuter, and Volker Buck — Thin Film Technology Group, Dept. of Physics, University of Duisburg-Essen, Universitätsstr.3-5, 45141 Essen, Germany

Diamond-like carbon films such as amorphous hydrogenated a-C:H and non-hydrogenated a-C films, are amorphous materials characterized by attractive mechanical, chemical and optical properties. In order to adjust their properties to tribological and biomedical applications, DLC films were deposited onto different types of substrates by using different deposition methods such as DC-anodic arc and RF-plasma source. The films were deposited on polished (100) Si and glass substrates. The variation in process parameters such as substrate bias and gas admixture is used to influence the film properties. The plasma parameters were monitored during deposition by Langmuir probe and mass-spectrometer. The pulsed bias was applied to substrate in two modes: unipolar and bipolar. The operating gas was H_2 at different flow rates. The surface morphology of the deposited films was analysed using Scanning Electron Microscopy (SEM). Residual stress was monitored by SSIOD technique. The structural properties of the films, mostly sp^3/sp^2 ratio, were characterized by Raman Spectroscopy and by FTIR, their optical properties were ex-situ examined by UV-IR Spectroscopy.

DS 4.3 Fr 15:15 TU H107

Energy level alignment at inorganic/organic interfaces: Si(111):H/ZnPc, F_4ZnPc, F_8ZnPc and F_{16}ZnPc — •Thomas Mayer[1], Ulrich Weiler[1], Wolfram Jaegermann[1], Christian Kelting[2], Derck Schlettwein[2], Sergey Makarov[3], and Dieter Wöhrle[3] — [1]Institute of Materials Science Darmstadt University of Technology, D-64287 Darmstadt — [2]Institute for Applied Physics Justus Liebig University Gießen, D-35392 Gießen — [3]Institute of Organic and Macromolecular Chemistry, University Bremen, D-28334 Bremen

Interfaces of ZnPc and its F substituted derivatives on Si(111):H have been investigated with UPS and SXPS as model systems of a bulk composite absorber material for photovoltaic applications. Combining good absorptivity of dye molecules with good transport properties of Si is expected to result in high efficiency. A systematic variation of the energy level alignment at inorganic/organic interfaces is expected by substitution of an increasing number of hydrogen atoms of the organic molecule by fluorine atoms. Using calculated ionisation potentials, the HOMO energy levels are expected in the Anderson approximation at 0.6,1.0,1.3 and 1.7 eV below the valence band maximum of Si(111):H for ZnPc, F_4ZnPc, F_8ZnPc and F_{16}ZnPc respectively. Combining SXPS and UPS we find the experimental HOMO levels at 0.45, 1.0, 1.0 and 1.55 eV respectively below the valence band maximum, mirroring the expected general trend. Interface dipoles are considered as the cause of the discrepancies to the Anderson line up. The consequences of the line up on expected charge transfer processes will be discussed.

DS 4.4 Fr 15:30 TU H107

Organic thin films on different inorganic substrates — •Helmut Sitter[1], Andrei Andreev[1], Harald Hoppe[2], Thomas Haber[3], Detlef Smilgies[4], Niyazi Serdar Sariciftci[2], and Roland Resel[3] — [1]Institute for Semiconductor and Solid State Physics, University Linz, A-4040 Linz, Austria — [2]Linz Institute for Organic Solar Cells (LIOS), Physical Chemistry, University Linz, A-4040 Linz, Austria — [3]Institute of Solid State Physics, Graz University of Technology, Austria — [4]CHESS G-line, Cornell University, Ithaca NY 14853, USA

Recently we reported that a self-organization of para-sexiphenyl (PSP) molecules occurs during Hot Wall Epitaxy (HWE) on mica, resulting in very long crystalline, parallel oriented nano-fibers emitting blue light with dichroic ratios up to 14. In this work we use Atomic Force Microscopy and X-ray diffraction to study comparably HWE grown PSP layers on different crystalline substrates like mica and KCl. Substrate temperature, substrate type and symmetry are decisive parameters for the growth mode. In particular, while PSP grows on mica in needle-like fashion with only one preferential direction, the growth on KCl(001) is characterized by co-existence of the needles and 3D-islands. The former are the initial growth stage of the films, generating a rectangular network in accordance with substrate surface symmetry. We investigated also the growth of PSP on other crystalline substrates: MoSe2, GeS, GaN and TiO2.

DS 5 Optische, metallische und magnetische Schichten

Zeit: Freitag 10:45–12:00 Raum: TU H110

DS 5.1 Fr 10:45 TU H110

Epitaktisches Wachstum von $Bi_3Fe_5O_{12}$–Schichten auf $Gd_3Ga_5O_{12}$ durch Gepulste Laserablation — •Stephan Leitenmeier, Andreas Heinrich und Bernd Stritzker — Uni Augsburg, EP IV, 86135 Augsburg

Magnetooptische (MO) Materialien finden weitverbreitet Anwendung als optische Schalter, optische Isolatoren oder Magnetfeldsensoren. Es ist von besonderem Interesse solche MO-Materialien als Funktionsstrukturen beispielsweise direkt auf Silizium zu integrieren. $Bi_3Fe_5O_{12}$ (BIG) zeigt bei Raumtemperatur einen starken MO–Effekt im sichtbaren Wellenlängenbereich und ist somit für solche Anwendungen besonders geeignet. Als Vorstufe zur Integration von BIG–Schichten auf Si, wurden mittels Gepulster Laserablation (PLD) zunächst Schichten von BIG und $Lu_{2,05}Bi_{0,95}Fe_{3,8}Ga_{1,2}O_{12}$ (LBIG) auf $Gd_3Ga_5O_{12}$ (GGG) Substraten abgeschieden. Zur Bestimmung geeigneter Wachstumsbedingungen wurde bei der Schichtherstellung die Substrattemperatur variiert. Die Untersuchung der Stöchiometrie der erzeugten Schichten erfolgte mit RBS und EDX. Zur Strukturanalyse wurden XRD, HRXRD und TEM eingesetzt. Die bisher gewonnenen Ergebnisse deuten auf ein epitaktisches Schichtwachstum von BIG bzw. LBIG auf GGG in einem engen Temperaturbereich hin, wobei die optimale Wachstumstemperatur für BIG geringer ist als für LBIG. TEM Aufnahmen belegen ebenfalls ein epitaktisches Schichtwachstum.

Im Vortrag wird eine Übersicht über die erzielten Ergebnisse gegeben und einzelne Resultate genauer vorgestellt.

Gefördert durch die DFG (SPP 1157)

DS 5.2 Fr 11:00 TU H110

Epitaktisch gewachsene dünne PLD-Sesquioxidschichten auf Quarz — •Stefan Ehlert, Sebastian Bär, Lutz Rabisch, Yury Kuzminykh, Hanno Scheife und Günter Huber — Institut für Laser-Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

Optisch aktive Schichten aus Sesquioxiden sind vielversprechende Materialien für optische Bauelemente wie z. B. Wellenleiter.

Ausgehend von dem bekannten Substratmaterial α-Al_2O_3 für Sesquioxidschichten wird in dieser Arbeit Quarz als Substrat verwendet, um einen größeren Brechungsindexunterschied zwischen Substrat und Schicht für das wellenleitende System zu erzielen.

Es sind die Systeme Y_2O_3, $Y_{1,5}Sc_{0,5}O_3$ und $Y_{0,2}Lu_{1,8}O_3$ hinsichtlich ihrer Gitteranpassung auf Quarz (0001) untersucht worden. Dünne Schichten im Bereich von 5 nm bis 100 nm aus diesen Materialien wurden per Pulsed Laser Deposition hergestellt und mittels Fluoreszenzspektroskopie, Röntgenbeugung und Rasterkraftmikroskopie charakterisiert.

Erste Ergebnisse zeigen, dass kristallines Wachstum der Schichten in (111)-Richtung möglich ist. Weitere Resultate werden vorgestellt.

DS 5.3 Fr 11:15 TU H110

RD-MOKE investigation of magnetic thin films — •R. Denk, R. Mittermair, M. Hohage, L.D. Sun, and P. Zeppenfeld — Institut für Experimentalphysik, Johannes Kepler Universität Linz, A-4040 Linz, Austria

Magnetic thin films of Ni, Co, and Fe on Cu(110) and Cu(110)(2x1)O have been studied by means of Reflectance Difference Spectroscopy (RDS). Besides the regular optical anisotropy signal, a RD-spectrometer can additionally address the magnetization of these films by measuring the rotation of the polarization due to the polar Magneto-Optical Kerr Effect (MOKE) [1]. To perform the magnetic measurements the UHV-chamber is equipped with an in-vacuum coil-magnet. This RD-MOKE setup allows conducting spectroscopic measurements of the magnetization of the films at transition energies between 1.5eV and 5.5 eV. By applying the RD-technique the optical anisotropy signal ($(\Delta r/r(M^+) + \Delta r/r(M^-)/2)$ can be separated from the MOKE signal($\Delta r/r(M^+) - \Delta r/r(M^-)$). Hysteresis curves at any desired energy between 1.5 eV and 5.5 eV may be obtained. The magnetic properties of films with substantially different film morphologies resulting from strongly variant growth conditions have been investigated. For characterization of the film morphology, the chamber is equipped with a STM and a LEED/AES system.

[1] M. Wahl, Th. Herrmann, N. Esser, and W. Richter, phys. stat. sol. 0, No. 8 3002 (2003)

DS 5.4 Fr 11:30 TU H110

Optical properties of ultrathin gold films — •Tobby Brandt, Natalia Drichko, Bruno Gompf, and Martin Dressel — 1. Physikalisches Institut der Universität Stuttgart

Ultrathin metal films (UTMF) serve as model systems for the insulator/metal transition in two dimensions. While the optical conductivity of thick metal films has been studied extensively, there are nearly no studies in the infrared and far-infrared region. Beside the fundamental question whether there exists a true metallic state at very low temperatures in 2-D-systemes at all, UTMFs show additional relaxation mechanisms due to electron-interface scattering and an changed electron structure due to electron confinement. To illuminate the conduction properties of UTMFs temperature and frequency dependent measurements are necessary. Optical properties of ultrathin Au films (<50Å) condensed on reconstructed Si(111)(7x7) surfaces have been measured in transmission and reflection between 400 cm^{-1} and 5000 cm^{-1} in situ in the temperature range between 5 K and room temperature. The development of the sheet resistance and conductivity of UTMFs is a function of film thickness will be discussed.

DS 5.5 Fr 11:45 TU H110

Gibbs-Thomson effect in reactive magnetron-sputtered stainless steel films — •Salvatore Cusenza, Christine Borchers, and Peter Schaaf — Universität Göttingen, II. Physikalisches Institut, Friedrich-Hund Platz 1, D-37077 Göttingen, Germany

Austenitic stainless steel (SS) has a face-centered cubic (γ) structure in contrast to magnetron-sputtered 316 SS films which exhibit body-centered cubic (α) structure or a mixture of α- and γ-phases.

In this work, the effect of the local environment on the hyperfine parameters, the influence of annealing, and the effect of carburizing were studied by Mössbauer spectroscopy, X-Ray diffraction (XRD), and Transmission Electron Microscopy (TEM). Vacuum annealed films were described by the kinetic model of Johnson-Mehl-Avrami. A phase transformation from α- to γ-phase with increasing substrate temperature is observed. Nickel content and substrate temperature are found as crucial factors for phase stability formation.

For carburized SS films, Mössbauer reveals a conversion of M_3C into M_7C_3 Carbides ($M = Fe, Cr, Ni$) with increasing substrate temperature. In a small range of methane gasflow an amorphous and soft ferromagnetic phase is observed. Corrosion tests are indicating that the formation of thin oxide films on the surface are responsible for high microhardness.

The phase transformations in SS can be explained with the Gibbs-Thomson effect, where the grain boundary energy of the grain size raises the Gibbs' free energy.

DS 6 Anwendung dünner Schichten

Zeit: Freitag 14:00–15:45 Raum: TU H110

Hauptvortrag

DS 6.1 Fr 14:00 TU H110

Strukturierung von dünnen Schichtsystemen auf EUV Photolithograpiemasken — •Jan Hendrik Peters — AMTC, 01109 Dresden, Rähnitzer Alle 9

Aussichtsreichster Kandidat in der Halbleiterindustrie für die Erzeugung von Chipstrukturen von 45 nm und darunter ist die EUV Lithographie. Bei einer Wellenlänge von 13.5 nm sind die herkömmlich verwendeten Maskenmaterialien nicht mehr transparent, so dass für EUV Photolithographiemasken auf neue Materialien ausgewichen werden muss. Hauptelement der Masken ist ein Multilagenspiegel von rund 280 nm Dicke aus 40 Doppellagen Mo und Si, welche die unter 6 Grad einfallende EUV Strahlung zu gut 65% reflektiert. Darüber werden weitere Schichten abgeschieden, die dem Schutz der Multilagen während der Nutzung (Capping Layer) bzw. während der Reparatur der Masken (Buffer Layer) dienen, sowie die eigentliche strukturgebende Schicht der Maske (Absorber Layer). Die Materialzusammensetzung und Dicken der Schichten werden durch die im Lithographieprozess benötigten optischen Eigenschaften der Maske bei 13.5 nm bestimmt, sowie durch die im Maskenherstellungsprozess verwendeten Strukturierungs-, Reparatur-, Reinigungs- und Messverfahren. In diesem Vortrag wird über die Verfahren zur Strukturierung von EUV Masken unter kommerziellen Rahmenbedingungen berichtet. Dabei wird nicht nur auf den Einfluss der Ätzverfahren auf die zu erreichenden Strukturgrößen und deren Uniformität über die Fläche der Maske eingegangen, sondern auch auf die Probleme beim Nachweis dieser Größen.

DS 6.2 Fr 14:45 TU H110

High resolution actinic defect inspection for EUVL multilayer mask blanks by photoemission electron microscopy — •U. Neuhäusler[1], A. Oelsner[2], M. Schicketanz[3], J. Slieh[1], N. Weber[3], U. Kleineberg[1], M. Brzeska[1], A. Wonisch[1], T. Westerwalbesloh[1], H. Brückl[1], M. Escher[3], M. Merkel[3], G. Schönhense[2], and U. Heinzmann[1] — [1]Fakultät für Physik, Universität Bielefeld, Postfach 10 01 31, 33501 Bielefeld — [2]Institut für Physik, Universität Mainz, Staudingerweg 7, 55128 Mainz — [3]Focus GmbH, Am Birkhecker Berg 20, 65510 Hünstetten-Görsroth

Photoemission electron microscopy (PEEM) is a widely used technique for the characterization of surfaces by photoelectron-imaging. As the development of extreme ultraviolet lithography (EUVL) progresses, PEEM becomes also important as a spatially resolving detector for "at-wavelength (13.5 nm)"metrology. We report here on the development of a new PEEM technique utilizing standing wave illumination near normal incidence at the actinic wavelength of 13.5 nm for inspection of buried defects in MoSi-multilayer mask blanks for EUVL. Due to the small escape depth of photoelectrons of just a few nm, structures buried in a bulk sample normally cannot be seen in PEEM. However, in multilayer-coated mask blanks, the incident wavefield propagates several 100 nm deep to the MoSi-multilayer-substrate interface. Thus, wavefront distortions caused by defects can be probed with a PEEM depending on the node/antinode phase condition at the multilayer surface. Experimental results of visualizing programmed defects down to 50 nm size in multilayer test samples will be presented.

DS 6.3 Fr 15:00 TU H110

Ordered arrays of semiconductor nanoparticles using thin films of block copolymers as templates — •Dong Ha Kim, Xue Li, and Wolfgang Knoll — Max Planck Institute for Polymer Research, 55128 Mainz

In this presentation latest developments concerning the use of self-assembled block copolymers for nanofabrication are discussed. Simple routes to fabricate patterned inorganic semiconductor nanostructures are presented using block copolymer thin films as templates. Asymmetric block copolymers provide a novel route by which ordered arrays of nanocylinders aligned normal to the film surface are produced by one-step spin coating from solution. Here micellar monolayer films of poly(styrene-co-2-vinyl pyridine) block copolymer (PS-b-P2VP) and thin films of poly(styrene-co-ethylene oxide) block copolymer (PS-b-PEO) were employed as scaffolds to incorporate inorganic materials within the polar PVP and hydrophilic PEO domains. Highly dense arrays of hexagonally-packed silica, titania, and composite titania/gold dot arrays were fabricated by chemical vapor deposition (CVD) methodology. The lateral spacing, i.e. the center-to-center distance between the dots and the size of the dots, were fine tuned by controlling the molecular weight of the block copolymers and ralative amounts of inorganic precursors to the block copolymers. Such site-specific semiconductor dot arrays patterned on a nanometer scale can have widespread uses for sensory and optoelectronic applications.

DS 6.4 Fr 15:15 TU H110

UV-nanoimprinting: A potential method for the fabrication of 3D-photonic crystals — •Thomas Glinsner[1], Farnaz Ghods Isfahani[2], and Kurt Hingerl[2] — [1]EV Group; DI Erich Thallner Strasse 1, 4780 Schärding, Austria — [2]Universität Linz, Halbleiter und Festkörperphysik; Altenbergerstr. 69, 4040 Linz, Austria

This contribution presents results achieved in ultraviolet nanoimprint lithography (UV-NIL) recommending this process as a potential fabrication method for photonic crystals. In photonic crystals the periodic arrangement of two materials with dissimilar dielectric properties exhibits a band of forbidden frequencies for the propagation of light (photonic band gap). Several techniques for the fabrication of 3D photonic crystals were proposed. Among them can be found wafer bonding, silicon micromachining, self-assembly, two-photon absorption, 3D holography as well as subsequent sputtering, DUV lithography and etching of consecutive planes. UV-NIL offers a low cost opportunity for the fabrication of nm-scale pattern transfer in single or multiple step application if compared to mainstream optical lithography. This next generation lithography technique is using quartz glass stamps, fabricated by e-beam lithography, which can be repeatedly imprinted in spin-on materials layers on silicon substrates. A concept for the fabrication of the woodpile structure will be demonstrated as well as achieved results. The woodpile structure consists of aligned rods where every subsequent layer is rotated 90° above the former layer so that the fifth layer is exactly above the first one and the piles of the third shall be located exactly between the piles of the first row.

DS 6.5 Fr 15:30 TU H110

Polarization splitting based on planar photonic crystals — •Veronika Rinnerbauer[1,2], Johann Schermer[2], and Kurt Hingerl[1] — [1]Christian Doppler Labor für oberflächenoptische Methoden, Institut für Halbleiter und Festkörperphysik, Univ. Linz, Altenbergerstr. 69, A-4040 Linz, Austria — [2]Photeon Technologies, Kirchstr. 35, A-6900 Bregenz, Austria

Planar polarization splitting devices based on photonic crystal slabs have been developed, their main advantages being the planar design and their possible integration into PLCs.

Due to their inherent polarization sensitivity, photonic crystals offer convenient solutions on a length scale of several tens of micrometers in silicon-based or other high index material systems. In a 2D photonic crystal slab, the presence of a horizontal symmetry plane allows us to decompose the guided modes into TE-like and TM-like polarization states, which are even and odd with respect to reflections through this plane. In this contribution, we will show three different principles that exploit the polarization dependency of these guided modes.

The first principle is based on reflection and transmission at a photonic crystal interface. The second one uses a defect waveguide for one polarization, and free propagation through the photonic crystal for the other polarization. In the third principle, defect waveguides with polarization-dependent guided modes are used for both polarizations.

Results from numerical simulations will be presented, which show that polarization splitting is possible with high efficiency in photonic crystal slabs.

DS 7 Ionenstrahlverfahren I

Zeit: Samstag 13:45–15:00 Raum: TU H107

Hauptvortrag DS 7.1 Sa 13:45 TU H107

The role of ion irradiation induced viscous flow in thin film structuring: Hard matter going soft — •S.G. Mayr — I. Physikalisches Institut, Georg–August–Universität Göttingen, Friedrich–Hund–Platz 1, 37077 Göttingen

Ion beams provide unique opportunities for modifying thin film structural and mechanical properties on length scales ranging from several nanometers to macroscopic dimensions. In a variety of materials, including polycrystalline and amorphous metals and semiconductors, plastic effects can dominate, which originates from processes in the small volumes of materials affected by a single ion impact. The underlying atomic–scale kinetics as well as its applications for self–organized structuring are investigated using a combination of experiments and molecular–dynamics (MD) computer simulations: We report experiments, that illustrate the impact of radiation induced viscous flow on morphology and stresses, such as interface smoothing [1], stress relaxation, radiation induced sintering or self–organized pattern formation. Using MD simulations [2] we study the underlying atomic–scale mechanisms for the two energy regimes, where local melting along the ion track is either dominant or not. We show, that macroscopic plastic flow does not require melting, indicating, that defect–like entities are sufficient to mediate plastic flow. *Financially supported by the DFG–SFB 602, TP B3*

[1] S.G. Mayr and R.S. Averback, Phys. Rev. Lett. 87 (2001), 196106

[2] S.G. Mayr, Y. Ashkenazy, K. Albe and R.S. Averback, Phys. Rev. Lett. 90 (2003), 55505

DS 7.2 Sa 14:30 TU H107

Formation of magnetic nanoclusters in crystalline silicon by ion implantation — •O. Picht[1], W. Wesch[1], E. Wendler[1], N.A. Sobolev[2], M.M. Araújo Oliveira[2], and J. Heinrich[3] — [1]Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena — [2]Departamento de Física, Universidade de Aveiro, Portugal — [3]Innovent Jena

The research interest on magnetic semiconductors has been strongly increased over the last few years. While the focus mostly rested on the doping of II-VI and III-V compound semiconductors with transition metal ions such as Fe, Co, Ni and mainly Mn, there are only few publications on group IV semiconductors like Si and Ge. The formation of magnetic structures is mostly accomplished by chemical vapor deposition, molecular beam epitaxy or ion implantation. With the latter technique we consecutively implanted As and Mn ions at high fluences of $2 \cdot 10^{16}$ at/cm^2 into weak p-type Si (100). The implantation was carried out at a temperature of 350°C and with energies of 200 keV (Mn) and 270 keV (As). After implantation, rapid thermal annealing (RTA) was carried out at 1100°C for a time span of 30 s. Our Rutherford backscattering spectrometry (RBS) measurements indicate that a strong redistribution of both species takes place during the annealing processes. Whilst the As ions are partially incorporated into the Si-lattice and their movement seems to be governed mainly by diffusion, the Mn ions depth distribution shows additional peaks, resulting from nucleation at defect structures. The Ferromagnetic Resonance (FMR) and SQUID-measurements show ferromagnetic behaviour and suggest a Curie-Temperature over 300 K.

DS 7.3 Sa 14:45 TU H107

Sauerstoffdiffusion und Phasenbildung in dünnen Eisenoxidschichten unter Bestrahlung mit schnellen schweren Ionen — •Tobias Roller, Tilman Joachim Renz, Hartmut Paulus und Wolfgang Bolse — Institut für Strahlenphysik, Universität Stuttgart

Die Bestrahlung von Eisenoxid-Schichtsystemen mit hochenergetischen schweren Ionen (MeV/amu) führt zu einer Verlagerung von Sauerstoff und der Bildung neuer Oxidphasen in unterschiedlichen Tiefen der Probe. So wurde z.B. an unterstöchiometrischen FeO$_x$-Schichten ($x<1$) bei deren Bestrahlung mit 350 MeV Au^{26+}-Ionen beobachtet, dass der oberflächennahe Bereich oxidiert und die darunter liegende Schicht teilweise reduziert wird. Mit zunehmender Bestrahlungsfluenz wandert die Grenze zwischen diesen Bereichen in größere Tiefen.

Zur Untersuchung der Phänomene wurden Rutherford Backscattering Spectroscopy (RBS), Elastic Recoil Detection Analysis (ERDA) und Mößbauerspektroskopie eingesetzt. Mit Hilfe von isotopisch markierten Schichten (^{18}O, ^{16}O) wurde die Herkunft des Sauerstoffs genauer untersucht.

DS 8 Ionen-Festkörper-Wechselwirkung I

Zeit: Samstag 15:15–17:00 Raum: TU H107

DS 8.1 Sa 15:15 TU H107

MD simulations of thermally induced and ion beam induced solid-phase crystallization in silicon — •Konrad Gärtner[1] and Brigitte Weber[2] — [1]Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena — [2]Fraunhofer-Institut für Angewandte Optik und Feinmechanik, 07743 Jena

Classical molecular dynamics (MD) simulations of thermally and ion beam induced solid-phase crystallization at the amorphous-Si/(001)Si interface have been performed using the Stillinger-Weber potential. The simulations were done for two a-Si/(001)Si systems with different sizes (5120 Si atoms and 49152 Si atoms). The evolution of the two systems at different temperatures shows that a realistic stationary interface can be obtained only with the large system. The topological structure of the resulting interface is characterized by extended hip roof structures which explain the large measured interface roughness (about 8 Å). The velocities of the motion of the stationary interface (rates) for the thermally induced and ion beam induced crystallization (and amorphization) are determined and discussed.

DS 8.2 Sa 15:30 TU H107

Experimental evidence for a glass transition in amorphous silicon — •André Hedler[1], Siegfried Klaumünzer[2], and Werner Wesch[1] — [1]Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena — [2]Hahn-Meitner-Institut Berlin, Glienicker Str. 100, 14109 Berlin

Silicon is one of the best investigated elements in materials science, but the phase transition between amorphous silicon and liquid silicon is still subject of discussion. Whereas the low-density amorphous phase is a tetrahedrally coordinated semiconductor, the high-coordinated high-density liquid shows metallic behavior. Because of these structural differences the transition has been classified as a first order phase transition. The melting point of amorphous silicon is believed to be at about 1450 K. In contrast to this, recent computer simulations and the experimental observation of pressure-induced amorphization of nanoporous silicon have revived the idea of an underlying liquid-liquid phase transition implying the existence of a low-density liquid and its glass transition to the amorphous solid. Here we demonstrate that during irradiation with high energy heavy ions amorphous silicon deforms plastically in the same way as conventional glasses. This behaviour provides experimental evidence for the existence of the low-density liquid. The glass transition temperature for a timescale of 10 ps is estimated to be about 1000 K. Our results support the idea of liquid polymorphism as a general phenomenon in tetrahedral networks.

DS 8.3 Sa 15:45 TU H107

Rapid amorphisation and damage annealing in InGaAs at temperatures between 15 K and 300 K — •Werner Wesch[1], Elke Wendler[1], and Mark C. Ridgway[2] — [1]Friedrich-Schiller-Universität Jena, Institut für Festkörperphysik, Jena — [2]Department of Electronic Materials Engineering, Australian National University, Canberra,

The production and stability of irradiation-induced disorder in InGaAs was studied in comparison to the binary extremes InAs and GaAs at 15 and 300 K using in situ irradiation and Rutherford backscattering-channelling (RBS/c). GaAs was easier to amorphise than InAs at 300 K, the opposite was true at 15 K. The temperature dependence or activation energies for the defect migration and annealing that determine residual disorder, presumably associated with the Group III component, must thus be greater in InAs than GaAs. In contrast to the well known behaviour of AlGaAs, the ternary InGaAs alloys did not exhibit amorphisation kinetics intermediate between those of the two binary extremes. At 300 K the critical nuclear energy deposition required to render InGaAs amorphous was less than that of both GaAs and InAs. At 15 K, both InAs and the ternary alloy amorphised at the same value of nuclear energy deposition. The rapid amorphisation of InGaAs is attributed to a greater stability of irradiation-induced defect clusters or amorphous nuclei in the ternary alloy which obviously results from significant differences in In-As and Ga-As bond lengths which are not present for the Al-As and Ga-As bonds in AlGaAs.

DS 8.4 Sa 16:00 TU H107

Effect of ion irradiation on Au nanoparticles deposited onto Si substrates — •Andreas Klimmer[1], Masaki Ozawa[2], Anitha Ethirajan[1], Hans-Gerd Boyen[1] und Paul Ziemann[1] — [1]Abt. Festkörperphysik, Universität Ulm — [2]Zentrale Einheit Elektronenmikroskopie, Universität Ulm

Arrays of hexagonally arranged Au nanoparticles on top of Si substrates ($\emptyset \approx 10$ nm, interparticle distances ≈ 80 nm) were sequentially irradiated with 200 keV Ar$^+$ ions up to fluences of 10^{16} ions/cm^2. The bombarded structures were analyzed by high-resolution SEM, AFM as well as cross-sectional TEM.

The Au nanoparticles seem to be stable up to a fluence of $\sim 10^{15}$ ions/cm^2 (~ 800 ion impacts on one nanoisland). Upon further irradiation the average particle height relative to the substrate level diminishes according to SEM and AFM. Subsequently, these techniques suggest an almost complete disappearance of the particles at fluences above 10^{16} ions/cm^2.

However, TEM measurements reveal that the Au particles have not been just sputtered from the surface but complete particles can be redetected within the Si substrate with their spherical shape conserved. This surprising effect might be due to bombardment induced changes in the visco-elastic properties of the underlying Si substrate. Whether for that process the substrate close to the nanoparticle has to be amorphized by the ion beam is not clear, yet.

DS 8.5 Sa 16:15 TU H107

Ion-beam induced nanosized silver metal clusters in glass — •H.-E. Mahnke[1], B. Schattat[1,2], V. Koteski[3] und N. Novakovic[1,3] — [1]Ionenstrahllabor ISL, Hahn-Meitner-Institut Berlin — [2]Institut für Strahlenphysik Stuttgart — [3]VINČA Institute Belgrade

We have studied the formation of silver metal clusters in soda lime glass induced by high-energy heavy ion irradiation at ISL, extending an earlier investigation by Battaglin et al. (NIM B200 (2003) 185) with He ions to much higher electronic energy losses. The metal cluster formation was detected with X-ray absorption spectroscopy (EXAFS) in fluorescence mode. Prior to the ion irradiation, silver has been introduced into the glass by a Ag-alkali ion-exchange process. The Ag containing glass platelets with a thickness of 0.15 mm were ion irradiated with 600-MeV Au ions with fluences between 1×10^{12} and 1×10^{13} ions/cm^2. Following a thermal treatment of either 250 °C annealing under reducing atmosphere of Ar with a few % H$_2$ for 5 hours or at 340 °C for 30 minutes (the same temperature and time at which the Ag was introduced by the exchange process), the glass samples were analysed by EXAFS at the X1 beamline at Hasylab for the local structure around Ag atoms in the glass. While Ag is originally incorporated into an oxidic environment, ion irradiation combined with an annealing treatment afterwards leads to the formation of Ag in the metallic form.

DS 8.6 Sa 16:30 TU H107

Kinetik des Selbstorganisationsvorganges bei der Bildung von SiC$_x$-Ausscheidungs-Arrays in C$^+$-Ionen-implantiertem Silizium — •Frank Zirkelbach, Maik Häberlen, Jörg K.N. Lindner und Bernd Stritzker — Universität Augsburg, Institut für Physik, Universitätsstr. 1, 86135 Augsburg

Die Implantation von C$^+$-Ionen in Silizium führt bei hinreichend hohen Dosen und geeigneten Implantationstemperaturen zur Bildung regelmäßig angeordneter Ensembles aus nanometrischen, sphärischen bzw. lamellaren amorphen SiC$_x$-Ausscheidungen in kristalliner Si-Matrix. Dieser Vorgang kann mittels eines Modells beschrieben und durch einen Monte-Carlo-Simulationscode nachvollzogen werden. Hierbei werden Mechanismen wie die ballistische, Kohlenstoff-induzierte und spannungsunterstützte Amorphisierung, Kohlenstoff-Diffusion und Segregation in amorphen Einschlüssen, sowie die Rekristallisation kohlenstoffarmer Bereiche berücksichtigt. Der Einfluss jedes einzelnen dieser Mechanismen auf die Verteilung amorpher Einschlüsse kann durch Variation der Modellparameter untersucht werden. Geeignete Modellparameter reproduzieren experimentell beobachtete Ausscheidungsverteilungen und erlauben es, die Kinetik des Selbstorganisationsvorgangs zu analysieren.

DS 8.7 Sa 16:45 TU H107

Herstellung von Silizium und Stickstoff dotierten a–C:H Schichten mittels PIII&D — •Florian Schwarz[1,2], Götz Thorwarth[1,2], Claus Hammerl[2], Marcus Kuhn[2] und Bernd Stritzker[1] — [1]Lehrstuhl für Experimentalphysik IV, UniversitätAugsburg, 86135 Augsburg — [2]AxynTeC DünnschichttechnikGmbH, Am Mittleren Moos 48, 86167 Augsburg

Diamantähnlicher Kohlenstoff (DLC) in der wasserstoffhaltigen Variante (a–C:H) gelangt dank seiner guten mechanischen und chemischen Eigenschaften zunehmend zu industrieller Anwendung. Trotzdem sind zusätzliche, gezielt einstellbare Eigenschaften, wie elektrische Leitfähigkeit und geringe Benetzbarkeit wünschenswert.

Dazu wurden mittels der Plasma Immersions Ionenimplantation und Deposition (PIII&D) silizium- und stickstoffhaltige a–C:H Schichten hergestellt. Basierend auf den Ergebnissen der beiden Dotiervarianten a–C:H:Si und a–C:H:N wurden die mögliche Realisierung von Nanokompositen aus Si$_3$N$_4$ in einer a–C:H Matrix untersucht. Die Analyse der Schichten umfasste sowohl RBS, XRD, TEM und Raman Spektroskopie, als auch Nanohärte-, Leitfähigkeits- und Kontaktwinkelmessungen.

DS 9 Elektronische Eigenschaften von Oberflächen

Zeit: Samstag 09:00–09:45 Raum: TU EB301

Hauptvortrag

DS 9.1 Sa 09:00 TU EB301

Low-dimensional electrons at silicon surfaces — •Franz J. Himpsel — Physics Dept., University of Wisconsin Madison, 1150 University Ave., Madison, WI 53706, USA

It has become possible to create a class of low-dimensional chain structures on silicon surfaces that are metallic [1,2]. Electrons near the Fermi level are de-coupled from the substrate because their energy lies in the band gap. The metal atoms, however, are rigidly tied to the silicon lattice in substitutional positions according to x-ray diffraction [3] and first principles band calculations [4]. The dimensionality can be controlled by using stepped surfaces with adjustable step spacing. Ratios of the intra-chain coupling to the inter-chain coupling between 10:1 and more than 70:1 have been achieved. In addition, the band filling can be varied, including fractional fillings, such as 8/3 of an electron per chain atom [2]. That creates an opportunity to systematically search the parameter space for exotic states predicted for one-dimensional electrons, such as a collective excitation where spin and charge separate. This wide-open territory of low-dimensional structures is explored in real and reciprocal space by scanning tunneling microscopy and angle-resolved photoemission. [1] Himpsel et al., J. Phys. Condens. Matter 13, 11097 (2001). [2] Crain et al., Phys Rev. Lett. 90, 176805 (2003) and Phys. Rev. B 69, 125409 (2004). [3] Robinson et al., Phys. Rev. Lett. 88, 096104 (2002). [4] Sanchez-Portal et al., Phys. Rev. B 65, 081401 (2002) and Phys. Rev. Lett. 93, 146803 (2004); Erwin, Phys. Rev. Lett. 91, 206101 (2003).

DS 10 FV-internes Symposium Anorganische Dielektrika für die künftige Mikro- und Nanotechnologie

Zeit: Samstag 10:00–13:45 Raum: TU H110

Hauptvortrag

DS 10.1 Sa 10:00 TU H110

Atomic-scale properties of high-k dielectrics for CMOS: ab initio study for Pr-based materials — •Jarek Dabrowski[1] and Andrzej Fleszar[2] — [1]IHP, Im Technologiepark 25, 15236 Frankfurt(Oder), Germany — [2]Universität Würzburg, Am Hubland, 97074 Würzburg, Germany

In the nearest future, a dielectric with a dielectric constant k several times higher than that of SiO_2 will be needed for the fabrication of CMOS devices. The search for an optimal dielectric is not complete. Numerous metal oxides and silicates are being investigated, various deposition and annealing techniques are being developed which try to utilize the effects attributed to alloying, incorporation of nitrogen, gettering of oxygen, etc. At the same time, the basic knowledge on the microscopic properties of these materials is poor. Ab initio calculations assist in the interpretation of the experimental results and in the choice of the direction of further work.

Using Pr-based dielectrics as a case study, we discuss the atomic and electronic structures of bulk oxides and silicates, of various defects and impurities, and of the interfaces to Si. We consider the native defects (vacancies and self-interstitials), the defects associated with such elements as Si, Ti, Sr, or B, the effect of moisture, and the diffusion of elements and moieties (e.g., of SiO_2 in Pr_2O_3). We describe the interaction between materials during fabrication of a dielectric film, e.g., the formation of electrically active defects in SiO_2 by a Pr layer deposited on top of a SiO_2 layer. Finally, we turn our attention to the formation of the interface between Si(001) and the Pr oxide and/or silicate.

Hauptvortrag

DS 10.2 Sa 10:45 TU H110

Epitaxial growth of oxide layers on silicon surfaces — •Wolfgang Moritz[1], Nicole Jeutter[1], Laure Libralesso[2], and Jörg Zegenhagen[2] — [1]Dept. of Earth and Environmental Sciences, LMU München — [2]ESRF, Grenoble, France

In the search for high-k dielectrics to replace the SiO_2 layer in silicon based devices only few materials have been found so far. The oxides have to be thermodynamically stable in contact with Si at temperatures up to 1000° C and the formation of interfacial SiO_2 layers has to be avoided. Among the possible materials are oxides with the perowskite type structure, Ba/$SrTiO_3$ and rare earth oxides like Pr_2O_3, Y_2O_3 and CeO_2. The current status of the growth of epitaxial oxide layers is reviewed. Most promising is Pr_2O_3 which forms well ordered epitaxial layers on the Si(111) surface and which can be overgrown by Si. Results from X-ray diffraction and LEED show the initial stages of growth and an SiO_2 free interface structure. On the (100) surface the growth of oxide layers in general leads to layers with lower crystalline quality due to rotational domains. These are avoided on the Si(113) surface and first results for growth studies of Pr_2O_3 on this substrate orientation are presented. A further promising field seems to be the growth of layers of ternary oxides which have rarely been studied up to now, except for the perowskite type structures. First results for the growth of aluminosilicates are presented.

Hauptvortrag

DS 10.3 Sa 11:30 TU H110

The role of interfaces in nanosize ferroelectrics oxides — •Marin Alexe, Lucian Pintilie, and Dietrich Hesse — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle

Multifunctional ferroelectric oxide materials offer a wide range of useful properties from switchable polarization that can be applied in memory devices to piezoelectric and pyroelectric properties used in actuators, transducers and thermal sensors. Generally speaking at the nanometer scale material properties are expected to be different. Fundamental problems such as the super-paraelectric limit, the influence of the free surface, and of the interface and bulk defects on ferroelectric switching, etc. arise when scaling down ferroelectrics. In order to study these size effects, fabrication methods of high quality nanoscale ferroelectric crystals have been developed. The present talk will briefly review self-patterning and self-assembly fabrication methods, including chemical routes, morphological instability of ultrathin films, microemulsion, and self-assembly lift-off, employed up to the date to fabricate ferroelectric nanoscale structures with lateral size in the range of few tens of nanometers. In depth structural and electrical investigations of interfaces performed to differentiate between intrinsic and extrinsic size effects will also be presented.

Hauptvortrag

DS 10.4 Sa 12:15 TU H110

DRAM capacitor scaling — •M. Gutsche[1], T Hecht[1], S Jakschik[2], C Kapteyn[2], G Krautheim[2], S Kudelka[2], J Lützen[2], A Sänger[2], U Schröder[2], H Seidl[2], A Avellan[2], J Heitmann[2] und G Hirt[2] — [1]Infineon Technologies — [2]Ifx

Über viele Jahre hinweg hat die DRAM-Industrie wesentlich zum Fortschritt bei der Miniaturisierung mikroelektronischer Bausteine beigetragen. Um auch weiterhin bei kleiner werdenden lateralen Strukturgrößen und innovativen Zelldesigns eine genügend hohe Zellkapazität einer einzelnen Speicherzelle zur Verfügung stellen zu können, sind innovative Konzepte in den Bereichen Zellenlayout, Kondensatorgeometrie sowie Materialauswahl erforderlich. Stapel- und Grabenkondensatoren werden zunehmend höhere Aspektverhältnisse aufweisen, woraus sich zusätzliche Anforderungen an Ätz- und Abscheidungsverfahren ergeben. Die einzelnen Kondensatoren sind so anzuordnen, dass sie den Raum optimal ausfüllen und zugleich ihre mechanische Stabilität verbessert wird. Durch geeignete laterale Aufweitung von Strukturen sowie durch Oberflächenaufrauhung kann zusätzlich Kapazität bereitgestellt werden. Vor allem aber ist es notwendig, dielektrische Materialien mit größerer dielektrischer Konstante zum Einsatz zu bringen. In Verbindung mit metallischen Elektroden können MIS- und MIM-Strukturen hergestellt werden, mit deren Hilfe sich signifikant kleinere äquivalente Oxiddicken realisieren lassen.

Hauptvortrag

DS 10.5 Sa 13:00 TU H110

Advance MOSFET gate dielectrics for high-performance microprocessors: Materials selection and analytical challenges — •E. Zschech[1], H.-J. Engelmann [1], K. K Dittmar [1], S. Ohsiek [1], B. Tracy[2], E. Adem [2], A. Myers[2], S. Robie [2], M. Sidorov [2], and J. Bernard [2] — [1]AMD Saxony LLC & Co. KG, Dresden, Germany — [2]Spansion Inc., Sunnyvale/CA, U. S.

According the 2003 ITRS roadmap [1], high-performance microprocessors (HP-MPUs) are driving the continuous shrinking of metal-oxide-semiconductor (MOS) feature sizes. The scal-ing down of the HP-MPU physical gate length follows a two-year cycle with a scaling factor of 0.7 until 2005 and switches to a three-year cycle thereafter, leading to 10 nm gates in 2015. The traditional down-scaling of MOS transistors leads to performance limitations that have to be overcome by the introduction of new materials in the gate stack, which result in new and exciting challenges to solid-state physicists and materials scientists. For leading edge logic products, the transistor performance can be further increased by metal oxide gate dielectrics with a high dielectric constant (high-k materials). The particular need for low-leakage devices is driving the implementation of high-k gate dielectric materials during the next couple of years - one of the key challenges for materials research and process inte-gration. However, until real high-k dielectrics will be introduced into the CMOS process, sili-con oxynitrides will being used as an interim solution. In this paper, material transitions that are necessary to improve the product performance and to maintain the product reliability of HP-MPUs are highlighted. Particularly, the reduction of gate leakage currents by the implementation of high-k materials (at first silicon oxynitrides, followed by metal oxides) for gate dielectrics in MOS transistors is discussed. The need of leading-edge analytics for the study of fundamental integration, performance and reliability issues of metal oxides and for the optimization silicon oxynitride thin films is demonstrated.

[1] International Technology Roadmap for Semiconductors (ITRS): Semiconductor Interna-tional Association (SIA), 2003 Edition, http://public.itrs.net

DS 11 Anorganische dielektrische Schichten

Zeit: Samstag 14:30–15:45 Raum: TU H110

DS 11.1 Sa 14:30 TU H110

Initial growth of Pr_2O_3 epitaxial layers on silicon substrates — •Laure Libralesso[1], Thomas Schröder[2], Tien-Lin Lee[1], Isabelle Joumard[1], and Jörg Zegenhagen[1] — [1]ESRF, Grenoble, France — [2]IHP, Frankfurt(Oder)

In microelectronics industry, the quality of the thermally and electrically stable Si-SiO_2 interface has made SiO_2 the gate-dielectric material of choice over the last 40 years. However, to follow in time the International Technology Roadmap for Semiconductors, the SiO_2 gate must be replaced by an alternative high-K dielectric layer. Among the proposed materials, thin Pr_2O_3 layers show outstanding dielectric properties. In the present study the Pr_2O_3/Si(111) system has been investigated as a model system.

The initial stages of Pr_2O_3 molecular beam epitaxy growth on Si(111) have been studied with in situ low energy electron diffraction and ultra high vacuum scanning tunneling microscopy (STM). Atomically flat Pr_2O_3 surfaces have been observed for coverages going from submonolayer range up to 2 monolayers. The evolution of the island size, the growth behaviour as well as the nucleation process will be described. Pr_2O_3 deposits have also been investigated on Si(001) substrates. STM as well as surface X-ray diffraction results will be briefly discussed.

DS 11.2 Sa 14:45 TU H110

The initial interaction of Pr2O3 to (001) and (111) oriented Si substrates — •Dieter Schmeisser — Angewandte Physik-Sensorik, BTU Cottbus, Postfach 10 13 44, D-03013 Cottbus, Germany

The high surface sensitivity of synchrotron based core level spectroscopy is employed to study the initial growth of Pr2O3 on Si(001) and Si(111) substrates. The Si2p core levels are different for the two substrates when the exposure is below 1nm. The core level shifts indicate a single bonding of the oxide on the terminal Si atom in Si(111) while on Si(001) the two dangling bonds are reactive. On both surfaces a significant broadening in the substrate emission is found and interpreted in terms of non bonding Si atoms located at the interface. Upon increasing the Pr2O3 exposure above 1nm the Si back bonds in the first Si layer are attacked to form Si - O - Pr bonds which cause a silicate like core level shift.

DS 11.3 Sa 15:00 TU H110

Heteroepitaxial silicon / Pr_2O_3 / silicon structures for nanoelectronics applications — •Thomas Schroeder[1,2], Peter Zaumseil[1], Christian Wenger[1], Gunther Lippert[1], Grzegorz Lupina[1], Hans Joachim Muessig[1], Laure Libralesso[2], and Joerg Zegenhagen[2] — [1]IHP, Im Technologiepark 25, 15236 Frankfurt (Oder), Germany — [2]ESRF, BP 220, 38043 Grenoble, France

Epitaxial Si/Pr_2O_3 /Si structures are promising semiconductor-insulator-semiconductor (SIS) stacks for applications as engineered wafer materials (silicon-on-insulator (SOI)) or for innovative transistor designs (multiple gate transistors). Here, we report the molecular beam epitaxy (MBE) growth of such structures on Si(111). The growth of Pr_2O_3 films on Si(111) was studied by reflection high energy electron diffraction (RHEED) to determine the growth mode. Scanning tunnelling microscopy (STM) visualizes the formation of a closed oxide overlayer. Synchrotron radiation-grazing incidence X-ray diffraction (SR-GIXRD) studies monitored the transition from pseudomorphism to bulk behaviour in the ultra-thin thickness regime (¡ 10 nm). Thicker oxide layers (up to 50 nm) were studied by XRD and X-ray reflectivity (XRR) to monitor the crystalline quality and surface roughness. The Pr_2O_3 film grows in the (0001) oriented hexagonal phase on Si(111) but annealing transforms the oxide in its cubic phase with (111) orientation. The Si overgrowth was carried out on hexagonal as well as cubic oxide layers to tailor the strain in the Si epilayer. Pr_2O_3 /Si multilayer structures are also addressed in brief.

DS 11.4 Sa 15:15 TU H110

The interaction of Al, Au, Ag, and Ti metal contacts with Pr2O3 thin films — •Mohamed Torche and Dieter Schmeisser — Angewandte Physik-Sensorik, BTU Cottbus, Postfach 10 13 44, D-03013 Cottbus, Germany

Pr2O3 is one of the promising high-k oxides desirable to replace SiO2 for the sub-100nm field-effect transistors (FETs) and dynamic random access memory (DRAM) capacitors. Here we focus on the metallic contacts used for the MOS and MIM based structures. With the thickness of Pr2O3 being around 3nm the metal interaction is crucial to avoid a reduction of the dielectric properties by metal percolation, crack filling or diffusion processes. We use XPS and SRPS to study the initial interaction as well as the thermal stability of metals (Al, Ag, Au, and Ti) on Pr2O3 films. We show that Al, Ag, Au form initial metallic layer which react already at temperatures around 300°C. In contrast, Ti is found to be more stable than the other metals. We determine the formation of Ti-oxides at the Ti / Pr2O3 interface and its thermal stability. Ti is found to build a good diffusion barrier between the oxide and the metal.

DS 11.5 Sa 15:30 TU H110

Preparation of microcrystalline Si thin films by pulsed plasma CVD at normal pressures — •Maki Suemitsu[1], Hirotatsu Kitabatake[1], Yasutake Toyoshima[2], Setsuo Nakajima[3], and Tsuyoshi Uehara[3] — [1]CIR, Tohoku University, Sendai 980-8578 — [2]ETRI, AIST, Tsukuba 305-8568 — [3]Sekisui Chemicals Co. Ltd., Wadai, Tsukuba 300-4292

By employing a pulsed discharge, microcrystalline Si films have been successfully prepared by plasma-enhanced chmical vapor deposition (PECVD) operated under near-atmospheric pressures. A gas mixture of only monosilane and hydrogen was used without any further diluent gases. Under the operating pressure of 500 Torr and the substrate temperature of 180C, a Si film with dominant crystalline phase is prepared at a deposition rate of 2.0 nm/s. The thickness and the Raman ratio (crystal/amorphous) of the deposited film showed variation along the gas flow direction, both of which are well explained by assuming delayed production and consumption of silyl radicals along the flow direction. In normal-pressure PECVDs, "flow"can be a feasible, additional degree of freedom in analyzing the growth mechanism of microcrystalline thin films.

DS 12 Ionen-Festkörper-Wechselwirkung II

Zeit: Montag 10:45–12:45 Raum: TU H107

Hauptvortrag

DS 12.1 Mo 10:45 TU H107

Solid matter under extreme conditions - Electronic excitations by swift highly charged ions — •Gregor Schiwietz — Hahn-Meitner-Institut Berlin, Abt. SF4, Glienicker Str. 100, 14109 Berlin

The kinetic energy of fast ions is transferred virtually only to the electrons of the medium. The individual energy-loss events occur within 10^{-17} s and typical energy transfers are between a few eV up to several keV. Thus, the energy deposition of a single swift heavy ion, as delivered, e.g., by the ISL cyclotron at the Hahn-Meitner-Institut, is comparable to the giant focussed multi-photon pulse that will be available at the future free-electron laser XFEL.

The talk will address ion-induced electronic excitations inside solids and subsequent atomic rearrangement processes that lead to materials modifications once a certain threshold excitation-density is exceeded. Surface-sensitive experiments under ultra-high vacuum conditions will be presented and snapshots of the short-time evolution are extracted from high-resolution Auger electron spectra for different materials.

DS 12.2 Mo 11:30 TU H107

Swift heavy ion irradiation of InP: Why a thin surface layer remains crystalline? — •Andrey Kamarou, Werner Wesch, and Elke Wendler — Institut für Festkörperphysik, Universität Jena, Max-Wien-Platz 1, 07743 Jena

Irradiation of single-crystalline InP with large fluences of swift heavy ions (SHI) causes formation of amorphous layers within the depth range of dominating electronic energy loss ε_e. However, unlike the bulk, thin surface layers (tens of nm) remain almost undamaged. In order to amorphise also those thin crystalline surface layers (TCSL), much higher SHI fluences are necessary. Hence, two suggestions can be made: (a) either the surface acts as a powerful sink for defects generated by SHI irradiation near the surface (i.e., they move towards the surface and annihilate there), or (b) SHI energy deposition is not constant within thin surface layers.

Our results show that the existence of TCSL can not be solely due to migration of defects to the surface, but should be ascribed to ε_e that increases with depth in the thin surface layers. Particularly, the last feature is characteristic to SHI having the initial charge lower than the equilibrium one for the bulk. Generally, one can state the dominating influence of SHI charge state; the influence of the surface itself is less significant, but can not be ruled out completely.

DS 12.3 Mo 11:45 TU H107

Ion-induced sputtering — •Bente Walz[1,2], Gregor Schiwietz[2], Melanie Roth[2] und Beate Schattat[2] — [1]Institut für Experimentelle und Angewandte Physik, Universität Regensburg, Universitätsstraße 31, 93053 Regensburg — [2]Hahn-Meitner-Institut Berlin, Glienickerstaße 100, 14109 Berlin

Treffen schnelle schwere Ionen auf ein Festkörpertarget kommt es aufgrund des hohen elektronischen Energieeintrags entlang ihrer Flugbahn zur Ausbildung von Ionenspuren. Aufgrund dessen werden von der Targetoberfläche sowohl geladene, als auch neutrale Teilchen emittiert. Informationen über die zeitliche Entwicklung der Ionenspur erhält man über eine energieaufgelöste Detektion der emittierten Teilchen. Zum Nachweis der emittierten Neutralteilchen wurde im Ionenstrahllabor am Hahn-Meitner-Institut in Berlin ein neuer Experimentierplatz aufgebaut. Es werden erste Testmessungen vorgestellt.

DS 12.4 Mo 12:00 TU H107

Self-organisation of thin NiO-films under swift heavy ion bombardment — •M. Kalafat[1], A. Feyh[1], W. Bolse[1], D. Etissa-Debissa[1], S. Klaumünzer[2], G. Schumacher[2], and G. Bilger[3] — [1]Institut für Strahlenphysik, Stuttgart — [2]Hahn-Meitner-Institut, Berlin — [3]Institut für Physikalische Elektronik, Stuttgart

NiO films with thicknesses from 5 to 260nm on SiO_2 have been irradiated with swift heavy ion (Mev/amu) at 80K under different tilt angles ($\geq 75°$) with respect to the beam direction.
At low fluences the initially smooth and coherent NiO-layer was found to crack periodically and transform into a periodic lamellae structure with increasing fluence. The lamella (as the cracks) are oriented perpendicular to the projection of the beam direction onto the surface. They have a height of up to 2μm and a width down to 0,1μm. Their distances varied between 1 and 5μm. The characteristics of the lamellae structure depend on the irradiation conditions (ion, energy, fluence, angle, temperature). Multiple irradiation from different directions results in complex structures on a sub-μm scale. Post-irradiation of already existing structures under large angles and permanent rotation of the sample allows to homogeneously shrink their dimensions. This way we were able to generate an almost regular, large area covering arrangement of pillars of <200nm in diameter and some μm height.

DS 12.5 Mo 12:15 TU H107

Trapping and transport of gold atoms in tracks of swift heavy ions — •C. Dais[1], W. Bolse[1], and J. K. N. Lindner[2] — [1]Institut für Strahlenphysik, Universität Stuttgart — [2]Institut für Physik, Universität Augsburg

We have investigated the modification of single- and multimarkerlayers of Au in NiO on Si-substrate due to irradiation with swift heavy ions. The samples were analysed with RBS, TEM and AFM. A redistribution of the Au-atoms into cylindrical tracks parallel to the beam direction was found. For Kr-irradiation the Au filled tracks have a length of 20-30nm and are symmetrically distributed around the initial marker plane. For Au and Xe ions these tracks reach the surface where the Au segregates into spherical nano-particles. In case of Au irradiated multilayers continous Au nanowires of about 6nm in diameter and a length of up to 180nm are formed.
Trapping and transport of Au was found to depend on the marker-thickness, marker-position, irradiation angle and irradiation temperature. The marker-thickness is of particular importance: the lower the thickness the slower is the Au transport. We present a model which explains the phenomenon by a combination of trapping in and transport along the hot ion track. Trapping of the Au-atoms occurs due to recrystalisation of the ion track, while the transport is induced by the high pressure build up in the melt phase.

DS 12.6 Mo 12:30 TU H107

High-energy Au implantation of GaAs at 16 K — •E. Wendler, R. Lauck, and W. Wesch — Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena

In GaAs implanted with high-energy ions (10 MeV range) and analysed at room temperature, the defect concentration close to the surface was found to be lower than expected from theoretical simulations. Thermal or ionisation-induced annealing of defects was considered to be the cause for that. In the present paper GaAs was irradiated with 10 MeV or 17.5 MeV Au ions at 16 K and subsequently measured at the same temperature. Under these conditions ion-beam induced processes can be studied whilst thermal effects are widely excluded. It is found that the measured defect concentration scales with the number of displacements per lattice atom (representing the nuclear energy deposition) independent of the ion energy and of the depth. This result demonstrates that, for the chosen ion energies, the electronic energy deposition itself does not influence the damage production in GaAs. The explanation for the previously observed effects is a preferred annealing of lightly damaged areas during warming the samples to room temperature for measurement.

DS 13 Ionenstrahlverfahren II

Zeit: Montag 14:15–15:15 Raum: TU H107

DS 13.1 Mo 14:15 TU H107

Topography of simultaneously sputtered and rotated solid surfaces: A numerical study — •Emmanuel O. Yewande, Reiner Kree, and Alexander K. Hartmann — Institut für Theoretische Physik, Universität Göttingen

Rippled topography that arises from the bombardment of solid surfaces by beams of oblique incidence ions, is undesirable in the dopant profiling of semiconductors since the periodic height modulations lead to a rapid degradation of depth resolution during depth profiling. This problem can be overcome, as demonstrated experimentally [1] and theoretically [2], by Zalar rotation which ensures that the surface remains smooth as it is rotated during erosion. Furthermore, it has been observed [3] that such simultaneously rotated and sputtered surfaces evolve some characteristic lengthscales. By means of a SOS model of ion-beam surface sputtering [4, 5], we performed a numerical investigation of the effects of sample rotation, during ion bombardment, on the surface topography. Our analysis, at different angles of incidence, includes the time evolution of the rms fluctuation in the surface height, and the height-height correlation function. [1] E. -H. Cirlin, J. J. Vajo, R. E. Doty, and T. C. Hasenberg, J. Vac. Sci. Technol. A **9**, 1395 (1991). [2] R. M. Bradley, PRE **54**, 6149 (1996). [3] F. Frost, A. Schindler, and F. Bigl, PRL. **85**, 4116 (2000). [4] A. K. Hartmann, R. Kree, U. Geyer, and M. Kölbel, PRB **65**, 193403 (2002). [5] E. O. Yewande, A. K. Hartmann, and R. Kree, cond-mat/0405363.

DS 13.2 Mo 14:30 TU H107

Ion induced pattern formation on Ge and Si surfaces — •Bashkim Ziberi, Frank Frost, and Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung e. V., Permoserstrasse 15, D-04318 Leipzig

Pattern formation during low-energy ion beam erosion can be observed on various semiconductor surfaces and is related to the complex interplay between surface roughening by ion erosion and surface smoothing by different surface relaxation mechanisms. This formation of regular structures with nanometer dimensions (structure dimensions < 100 nm) originated from self-organization processes during ion beam erosion offers a promising tool for large-area nanostructured surfaces. For the technologically most important semiconductor materials Ge and Si the topography evolution during low-energy noble gas ion bombardment was investigated and analyzed by high resolution scanning force microscopy (AFM). Depending on ion beam parameters, i. e. ion energy, ion incidence angle and ion mass, different patterns can evolve on the surface. For example in the case without sample rotation, at small ion incidence angles (5° - 15° with respect to surface normal), very well ordered ripple patterns with wavelength ≈ 50 nm can form in both materials for similar sputtering conditions. However, highly ordered nanostructures on Ge surfaces can be only observed under bombardment with Xe^+ instead of Ar^+ ions.

DS 13.3 Mo 14:45 TU H107

Smoothening, mixing and sputtering of semimetal- and halogenide-coatings by swift heavy ion irradiation — •Hartmut Paulus, Wolfgang Bolse, and Bouschaib Bahouchi — Institut für Strahlenphysik, Stuttgart

Thin layers of Bismuth and several Halogenides have been deposited onto Silicon and Silicon Oxide substrates by thermal evaporation at different substrate temperatures. The samples were irradiated with different swift heavy ions (SHI) of various energies and fluences at a temperature of about 80K. After irradiation the irradiated as well as the remaining non-irradiated parts of the samples were characterized by surface profilometry (SP) and Rutherford backscattering spectrometry (RBS). From the RBS data the thickness of the coating can be determined. The combination of SP and RBS allows to distinguish between surface roughness and interface mixing. It is well-known that depending on the deposition conditions these materials exhibit a more or less rough surface, which in fact was also observed in our case. The irradiation with SHI results in 3 different effects. At low fluences smoothening, which is probably due to compaction of the material (reduction of the interface variances in the RBS spectra), occurs. Higher fluences on the other hand lead to significant intermixing of the coating with its substrate (increase of the interface variances in the RBS spectra). At very high fluences also sputtering can be observed. These effects will be discussed in terms of transport of matter in ion tracks.

DS 13.4 Mo 15:00 TU H107

Einfluss der Substrattemperatur und der Substratvorstrukturierung auf das 3D-Nanostrukturwachstum bei der Ionenstrahl-Sputterabscheidung mit GLAD — •John Fahlteich, Eva Schubert, Bernd Rauschenbach und Thomas Höche — Leibniz-Institut für Oberflächenmodifizierung e.V. (IOM), Permoserstrasse 15, 04318 Leipzig

Durch extrem flachen Teilcheneinfall bei geeigneter Substratrotation lassen sich dreidimensionale Nanostrukturen mit vielfältiger Geometrie auf einem Silizium(Si)-Target erzeugen. Es wurde untersucht, wie sich Temperatur und Substratvorstrukturierung auf das Wachstum vierzähliger Spiralen auswirken. Als Vorstrukturen dienten Si-Punktstrukturen oder zusätzlich aufgetragene Goldpartikel. Für das Strukturwachstum wurde ein Si-Target mit Argon(Ar+)-Ionen beschossen. Die zerstäubten Si-Atome gelangten unter einem Winkel von 85° auf das Substrat, wobei das Stukturwachstum in einem Temperaturbereich zwischen Raumtemperatur und 400°C untersucht wurde. Zur Erzeugung der Spiralen wurde ein Si-Substrat in Schritten von 90° azimutal gedreht und ein Spiralarm für jeweils 45 min bei feststehendem Substrat gewachsen. Die Nanostrukturen wurden mit Hilfe eines Rasterelektronenmikroskops (REM) hinsichtlich ihres Aufbaus, Abstands und ihrer Größe untersucht. Es wird gezeigt, dass bei zunehmender Temperatur der Durchmesser der Strukturen deutlich kleiner wird. Die Größe und Anordnung der Nanospiralen hängt zudem vom räumlichen Arrangement und der Größe der Vorstrukturen auf dem Substrat ab. Die Analyse der kristallographischen Struktur erfolgte mit Röntgenbeugung (HR-XRD).

DS 14 Schichtherstellung mit Laserverfahren

Zeit: Montag 15:15–16:45 Raum: TU H107

DS 14.1 Mo 15:15 TU H107

Laser-carburizing of iron — •Michael Kahle[1], Ettore Carpene[2], and Peter Schaaf[1] — [1]Universität Göttingen, II. Physikalisches Institut, Friedrich-Hund-Platz 1, D-37077 Göttingen, Germany — [2]Dipartimento di Fisica, Politecnico di Milano, Piazza Leonardo da Vinci 32, I-20133 Milano, Italy

Laser plasma treatments in reactive atmospheres have gained a large potential for technical applications, especially for surface coatings. The work pieces can be covered with hard, resistant carbides whose amount and structure is dependent of the processing parameters: Gas-pressure, number of pulses and energy. Here we present the results for a laser treatment of pure iron in a methane atmosphere. The structural, mechanical and chemical changes of the carburized surfaces are investigated by means of Rutherford Backscattering Spectrometry (RBS), Conversion Electron / X-Ray Mössbauer Spectroscopy (CEMS/CXMS), Nanoindentation and X-Ray Diffractometry (XRD). The results such as phase formation, carbon incorporation, hardness and stress are presented. The main focus is the transformation of the hexagonal ε-carbide into the hard orthorhombic θ-carbide (cementite).

DS 14.2 Mo 15:30 TU H107

Herstellung dünner DLC-Schichten auf metallischen Substraten mittels Laserablation — •Kerstin Wätje[1,2], Bernd Schey[2], Andreas Heinrich[1] und Bernd Stritzker[1] — [1]Universität Augsburg, Lehrstuhl für Experimentalphysik IV, 86135 Augsburg — [2]Axyntec Dünnschichttechnik GmbH, Am Mittleren Moos 48, 86167 Augsburg

Die hohe Härte und der geringe Reibwert von tetragonalem amorphen Kohlenstoff (ta–C) machen diesen besonders interessant für tribologische Anwendungen. Eine besondere Herausforderung stellt dabei die Realisierung einer optimalen Schichthaftung der ta–C Schichten auf industriell eingesetzten Stahlsorten dar. Ein Lösungsansatz ist dabei die Abscheidung entsprechender Pufferschichten.

Eine geeignete Methode zur Herstellung von dünnen ta–C Filmen ist die gepulste Laserdeposition (PLD), die es gleichzeitig ermöglicht Pufferschichten aus verschiedenen Stoffklassen in situ abzuscheiden.

Dünne ta–C Schichten wurden mittels PLD auf verschiedenen Substraten (z.B. Si, Stahl) mit und ohne Pufferschicht deponiert und der Einfluss der Prozessparameter auf die Härte und die Haftung der Schichtsysteme untersucht. Als Analysemethoden wurden Raman Spektroskopie und TEM eingesetzt, sowie Nanohärtemessungen und Haftungstests durchgeführt.

DS 14.3 Mo 15:45 TU H107

PLD dünner Hafniumoxidschichten auf Si(001): Einfluss der Substrattemperatur auf die Struktur — •Mathias Kappa, Markus Ratzke und Jürgen Reif — LS Experimentalphysik II, BTU Cottbus und JointLab IHP/BTU, Konrad-Wachsmann-Allee 1, 03046 Cottbus

Hafniumoxid ist eines der Materialien, die zurzeit als möglicher high-k-Ersatz von SiO_2 für zukünftige höchstintegrierte Halbleiterbauelemente diskutiert werden. Dünne Schichten dieses Oxids zeigen die gewünschten elektrischen Parameter wie geringe Leckstromdichte und hohe Kapazität. Allerdings sind viele Fragen bezüglich der Stabilität solcher Schichten, besonders am Interface zum Silicium, noch offen.

Aus diesem Grund wurde der Einfluss der Substrattemperatur auf die Schicht- und Interface-Struktur beim Wachstum mittels Pulsed Laser Deposition (PLD) auf Si(001) untersucht und bezüglich chemischer (XPS) und struktureller Stabilität (AFM) und Interface (Mikro-Raman-Spektroskopie) analysiert.

Die vorliegenden Ergebnisse zeigen, dass das System HfO_x/Si bereits bei vergleichsweise geringen Temperaturen unerwünschte Reaktionen zeigt. Dazu gehören die Bildung von Hafniumsilicid und Siliciumdioxid, ein starkes Aufrauen der Oberfläche durch Ätzprozesse sowie eine von der Wachstumstemperatur abhängige Verspannung der Substratoberfläche. Diese degradierenden Vorgänge erschweren eine Integration in die Silicium basierte Halbleitertechnologie.

DS 14.4 Mo 16:00 TU H107

Pulsed laser deposition of thin Na_xCoO_2 films — •Yoshiharu Krockenberger[1], I. Fritsch[1], A. Matveev[1], G. Cristiani[1], H.-U. Habermeier[1], L. Alff[2], and B. Keimer[1] — [1]Max Planck Institute for Solid State Research, Stuttgart, Germany — [2]Technical University of Vienna, Austria

At present layered cobaltates attract much interest as superconductivity was found in hydrated and deintercalated samples. Due to electronic and structural analogies between $Na_xCoO_2 \cdot 1.3H_2O$ and high T_c copper oxides, it is even discussed that superconductivity may have a similar underlying origin in both materials. Terasaki et al. reported large thermoelectric power values for Na_xCoO_2 with simultaneously low resistivity suggesting a promising material for thermoelectrical applications. Here, we report on the growth of thin Na_xCoO_2 films. Based on a $\log(p_{O_2})-1/T$ phase diagram single phase Na_xCoO_2 thin films have been grown from a Na_1CoO_2 target by pulsed laser deposition technique. In a high vacuum chamber optimization of kinetics and oxidation power was performed for oxygen and nitrous oxide. Additionally, different types of substrates were used in order to study the growth conditions of Na_xCoO_2. The samples have been characterized by x-ray diffraction and Raman spectroscopy. Resistivity measurements show good metallic behaviour.

DS 14.5 Mo 16:15 TU H107

Interface roughness of laser deposited Fe/MgO and FeCr/TiSc multilayers — •Andreas Meschede[1], Christian Fuhse[2], Thorsten Scharf[1], and Hans-Ulrich Krebs[1] — [1]Institut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen — [2]Institut für Röntgenphysik, Universität Göttingen, Geiststraße 11, 37073 Göttingen

Multilayers with double layer periods in the nanometer range are of high technological interest for the use as x-ray optics in the wavelength regime in the "water window". Here Fe/MgO and FeCr/TiSc multilayers were deposited by pulsed laser deposition (PLD) in ultra high vacuum and in an inert gas atmosphere at room temperature. The interface roughness obtained by x-ray reflectometry is less than 0.5 nm and mainly depends on the bilayer thickness. It increases for ultrathin films, slightly depends on the number of bilayers and also depends on the kinetic energies of the deposited particles, which will be discussed.

DS 14.6 Mo 16:30 TU H107

More-dimensional surface-relief gratings in thin films of organic glasses — •Sven Verpoort[1], Ansgar Draude[1], Hilmar Franke[1], Thomas Fuhrmann[2], and Roger A Lessard[3] — [1]Universität Duisburg-Essen, Abteilung Duisburg, Laboratorium für angewandte Physik, Lotharstr. 1, 47048 Duisburg — [2]Makromolekulare Chemie und molekulare Materialien, Universität Kassel, Heinrich-Plett Str. 40, 34109 Kassel — [3]COPL, departement de physique, university Laval, G1K7P4, Quebec, Canada

The formation of holographic gratings in thin films of azo-glasses with thicknesses $d \leq 10^{-6}$ m is investigated for the case of more-dimensional light-intensity patterns. The mechanism of the photo-isomerisation of the azo-compounds is used to form dual gratings with a refractive index grating and a surface-relief grating.

The diffraction efficiency as a function of the recording time in case of holographic 1D-gratings is discussed in a model of 2 consecutive processes with a phase shift. A material transport process is involved in the formation of relief patterns.

2D-gratings are formed using a 3-beam holographic set-up. The resulting light-patterns are simulated and AFM-measurements are used to confirm the simulated patterns. The modulation of the surface-relief gratings can be enhanced by the application of a Corona-discharge after the holographic recording.

Grating-coupling experiments were performed with the use of 2D surface-relief gratings in order to enhance the irradiation-characteristics of multi-layer systems.

DS 15 Vortrag des Gaede-Preisträgers

Zeit: Montag 09:45–10:30 Raum: TU EB301

Hauptvortrag

DS 15.1 Mo 09:45 TU EB301

Femtosecond dynamics of adsorbate-surface interactions studied by means of time-resolved photoelectron spectroscopy — •Michael Bauer — Fachbereich Physik, TU Kaiserslautern, Erwin-Schrödinger-Str. 46, 67663 Kaiserslautern

Time-domain studies of dynamical processes evolving on a subpicosecond timescale generally require optical pump-probe schemes using pulsed femtosecond light sources. In combination with photoelectron spectroscopy a direct access to ultrafast surface processes is possible. Particularly time-resolved Two-Photon Photoemission (2PPE) has been proven to be very successful in studying the dynamics of the electron relaxation of excited electronic surface states, such as image potential states and adsorbate resonances. For the later case, the alkali adsorption on noble metal surfaces is an ideal model system for investigations regarding the different decay channels of adsorbate excitations. In a time-resolved UPS scheme that allows for probing of the changes in the valence electronic distribution at a surface, we can furthermore study the ultrafast dynamics related to the nuclear motion of the adsorbate and changes in its chemical state during the course of a chemical reaction. This highly promising method has become possible just recently due to the development of laser-driven short-pulse EUV sources. In my talk I will report on experimental results regarding the femtosecond dynamics of adsorbate-surface interactions as probed by means of these two techniques.

DS 16 Dünnschichtanalytik III

Zeit: Montag 10:45–13:00 Raum: TU H110

DS 16.1 Mo 10:45 TU H110

Oberflächenstrukturen dünner aufgedampfter Siliziumdioxidschichten aus AFM und Streulichtmessungen — •G. Seewald, Ch. Scharfenorth, F. Elsholz und H.J. Eichler — Optisches Institut der TU-Berlin, Straße des 17.Juni 135, 10623 Berlin

Dünnschichtoptiken für Hochleistungslaser und meßtechnische Anwendungen erfordern den Einsatz von glatten und streuarmen Oberflächen. An Substraten und dünnen Siliziumdioxidschichten wurden Oberflächenrauhigkeiten im Nanometer-Bereich auf Flächen von 0,7 bis 80μm Kantenlänge mittels der Atomic Force Microscopy (AFM) gemessen. Größere Flächen wurden durch ortsaufgelöste Streulichtmessungen charakterisiert, aus denen ebenfalls Oberflächen-Rauhigkeiten bestimmt werden können. Die Ergebnisse von AFM und Streulichtmessungen werden vergleichend diskutiert.

gefördert durch BMBF (FKz.:03C0330A)

DS 16.2 Mo 11:00 TU H110

Ultrathin metal film physical properties determined by in situ spectroscopic ellipsometry — •Thomas Oates[1], Luke Ryves[2], Mykola Vinnichenko[1], Marcela Bilek[2], and David McKenzie[2] — [1]Forschungszentrum Rossendorf e.V., Institute of Ion Beam Physics and Materials Research, P.O.Box 51 01 19, Dresden 01314, Germany — [2]Applied and Plasma Physics, School of Physics, University of Sydney, 2006, Australia

Ultrathin and discontinuous metal films have many modern applications, including biosensors, energy efficient windows and temperature sensors. In this paper we present results of real time in situ spectroscopic ellipsometric (SE) determination of the film properties of ultrathin metal films during deposition by PVD. In all cases the film thickness and optical constants are initially evaluated. For thin titanium films the Drude-Lorentz theory is applied to determine the electrical resistance and electron mean free path for films above the percolation threshold. The results are compared with simultaneous in situ DC resistivity measurements. The height and void content of silver island films are determined using SE. Plasmon polariton oscillations are prominent in the optical response and are used to deduce the surface area coverage. Post deposition instabilities (aging) are observed by both SE and resistivity measurements. The aging differs for films before and after the percolation threshold which is determined from the optical constants and confirmed by SEM. Analysis of the SE data suggests the instabilities are due to short term changes in island height followed by longer term changes attributed to chemical and grain size modifications.

DS 16.3 Mo 11:15 TU H110

Role of Y_2O_3 on borocarbide thin films grown on MgO (100) substrate — •K. Subba rao[1], R. Tamm[1], S.C. Wimbush[2], G.H. Cao[1], C.-G. Oertel[1], W. Skrotzki[1], and B. Holzapfel[2] — [1]Institute of Structural Physics, Division of Metal Physics, Dresden University of Technology, 01062 Dresden, Germany — [2]IFW Dresden, Helmholtzstr. 20, 01069 Dresden, Germany

Epitaxial thin films of the superconducting borocarbide compound YNi_2B_2C were grown on single crystal MgO (100) substrates without and with Y_2O_3 buffer layer using pulsed laser deposition (PLD). In both cases YNi_2B_2C grows with [001] normal to the substrate. However, the in-plane texture depends on the starting condition. For samples without buffer layer, oxygen from the substrate diffuses into the film and forms an Y_2O_3 reaction layer at the interface. As a consequence, a deficiency of Y is generated giving rise to the formation of secondary phases. On the other hand, using an artificial Y_2O_3 buffer layer secondary phases are suppressed. The texture of the Y_2O_3 layers determines the texture of the YNi_2B_2C film. The superconducting properties of the borocarbide films are discussed with respect to texture and phase purity.

DS 16.4 Mo 11:30 TU H110

Untersuchung der Anreicherung von Germanium in heliumimplantierten SiGe/Si-Heterostrukturen durch Oxidation — •N Hueging[1], M Luysberg[1], D Buca[2], B Holländer[2], S Mantl[2], R Loo[3], M Caymax[3] und K Urban[1] — [1]Institut für Festkörperforschung IFF, Forschungszentrum Jülich, 52425 Jülich — [2]Institut für Schichten und Grenzflächen ISG, Forschungszentrum Jülich, 52425 Jülich — [3]IMEC, Leuven, Belgium

Eine Möglichkeit die Leistungsfähigkeit siliziumbasierter Bauelemente zu erhöhen ist die Verwendung von verspanntem Silizium. Ein Weg diese verspannten Schichten zu erzeugen ist die Nutzung von relaxierten SiGe Schichten auf Si-Substrat, die im sogenannten "Jülicher Prozess"durch Heliumimplantation und thermische Behandlung hergestellt werden. Die Nutzung von Schichtsystemen mit hohen Germaniumgehalten (> 20%) kann Bildung von Stapelfehlern führen während der thermischen Behandlung führen.

Gegenstand dieser Untersuchung ist die Untersuchung von Germaniumsilizium/Silizium Schichtsystemen mit Schichtdicken von 100 - 400 nm und Germaniumgehalten unter 30 %, die nach Heliumimplantation und thermischer Behandlung bei 850 °C einem zusätzlichen thermischen Oxidationsschritt bei 950 °C unterzogen werden. Die so induzierte Anreicherung von Germanium nahe der Oberfläche wird in Abhängigkeit der Schichttiefe gemessen. Der Einfluß der zusätzlichen Oxidation auf die Mikrostruktur wird mittels der Elektronenmikroskopie untersucht, insbesondere in Hinblick auf eine Verbesserung, z.B. der Stapelfehlerdichte, im Vergleich zu konventionell hergestellten Proben.

DS 16.5 Mo 11:45 TU H110

Comparison of X-ray reflectometry and fundamental parameter based X-ray fluorescence analysis for the precise investigation of thin films on silicon — •Michael Kolbe, Burkhard Beckhoff, Michael Krumrey, and Gerhard Ulm — Physikalisch-Technische Bundesanstalt, Abbestraße 2-12, 10587 Berlin, Germany

X-ray reflectometry is a reliable method for determining the thickness of nanolayered systems with small uncertainties. In view of known limitations of this method for extremely thin or laterally inhomogeneous layers we compared X-ray reflectometry with fundamental parameter based X-ray fluorescence analysis using synchrotron radiation in the PTB laboratory at BESSY II. The results of both methods for sample systems with transition metal layers of various thicknesses ranging from 5 nm to 50 nm deposited on silicon wafers were compared and showed good agreement within their respective uncertainties. For the investigation of layered systems both methods are very appropriate and, in addition, can give complementary information about the layers. In particular, the layer density can be determined by X-ray reflectometry, whereas X-ray fluorescence analysis provides information about trace elements within the layers and the layer homogeneity.

DS 16.6 Mo 12:00 TU H110

Charakterisierung thermomechanischer Transformationen von Formgedächtnisschichten mit Flächendetektor-Röntgendiffraktometrie — •J. Feydt, R. Hassdorf, S. Thienhaus und M. Moske — Forschungszentrum caesar, AG Dünne adaptive Schichten, 53175 Bonn

Mit einem D8/GADDS-Röntgendiffraktometer wurde die martensitische Transformation von Formgedächtnismaterialien untersucht. Verwendet wurde eine Parallelstrahl-Primäroptik. Hierdurch wird ermöglicht, die Vorteile des GADDS-Flächendetektors auszunutzen. So können in kurzen Zeiten Phasendiagramme von Materialsystemen ermittelt werden, die z.B. mittels eines kombinatorischen Ansatzes als Gradientenschichten hergestellt wurden.

An hochorientierten TiNiCu-Schichten, hergestellt mittels MBE-Technik, wurde die martensitische Transformation in einer speziell entwickelten Heizkammer in Abhängigkeit der Temperatur charakterisiert. Parallel hierzu werden erste Ergebnisse mit einer Kühlkammer gezeigt. Weiterhin konnte die martensitische Transformation, induziert durch mechanischen Zug, mit einer in das Röntgendiffraktometer eingebauten Zugmaschine direkt verfolgt werden. Darüber hinaus wurde in einer modifizierten 3-Punkt-Biegemessaparatur die Bildung von spannungsinduziertem Martensit an TiNi-Drähten *in situ* beobachtet.

DS 16.7 Mo 12:15 TU H110

C_{60} als Matrix zur Herstellung von Metallclustern — •Helge Kroeger[1] und Petra Reinke[2] — [1]Universität Göttingen, II: Physikalisches Institut, Friedrich-Hund-Platz 1, 37077 Göttingen, Deutschland — [2]University of Virginia, Department of Materials Science and Engineering, Charlottesville, USA

C_{60}-Schichten weisen aufgrund der runden Form der Moleküle Lücken zwischen den einzelnen Molekülen auf, in denen Platz zum Wachstum von Clustern anderer Atome ist. Es wurden unter UHV-Bedingungen Schichten hergestellt, bei denen simultan C_{60} und verschiedene Konzentrationen von Gold aufgedampft wurden. Au stellt ein interessantes Material dar, weil seine Cluster wünschenswerte optische Eigenschaften aufweisen, wie z.B. PL. Das Ziel ist die Herstellung von Schichten die eine regelmäßige Verteilung von einheitlichen Clustern aufweisen. Die hergestellten Schichten wurden mit TEM und AFM untersucht, wobei für die Au-Schichten die Rauhigkeit mit zunehmender Konzentration abnimmt. Die optischen Eigenschaften der Schichten wurden mit UV-VIS, FTIR und PL untersucht, wobei sich zeigt, dass ein effektives Quenching schon für Au-Konzentrationen im niedrigen at%-Bereich die PL des C_{60} fast vollständig unterdrückt.

DS 16.8 Mo 12:30 TU H110

Textur von ITO-Schichten — •Dieter Mergel[1], Zhaohui Qiao[1] und Karola Thiele[2] — [1]Universität Duisburg-Essen, Fb Physik, AG Dünnschicht-Technologie, 45117 Essen — [2]Universität Göttingen, Institut für Materialphysik

Es wurde die Textur der Kristallorientierung von vier ITO-Schichten untersucht, die mit rf- oder dc-Plasmaanregung und in Mitte- oder Randlage relativ zum Target abgeschieden wurden. Theta-2Theta Röntgenbeugungs-Diffraktogramme und Polfiguren wurden so normiert, dass sie miteinander verglichen und gemeinsam interpretiert werden können.

Die vier Proben zeigen charakteristische Unterschiede, die versuchsweise auf unterschiedlichen Sauerstoffeinbau infolge unterschiedlicher Bombardierung mit energetischen Teilchen zurückgeführt werden, gemäß dem Modell, welches in [1-3] entwickelt wurde.

[1] J.Appl.Phys. 88 (2000) 2437-2442.

[2] Thin Solid Films 392 (2001) 91.

[3] J.Appl.Phys. 95 (2004) 5608-5615.

DS 16.9 Mo 12:45 TU H110

Preparation of aluminosilicate crystalline coatings from sol-gel derived alumina films deposited on various silicon/silica substrates — •Emanuel Gutmann, Dirk C. Meyer, Alexander A. Levin, and Peter Paufler — ISP-TU Dresden, Zellescher Weg 16, 01069 Dresden

The dedicated formation of crystalline coatings of the trimorphous aluminosilicates with the composition of Al2SiO5 starting from a low-cost sol-gel deposition of alumina thin films is reported. The influence of substrate type and film thickness on the crystallisation behaviour and film morphology is studied by means of wide-angle X-ray scattering (WAXS) and X-ray reflectometry (XR). When annealed at a temperature of 1150 °C under high-vacuum conditions, formation of the aimed phases was achieved only for films deposited on naturally oxidised Si-substrates covered with a thin silica layer (thickness is about 3 nm). In case of films deposited on amorphous quartz glass and thermally oxidised Si-substrates covered with a thick silica layer (thickness is about 500 nm) no crystallisation occurred at this temperature. After annealing at the higher temperature of 1300 °C under high-vacuum conditions, in the films deposited on both kinds of Si-substrates mullite (Al4SiO8) crystallises together with cristobalite (SiO2) whereas the film deposited on the quartz glass substrate remains amorphous from viewpoint of WAXS.

DS 17 Harte Schichten und mechanische Eigenschaften

Zeit: Montag 13:30–15:15 Raum: TU H110

Hauptvortrag

DS 17.1 Mo 13:30 TU H110

Mechanisms of mechanical deformation in artificial superlattices and self-organized nanostructured thin films — •Lars Hultman — Thin Film Physics Division, Department of Physics, IFM, Linköping University, S-581 83 Linköping, Sweden

Nanostructured thin films are attractive in that materials can be synthesized for tailored mechanical properties. This presentation gives an overview of mechanical deformation mechanisms in different types of nanostructured materials exhibiting superhardening (nitride superlattices and nanocomposites), extreme elasticity (fullerene-like carbon nitride) or reversible plasticity (MAX-phase ceramics). In TiN/NbN superlattices, glide within the layers is shown to be the dominant deformation mechanism in support of theory for superhardening that presumes plasticity with dislocation hindering at interfaces between phases of different shear modulus. Age hardening of ceramic coatings is introduced for advanced surface engineering with the example of metastable TiAlN. Spinodal decomposition with coherent cubic-phase nm-size domains of TiN and AlN that hinder dislocation glide is demonstrated. Thin films of inherently nanolaminated hexagonal Mn-1AXn-phases are produced (n=1,2,3; M=transition metal; A-group element; X=C/N) such as Ti3SiC2. Ductile mechanical deformation is observed with kink formation and cohesive delamination on the basal planes. CNx compounds are resilient (hard and extremely elastic). They consist of sp2-coordinated basal planes that are buckled from the incorporation of pentagons, but also cross-linked due to the substitutional bonding of N. Carbon nitride can store deformation energy by bending of such fullerene-like units.

DS 17.2 Mo 14:15 TU H110

Abscheidung von spannungsarmen nanokristallinen Diamantschichten mit Hilfe einer MW-CVD Plasmaquelle — •Nicolas Wöhrl, Alexei Poukhovoi und Volker Buck — AG Dünschichttechnologie, Universität Duisburg-Essen, Universitätsstr. 3-5, 45141 Essen

Nanokristalliner Diamant bietet durch seine speziellen mechanischen und elektrischen Eigenschaften, welche die herausragenden Eigenschaften der seit Jahren technisch eingesetzten mikrokristallinen Variante um einige interessante Aspekte ergänzt, neue Möglichkeiten der technischen Anwendung. Es werden die Ergebnisse zur Abscheidung Nanokristalliner Diamantschichten mit Hilfe einer MW-CVD Plasmaquelle auf Siliziumsubstraten vorgestellt, für die der Abscheideprozess optimiert wurde. Hierbei wurden insbesondere Wachstumsrate und Schichtqualität in Abhängigkeit von Prozessparametern wie Gaszusammensetzung, Druck und Gasfluss optimiert. Die Schichtqualität der Nanokristallinen Diamantschichten wurde mit Hilfe der Ramanspektroskopie ermittelt. Der Einfluss auf den für den technischen Einsatz sehr kritischen Aspekt der mechanischen Spannungen in den Schichten wurde ebenfalls untersucht. Dabei kam eine ex-situ Apparatur zur Bestimmung des Krümmungsradius der Proben zum Einsatz. Es zeigte sich, dass sich, bei geeigneter Wahl der Prozessparameter spannungsfreie Schichten abscheiden lassen.

DS 17.3 Mo 14:30 TU H110

Probing superelasticity in NiTi-based shape memory thin films and foils – an advanced experimental approach — •R. Hassdorf[1], J. Feydt[1], S. Thienhaus[1], L. Buforn[2], N. Conté[2], O. Pykhteev[1], M. Kružík[1,3], N. Botkin[1], and M. Moske[1] — [1]Forschungszentrum caesar, 53175 Bonn, Germany — [2]CSM Instruments SA, 2034 Peseux, Switzerland — [3]Academy of Sciences, 182 08 Prague, Czech Republic

With the advent of functional vapor-deposited thin films, the incorporation of shape memory and superelastic materials into coatings and lithographically processed microstructures has gained high prospects and technological importance. This holds specifically for their use in medical devices and thermal actuators. However, with shrinking size scale, characterization of the nonlinear superelastic behavior has become more and more demanding. In this respect, we present a study demonstrating the use of different advanced characterization techniques. One of them is nanoindentation with spherical tipped indenters tested on MBE-grown submicron NiTiCu alloy thin films. By applying Hertzian contact mechanics, the full range of mechanical response can be obtained from elastic, through the yield point, to permanent deformation. Moreover, using an analytical approach the indentation data can be converted into a stress-strain scenario aimed at simulating uniaxial tension load. Therefrom, for the above mentioned films, the width of the superelastic region is determined to be around 3% strain which complies with finite-element simulations used to fit the indentation curves.

Supported by BMBF under contract no. 03N4031A.

DS 17.4 Mo 14:45 TU H110

Strahlengehärtete Nanokomposit-Schutzbeschichtungen — •Hans-Jürgen Gläsel[1], Siegbert Rummel[1], Eberhard Hartmann[1], Reiner Mehnert[1] und Winfried Böhlmann[2] — [1]Leibniz-Institut für Oberflächenmodifizierung (IOM), D-04318 Leipzig — [2]Institut für experimentelle Physik II, Universität Leipzig, D-04193 Leipzig

In der Formulierung von strahlenhärtbaren Acrylat-Nanodispersionen werden vornehmlich kommerzielle Nanopartikel (n-SiO_2) verwendet, denen in einer heterogenen hydrolytischen Kondensation (HHC) funktionalisierte Trialkoxysilane in situ aufgepropft wurden. Für die Beschichtung ist das rheologische Verhalten von ausschlaggebender Bedeutung (Walzenauftrag ca. 1.5 Pas). Bei einem Füllstoffgehalt um 25 Ma.% erhöht sich die Kratz- und Abriebfestigkeit beträchtlich (Faktor 5), wobei eine zugegebene Mikrokomponente (10 Ma.%) die oberflächenmechanischen Parameter nochmals verbessert (weiterer Faktor 10). Die HHC-Modifizierung kann durch eine rein adsorptive Partikelorganophilierung (APO) ersetzt werden, wodurch bedenkliche Abprodukte vermieden werden. ^{13}C-NMR-Messungen konnten ein mechanistisches Bild der APO-Route verifizieren. Mittels praktisch bedeutsamerer metallorganischer Nanopulver wurden nun bei günstigerer Rheologie (0.3 bis 1.5 Pas) die oberflächenmechanischen Ergebnisse der HHC-Modifizierung übertroffen, auch werden nun spritzbare Nanolacke auf nichtwässriger Basis möglich.

H.-J. Gläsel, F. Bauer, E. Hartmann, H. Möbus, V. Ptatschek, Nucl. Instr. and Meth. B 208C (2003) 303.

DS 17.5 Mo 15:00 TU H110

Mechanical characteristics of PMMA films prepared by pulsed laser deposition — •Thorsten Scharf[1], Erik Süske[1], Peter Rösner[2], and Hans-Ulrich Krebs[1] — [1]Institut für Materialphysik, Universität Göttingen, Friedrich Hund Platz 1, D-37077 Göttingen — [2]I. Physikalisches Institut, Universität Göttingen, Friedrich Hund Platz 1, D-37077 Göttingen

Pulsed laser deposition has turned out to be a promising method for the preparation of thin polymer films. Nevertheless not only the chemical properties differ slightly from those of the pure bulk target. Mechanical hardness is increased and depends strongly on the thermal treatment of the films and the deposition conditions like the used laser fluence. Additionally, the complex elastic modulus depends on the frequency as well as the temperature at which it is observed. This behavior, which is common for amorphous polymers, was observed via mechanical spectroscopy. In this contribtion mechanical characteristics are discussed with respect to chemical structure and preparation parameters.

DS 18 Optische Spektroskopie dünner Schichten I

Zeit: Montag 15:15–16:45 Raum: TU H110

DS 18.1 Mo 15:15 TU H110

Infrared ellipsometric study of electrochemically grafted organic layers on TiO_2 and Si — •Katy Roodenko[1], Michael Gensch[1], Jörg Rappich[2], Ullrich Schade[3], Ralf Hunger[4], Thomas Dittrich[5], Alexandra Merson[6], Yoram Shapira[6], Norbert Esser[1], and Karsten Hinrichs[1] — [1]ISAS - Department Berlin, Albert-Einstein-Str. 9, 12489 Berlin — [2]HMI, Abteilung SE1, Kekulestr. 5, 12489 Berlin — [3]BESSY, Albert-Einstein Str.15, 12489 Berlin — [4]Institute of Material Science, TU Darmstadt, Petersenstr.63, 64287 Darmstadt — [5]HMI, Abteilung SE2, Glienicker Str. 100, 14109 Berlin — [6]Department of Physical-Electronics, Faculty of Engineering, Tel-Aviv University, 69978 Tel-Aviv, Israel

Infrared spectroscopic ellipsometry (IR-SE) has been applied for the characterization of electrochemically grafted thin nitrobenzene layers on TiO_2 and Si. An optical layer model was used for the interpretation of ellipsometric spectra. This allowed a determination of the high frequency refractive index, molecular orientation and the thickness of the grafted films on the TiO_2. The earlier derived optical constants for ultra thin nitrobenzene films less than 2nm on Si(001) [1] were used as an input data in these calculations. The results were confirmed by additional methods, such as VIS-ellipsometry and X-ray photoemission spectroscopy (XPS). [1] M. Gensch et al, The use of infrared spectroscopic ellipsometry for studying ultra thin organic layers: nitrobenzene on Si(001), submitted for publication

DS 18.2 Mo 15:30 TU H110

Ultra-violet ellipsometry of ultra thin organic layers — •Ovidiu D. Gordan[1], C. Himcinschi[1], M. Friedrich[1], C. Cobet[2], N. Esser[2], W. Braun[3], and D. R. T. Zahn[1] — [1]Institut für Physik, TU Chemnitz, 09107 Chemnitz, Germany — [2]ISAS, 12489 Berlin, Germany — [3]BESSY GmbH, 12489 Berlin, Germany

Ultra-thin films of tris-(8-hydroxyquinoline)-aluminum(III) (Alq_3) were prepared by organic molecular beam deposition (OMBD) on hydrogen passivated silicon substrates in ultra high vacuum (UHV). In situ ellipsometric measurements were performed at a fixed angle of incidence (68°) in the spectral range from 4 to 9.5 eV using synchrotron radiation at BESSY II. For the first time we proved that the dielectric function can be reliably obtained in this range for strong absorbing materials even for sub-monolayer coverage. The results obtained via a complex fitting procedure are compared with direct calculation [1] using the experimental spectra. The absorption bands of a Alq_3 sub-monolayer coverage are shifted to higher energies compared to the bulk features. In addition, the shape of the extinction coefficient is in very good agreement with calculations employing time-dependent density functional theory.

[1] D. Aspnes-Spectroscopic Ellipsometry of Solids, Chap 15, Optical Properties of Solids New Developments, ed B.Seraphin, North Holland 1976

DS 18.3 Mo 15:45 TU H110

The crucial role of surface roughness in SEIRA and SERS — •Annemarie Pucci[1], Andreas Priebe[1], Matthias Lust[1], Gerhard Fahsold[1], and Andreas Otto[2] — [1]Kirchhoff-Institut fuer Physik, Universitaet Heidelberg, Im Neuenheimer Feld 227, D-69120 Heidelberg, Germany — [2]Institut fuer Physik der kondensierten Materie, Universitaet Duesseldorf, Universitaetsstr. 1, D-40225 Duesseldorf, Germany

On atomically rough metal surfaces selection rules for infrared (IR) absorption and for Raman scattering break down; additional vibration lines with increased oscillator strength may appear. Depending on the adsorbate species, the additional lines correspond to molecules with modified bonding (e.g. C2H4 on Cu) or to new chemical species (e.g. N2O and N2 from NO on Cu). Concerning the detection of the new species, surface enhanced IR absorption (SEIRA) and surface enhanced Raman scattering (SERS) show a very different sensitivity, which may be due to the basic differences in the excitation processes of the two methods. Molecules with excited states well above the Fermi energy do not show spectral changes due to the surface roughness.

DS 18.4 Mo 16:00 TU H110

Raman investigations of metal contacts on organic thin films: reactivity, indiffusion, and metal morphology — •G. Salvan, B. A. Paez, L. Mancera, R. Scholz, and D.R.T. Zahn — Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz, Deutschland

Metallic contacts are essential constituents in novel devices based on organic semiconductors. Here, in situ Raman scattering by internal and external vibrational modes in crystalline organic semiconductor layers is employed to assess issues like chemistry, indiffusion, and metal morphology at the metal/organic interfaces. As model systems two perylene derivatives, 3,4,9,10-perylene-tetracarboxylic dianhydride (PTCDA) and N,N'-dimethyl 3,4,9,10-perylene-tetracarboxylic diimide (DiMe-PTCDI) were investigated. Ag, In, and Mg were deposited onto organic layers grown on passivated GaAs(100). The results reveal that Ag and Mg form abrupt interfaces while In strongly diffuses into the organic layers. For Mg, however, the strong differences observed in the lineshape of the Raman bands compared to those induced by Ag and In indicate a reactive nature of the Mg/PTCDA interface. Mg films also exhibit the lowest degree of roughness.

DS 18.5 Mo 16:15 TU H110

Raman spectroscopy of embedded semiconductor monolayers: CdSe in BeTe and ZnSe — •U. Bass[1], S. Mahapatra[1], T. Muck[2], V. Wagner[2], K. Brunner[1], and J. Geurts[1] — [1]Physikalisches Institut der Universität Würzburg, EP III, Am Hubland, D-97074 Würzburg — [2]International University Bremen, School of Engineering and Science, Campus Ring 8, D-28759 Bremen

Utilizing resonant excitation, Raman spectroscopy allows the analysis of single monolayers. In this way, resonant Raman spectroscopy gives access to surface layers as well as embedded monolayers. We apply this technique for II-VI semiconductor heterostructures: CdSe monolayers embedded either in BeTe or in ZnSe. When comparing these systems, we observe significant differences in interface abruptness, localization behavior of the monolayer vibration modes, and band structure alignment of ML and barrier material. Best interface abruptness and mode localisation occurs for CdSe/BeTe, while CdSe/ZnSe shows a considerable intermixing. Furthermore, the Raman spectra are distinctly influenced by details of the growth process, such as the atomic switching sequence at the interfaces and the temperature profile during growth. We correlate the Raman scattering efficiency with the photoluminescence spectra, originating from spatially direct transitions in CdSe/ZnSe, and from indirect ones in CdSe/BeTe.

DS 18.6 Mo 16:30 TU H110

In-situ Untersuchungen von Wachstumsparametereinflüssen auf die MOVPE von GaN — •H. Hardtdegen[1], R. Steins[1], N. Kaluza[1], Z. Sofer[1], Y.S. Cho[1], M. Zorn[2], K. Haberland[3] und J.-T. Zettler[3] — [1]Institut für Schichten und Grenzflächen, Center of Nanoelectronic Systems for Information Technology (CNI), Forschungszentrum Jülich GmbH, 52425 Jülich — [2]Ferdinand-Braun-Institut für Höchstfrequenztechnik, Gustav-Kirchhoff-Str. 4, 12489 Berlin — [3]LayTec Gesellschaft für in-situ und Nanosensorik mbH, Helmholtzstr. 13-14, 10587 Berlin

Die in-situ Reflektometrie ist eine etablierte Methode, um die Morphologieentwicklung und den Einfluss der Wachstumsparameter bei der Epitaxie von Gruppe III-Nitriden zu beobachten. Seit kurzem ist es zusätzlich möglich, die absolute Oberflächentemperatur transparenter Substrate mittels emissivitätskorrigierter Pyrometrie zu bestimmen. Die Temperaturabhängigkeit der SiC Bandlücke wird dabei zur Kalibrierung eingesetzt. In diesem Beitrag wird die neue Methode vorgestellt, der nunmehr beobachtbare Einfluss der Wachstumsparameter auf die absolute Oberflächentemperatur bestimmt, sowie die Auswirkungen auf die Epitaxie diskutiert.

DS 19 Schichtabscheidung

Zeit: Dienstag 13:45–15:15 Raum: TU H107

Hauptvortrag

DS 19.1 Di 13:45 TU H107

In-situ-Charakterisierung der Schichtabscheidung mit gepulsten Magnetrons — •Thomas Welzel — TU Chemnitz, Institut für Physik, 09107 Chemnitz, Germany

In den letzten Jahren hat die Schichtabscheidung mit gepulsten Magnetronentladungen im kHz-Bereich stark an Bedeutung gewonnen. Durch den Pulsbetrieb ist ein stabiler Betrieb der Entladung auch in reaktiver Umgebung möglich, da isolierende Schichten in der Pulspause entladen werden. So können Schichten verbesserter Qualität abgeschieden werden, wobei noch nicht geklärt ist, was außer der Arc-Unterdrückung diese Verbesserung bewirkt. Um diese Mechanismen untersuchen zu können, werden In-situ-Diagnostiken benötigt, die die gepulste Entladung zeitaufgelöst messen. Zwei Möglichkeiten sind dabei Langmuir-Sonden und die optische Emissionsspektroskopie (OES). Deren zeitaufgelöste und statische Anwendung auf die Magnetronentladungen der MgO- und TiO_2-Abscheidung wird vorgestellt. Es wird gezeigt, dass die Plasmaparameter zwar durch die Targetspannung bestimmt sind, jedoch kein einfaches Abbild dieser darstellen, sondern sich komplexe, charakteristische Strukturen im Zeitverhalten bilden, die eine Prozessbeschreibung nur aus gemittelten Größen unmöglich machen.

DS 19.2 Di 14:30 TU H107

The preparation of diamond / tungsten carbide composite films by microwave plasma assisted chemical vapour deposition (MWCVD) — •Hisham Abu Samra[1], Srikanth Vadali[1], Xin Jiang[1], and Hans-Joerg Deiseroth[2] — [1]Lehrstuhl fuer Oberflaechen und Werkstofftechnologie, Institut fuer Werkstofftechnik. Universitaet Siegen. Paul-Bonatz-Strasse 9-11, D-57068 Siegen, Deutschland — [2]Institut fuer Anorganische Chemie. Adolf-Reichwein-Straße, 57068 Siegen Deutschland

Diamond / tungsten carbide composite films were prepared by microwave plasma assisted chemical vapour deposition (MWCVD) using a gas mixture of WCl6 - CH4 - H2. The tungsten carbide phase consisted of WC and W2C. The films were deposited on silicon, tungsten and tungsten carbide/cobalt substrates and studied by scanning electron microscopy and grazing-angle X-ray diffraction. The influence of process parameters, such as gas flow rates, substrate temperature and pressure on the volume fractions of tungsten carbide and diamond as well as the surface morphology were investigated. The work shows that it is possible to deposit tungsten carbide and diamond composite in a single process, whereby the volume fractions of WC, W2C and diamond can be varied by controlling the WCl6 / CH4 mole ratio in the gas mixture. Based on these results, a film with a gradient compositional change normal to the substrate surface can be deposited in a single process. Such a tailor-made interlayer can serve as a diffusion barrier as well as improve the adhesion of a diamond film on a non-diamond substrate.

DS 19.3 Di 14:45 TU H107

Physics of the formation of polycrystalline silicon thin films by aluminum-induced layer exchange — •Jens Schneider, Juliane Klein, Andrey Sarikov, Martin Muske, Stefan Gall und Walther Fuhs — Hahn-Meitner-Institut Berlin, Kekuléstr. 5, 12489 Berlin, Germany

Polycrystalline silicon (poly-Si) thin films on foreign substrates are of great interest for large area electronic devices such as solar cells. Recrystallization of amorphous silicon (a-Si) is one approach to achieve such films. The use of in-expensive substrates like glass limits the process temperature to below the glass softening point at around 650°C. Solid phase crystallization (SPC) at these low temperatures is very slow and thus alternatives are searched for. Metals in contact with a-Si have been shown to reduce crystallization times. In metal-induced crystallization (MIC) silicide and non-silicide forming metals are distinguished. The use of Al (non-silicide forming) allows for an aluminum-induced layer exchange (ALILE) process. In ALILE a-Si/Al bi-layers are annealed below the eutectic temperature of Si and Al. The layers exchange position with a concurrent crystallization of silicon.

Here experimental results giving insight into the physics of the layer exchange are presented. The role of the initial a-Si/Al interface as well as the temperature influence is elucidated and their interaction explained. The process is discussed in the phase diagram. Classical nucleation theory is used to interpret the results.

DS 19.4 Di 15:00 TU H107

Investigation of a pulsed magnetron discharge by time-resolved diagnostics — •Thoralf Dunger, Thomas Welzel, Stephan Welzel und Frank Richter — TU Chemnitz, Institut für Physik, 09107 Chemnitz, Germany

An asymmetric bipolar pulsed magnetron sputtering process with a Mg target in $Ar\,/\,O_2$ was investigated by time-resolved Langmuir double probe measurements and optical emission spectroscopy (TrOES).

In the "on phase", the charge carrier density $n(t)$ shows two initial maxima followed by a transition into a stationary state. Both height and temporal position of the maxima were found to be influenced by the pulse parameters. In the "off phase", the charge carrier density decreases exponentially with typical time constants of 0.5 μs. The second maximum is mainly influenced by the reverse time which is related to the residual charge carrier density at the end of the "off phase".

With TrOES, the most intense Ar and Mg emission lines were studied. Their temporal behaviour is comparable to that of the charge carrier density. However, the maxima appear usually somewhat after those of the charge carrier density and the decay constants are larger. These differences depend on the particular emission line due to differences in the excitation mechanisms. It was found, that the Ar 750.4 nm line is best suited for a comparison to the charge carrier density.

DS 20 Schichtwachstum

Zeit: Dienstag 15:15–16:30 Raum: TU H107

DS 20.1 Di 15:15 TU H107

Wachstum von selbstorganisierten nanoskaligen Kohlenstoff-Metall-Multilagen — •H. Zutz, I. Gerhards, H. Stillrich, C. Ronning und H. Hofsäss — II. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen

Schichten aus amorphem Kohlenstoff und Metallen wurden mittels niederenergetischer massenselektierter Ionenstrahldeposition und mittels Magnetron-Sputtern hergestellt. Bei der Co-Deposition des Kohlenstoffes und der verschiedenen Metalle bildet sich eine Multilagenstruktur mit einer Periodizität von einigen nm aus, welche durch Selbstorganisationseffekte getrieben wird. Die metallreichen Lagen bestehen aus metallischen Nanokristallen. Experimente zeigen beispielsweise die Multilagenbildung bei der Co-Deposition von Kohlenstoff und Gold und Kohlenstoff und Eisen. Der Schwerpunkt der Untersuchungen lag bei den Eisen-Kohlenstoff-Multilagen, wobei mittels TEM die Periodizität bestimmt wurde und mit Mössbauerspektroskopie die Eisen-Carbid-Phasen untersucht wurden. Schließlich werden die Effekte, die zur Selbstorganisation der Multilagen führen, in diesem Vortrag diskutiert.

DS 20.2 Di 15:30 TU H107

Pattern formation in quasi-three-dimensional thin film growth simulations — •Frank Elsholz[1], Eckehard Schöll[1], Hans Eichler[2], and Chris Scharfenorth[2] — [1]Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstrasse 36, D–10623 Berlin — [2]Optisches Institut, Technische Universität Berlin, Hardenbergstrasse 36, D–10623 Berlin

Growth of thin dielectric films on glass substrates is investigated by means of a quasi-three-dimensional solid-on-solid growth model, which is solved by kinetic Monte-Carlo simulations. While growth of the first layer on a crystalline substrate in epitaxy can by investigated within a two-dimensional growth model without voids or overhangs, thin films with a thickness of several monolayers has to account for vertical diffusion also. We propose a new quasi-three-dimensional model which allows for simulating growth of several hundreds of nanometer film thickness at considerable simulation system size of 200×200 nm^2 even at lower available computer memory resources. Theoretical and experimental results are compared to each other, discovering three stages of thin film growth.

DS 20.3 Di 15:45 TU H107

Growth kinetics of InGaAsN quantum wells analysed by transmission electron microscopy — •Martin Albrecht[1], Ines Häsuler[1], Thilo Remmle[1], Lutz Geelhaar[2], and Henning Riechert[2] — [1]Institut für Kristalzüchtung, Max-Born-Strasse 2, 12489 Berlin — [2]Infineon Coporate Research Photonics, Otto-Hahn-Ring 6, 81730 München

Growth kinetics essentially influences the structural and thus optical properties of quantum wells based on InGaAsN. Although it is well known that InGaAsN undergoes a transition from 2D- to 3D growth with increasing growth temperature and increasing N-concentration a detailed study on the influence of N on the growth ofvthis pseudo ternary alloy is missing. In this contribution we present experimental work based on high resolution transmission electron microscopy. InGaAs, GaAsN and InGaAsN samples are grown by radio frequency plasma source molecular beam epitaxy in the temperature range between 400°C-450°C. We study the transition from 2D growth to 3D growth as dependent on temperature, layer thickness and growth rate. Our results clearly show that it is the interaction of In and N that causes 3D growth. Energy filtered transmission electron microscopy reveals that N-incorporation decreases with increasing In-content. In case of 3D-growth a reduced In-concentration is found in the wetting layer. We discuss our experimental findings in terms of In-segregation facilitated by N.

DS 20.4 Di 16:00 TU H107

Cu/MgO(001)studied with IR spectroscopy and AFM — •Fanzhen Meng, Andreas Priebe, Matthias Lust, Dominik Enders, Gerhard Fahsold, and Annemarie Pucci — Kirchhoff-Institut für Physik,Universität Heidelberg

In this work we consider metal films of Cu which are grown on MgO(001) at room temperature and with similar deposition rate (about 0.1 nm/min) in a UHV chamber. The Cu films were grown under CO exposure (pressure is about $4*10^{-8}$ mbar) during the whole film growth or only in the beginning of film growth. CO exposure at different phases of the whole film growth process has different effects on film morphologies. We study these films with in-situ IR-transmittance spectroscopy during film growth. We also calculated IR spectra with a Drude-type model and with an effective medium model.

Adsorbates on metal island films can show surface enhanced infrared absorption (SEIRA). The Cu films were cooled down to 100 K for CO exposure and in-situ the IR transmittance was measured.

AFM pictures were taken after transfering of the films into air. The AFM pictures correspond to our findings on film morphology from IR transmission spectra of the metal film and from SEIRA.

DS 20.5 Di 16:15 TU H107

Effects of deposition on Cu-induced surface nanostructures on VSe$_2$ layered crystals — •F. Dietz[1], E. Spiecker[1], S. Hollensteiner[1], W. Jäger[1], H. Haselier[2], and H. Schroeder[2] — [1]Technische Fakultät der Christian-Albrechts-Universität zu Kiel — [2]Forschungszentrum Jülich

The present study aims at the investigation of nanostrucuture networks which form upon Cu deposition on VSe$_2$ surfaces [1] as templates for the formation of nanowires. The nanostructures were created applying UHV electron beam evaporation of Cu ($\leq$ 2 nm) onto freshly cleaved (0001)-oriented VSe$_2$ crystals at ambient temperature and at 200°C. Subsequently Au with nominal coverage up to 2.5 nm was deposited at identical temperature. Light microscopy, scanning electron microscopy, and transmission electron microscopy investigations have been combined to characterize the effects of Au deposition following nanostrucuture formation. Au deposition at ambient temperature leads to formation of 2-dimensional islands within the network meshes forming an interconnected film at increased coverage. Detailed electron diffraction analyses show that the film corresponds to $< 111 >$ textured fcc Au with an $(220)\text{Au}\parallel(\bar{1}\bar{1}20)\text{VSe}_2$ orientation relationship. Along the nanostructures decoration with large Au clusters occurs. At deposition temperature of 200°C the decoration is even more pronounced leading to linear arrays of Au clusters.

[1] Spiecker et al., Microsc. Microanal. (2004), accepted.

DS 21 FV-internes Symposium Optische Spektroskopie von dünnen Schichten und Grenzflächen

Zeit: Dienstag 09:45–13:30 Raum: TU H110

Hauptvortrag DS 21.1 Di 09:45 TU H110

Real-time optical diagnostics for epitaxial growth — •D. E. Aspnes — Physics Dept., NC State University, Raleigh, NC 27695-8202

Optical diagnostics are currently the only means of assessing the epitaxial growth of materials in the relatively high pressure environments characteristic of organometallic chemical vapor deposition (OMCVD). These diagnostic techniques include reflectance-anisotropy (-difference) spectroscopy (RAS/RDS) for determining surface reconstructions and terminations, laser light scattering (LLS) for detecting the onset of microscopic roughness, and spectroscopic ellipsometry (SE) for measuring compositions and thicknesses of depositing layers. As a result of the needs of the semiconductor industry, the capabilities of SE in particular have been significantly enhanced in the last several years, with the result that the rotating-polarizer and -analyzer configurations that dominated SE for the last 30 years are being replaced by rotating-compensator designs. When coupled with photodiode-array detectors, rotating-compensator systems allow highly accurate SE data to be obtained at rates of the order of Hz, significantly extending capabilities for growth assessment as well. As a general example I discuss the use of SE and LLS in an integrated OMCVD reactor to optimize the heteroepitaxial growth of GaSb on GaAs, which allowed the production of material where interface defects were limited to those needed to accommodate the 7.8% lattice mismatch between substrate and overlayer. Analysis of data obtained at 1 s (0.2 nm growth) intervals during the critical initial stages of heteroepitaxy showed that in this case heteroepitaxy initiated as GaSb islands in GaAs.

Hauptvortrag DS 21.2 Di 10:30 TU H110

Ab-initio calculations of electronic and optical properties of surfaces — •Olivia Pulci — INFM, Department of Physics, University of Rome, Tor Vergata, Via della Ricerca Scientifica 1, I-00133 Rome, Italy

The microscopic study of complex systems has nowadays reached a high level of accuracy that allows for a deep understanding of the electronic excitations. Ab-initio description of experiments such as direct or inverse photoemission, optical absorption, electron energy loss, have become possible thanks to the huge progress in theory and the increased computational power. Charged excitations, as well as neutral excitations, can now be studied within the Many-Body Perturbation Theory based on the Green's function formalism. Optical spectra can be calculated with inclusion of the electron hole interaction by solving the Bethe Salpeter equation (BSE) within the framework of Green's function theory. Moreover, optical spectra can be nowadays also well described within the Time Dependent Density Functional Theory (TDDFT).

In this seminar we will present results for the electronic structure and reflectance anisotropy of diamond and silicon surfaces within DFT, GW, and BSE approach. Results for the optical spectrum of Si(111)2x1, calculated within the TDDFT approach will be also discussed.

Hauptvortrag DS 21.3 Di 11:15 TU H110

Optical analysis of monolayers at surfaces and interfaces — •V. Wagner — School of Engineering and Science, International University Bremen, Campus Ring 8, D-28759 Bremen, Germany

Controlling of surface and interface properties is crucial for tailoring advanced materials, especially if the structure size in one or more dimensions approaches the nanoscale regime. Thus, analysis and modification of the last atomic layer is of crucial importance. Optical probes offer the advantage of high spectral resolution and the possibility to analyze under liquid, vapor and vacuum environments. With emphasis on Raman spectroscopy and modulation spectroscopy various examples of analysis of structural and binding properties of such monolayers are discussed. Especially materials used in electronic applications, i.e. organic and inorganic semiconductors, are addressed. It is demonstrated how the orientation of surface reconstructions of II-VI semiconductors are determined by

Raman spectroscopy or the modification of bonding properties is sensed of organic molecules, e.g. 3,4,9,10-perylene-tetracarboxylic-dianhydride (PTCDA) on top of metallic silver surfaces. Furthermore, modulation spectroscopy is applied to follow the changes of the electronic properties and provides complementary information to the vibrational data obtained by Raman scattering.

Hauptvortrag

DS 21.4 Di 12:00 TU H110

Biomolecular layers on silicon studied by optical spectroscopy — •Dietrich R.T. Zahn — Institut für Physik, TU Chemnitz, D-09107 Chemnitz

Amongst biomolecules the DNA base molecules adenine, cytosine, guanine, and thymine may also find interesting applications in organic electronics. They have optical gaps in the near ultra-violet and have already been considered as charge transport molecules in organic field effect transistors. Still there is very little knowledge on their electronic and optical properties when deposited as layers on inorganic substrates. Here the optical properties of the DNA bases deposited on flat and vicinal, hydrogen passivated Si(111) substrates are studied using spectroscopic ellipsometry (SE) up to 9.5 eV photon energy employing synchrotron radiation and reflectance anisotropy spectroscopy (RAS). The results for the dielectric function reveal strong optical anisotropy for adenine and guanine while the other two molecules form layers with isotropic properties. The experimentally derived dielectric functions are compared to density functional theory calculations of the optical response. Particularly interesting is the RAS response of the DNA bases as a function of thickness when deposited on vicinal Si surfaces. Ordering in the layers is induced by the step and terrace structure of the vicinal Si substrates. Even though the molecular structure is not dramatically different the RAS response is very distinct and allows an unambigious identification of the bases.

Hauptvortrag

DS 21.5 Di 12:45 TU H110

Infrared ellipsometry for structure analysis of organic films — •Karsten Hinrichs[1], Michael Gensch[1,2], Katy Roodenko[1], and Norbert Esser[1] — [1]ISAS - Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Str. 9, 12489 Berlin, Germany — [2]Gesellschaft zur Förderung angewandter Optik, Optoelektronik, Quantenelektronik und Spektroskopie e.V., Rudower Chaussee 29, 12489 Berlin, Germany

FT-IR reflectance methods such as infrared spectroscopic ellipsometry (IRSE) provide structural information of thin films by probing the reflectance for radiation differently polarized with respect to the plane of incidence [1-3]. From IRSE not only the real and imaginary part of the dielectric function is derived but also the depolarisation within the sample can be measured. Thereby the high analytical potential is based on (i) a non-contact and non-invasive measurement (ii) monolayer sensitivity (iii) identification of chemical bonds of the film and interface by vibrational absorption bands and (iv) optical modelling with respect to molecular orientations and structure. The high sensitivity and the high chemical information allowed valuable studies of ultra thin films and their interfaces (e.g. Nitrobenzene on Si(001), H/Si(001) and SiO_2/Si(001). [1] K. Hinrichs, D. Tsankov, E. H. Korte, A. Röseler, K. Sahre and K.-J. Eichhorn, Appl. Spectrosc. 56 (2002) 737 [2] N. A. Nikonenko, K. Hinrichs, E. H. Korte, J. Pionteck, K.-J. Eichhorn, Macromolecules 37 (2004) 8661 [3] K. Hinrichs, M. Gensch, A. Röseler, N. Esser, J. Phys.: Cond. Matt. 16 (2004) S4335

DS 22 Optische Spektroskopie dünner Schichten II

Zeit: Dienstag 14:30–16:45 Raum: TU H110

DS 22.1 Di 14:30 TU H110

Optical response of a π-conjugated molecular monolayer adsorbed on Si(001): A *first-principles* study — •Andreas Hermann, Wolf G. Schmidt, and Friedhelm Bechstedt — Institut für Festkörpertheorie und -optik, Friedrich–Schiller–Universität, Max–Wien–Platz 1, 07743 Jena, Germany

Organic functionalization of semiconductor surfaces has become important for developing new semiconductor-based devices. The modification of the surface optical response for the prototypical system of the π-conjugated molecule 9,10–phenanthrenequinone adsorbed on Si(001) is investigated by means of *first-principles* calculations . Optical properties are calculated within the independent-particle approximation from all-electron wave functions obtained by the projector augmented wave method (PAW). Structural data and Reflectance Anisotropy Spectra (RAS) agree well with recent experimental findings [1,2]. The detailed analysis of the optical signal shows that intramolecular π–π^* transitions as well as adsorption–modified Si bulk states contribute to the surface spectrum. The calculations illustrate the sensitivity of optical spectroscopy to molecular adsorption but demonstrate clearly that a naive interpretation of the spectrum in terms of gas-phase molecular data fails.

[1] L. Fang *et al.*, Surf. Sci. **514**, 362 (2002).

[2] C. Hacker and R. J. Hamers, J. Phys. Chem. B **107**, 7689 (2003).

DS 22.2 Di 14:45 TU H110

Dielektrische Simulation der optischen Eigenschaften von TCO-Schichten — •Dieter Mergel und Zhaohui Qiao — Universität Duisburg-Essen, Fb Physik, AG Dünnschicht-Technologie, 45117 Essen

Transmissions- und Reflexionsspektren dünner Schichten aus In(2)O(3):Sn [1] und ZnO:Al [2] lassen sich sehr gut mit einer dielektrischen Funktion simulieren, die einen harmonischen Oszillator für die Interbandübergänge, ein Drude-Modell mit Energie-abhängigem Streuterm und ein angepasstes Modell für die Bandkantenabsorption enthält.

Aus dem Drude-Term können Werte für Ladungsträgerdichte und - Beweglichkeit ermittelt werden, die mit Hall-Effekt-Werten verglichen werden und Aussagen über effektive Massen oder Korngrenzen-Widerstände erlauben.

Ellipsometrische Spektren können mit derselben dielektrischen Funktion simuliert werden, wenn man eine wenige nm dicke Oberflächenschicht ins Modell einführt, die zur Hälfte aus dem Volumenmaterial und Luft besteht (entsprechend einer Oberflächenrauhigkeit).

[1] D. Mergel, Z. Qiao, J Phys D: Appl. Phys. 35 (2002) 794-801 [2] Z. Qiao, D. Mergel, C. Agashe, submitted for publication.

DS 22.3 Di 15:00 TU H110

Reflectance anisotropy spectroscopy as a versatile tool for the development and control of MOVPE growth processes for devices — •Martin Zorn[1], Thomas Zettler[2], and Markus Weyers[1] — [1]Ferdinand-Braun-Institut für Höchtsfrequenztechnik (FBH), Gustav-Kirchhoff-Str. 4, D-12489 Berlin — [2]LayTec GmbH, Helmholtzstr. 13/14, D-10587 Berlin

Reflectance anisotropy spectroscopy (RAS) in combination with reflectance (R) measurements has made the way out of research into production of layer structures for compound semiconductor devices by metal-organic vapour phase (MOVPE). The sensitivity of RAS to surface processes (e.g. oxide desorption and interface formation) as well as bulk properties (e.g. composition and doping concentration) and the possibility to perform measurements *in-situ* during the semiconductor growth process is the essential advantage in comparison to ex-situ techniques like x-ray diffraction and C/V profiling.

This contribution focuses on the usage of the RAS and R technique for the growth of layer structures for laser diodes. In these structures a high reproducibility of layer parameters like composition, doping profile and emission wavelength is needed to achieve the stringent requirements of the final laser device which increase steadily. Examples will be given for *in-situ* measurements of e.g. composition, doping profiles and emission wavelength during MOVPE growth in a production-like environment. For the layer structures presented in this work the focus is mainly on the material systems AlGaAs, AlGaInP and GaAsP. Furthermore, the reproducibility of the growth process and the measurement itself is discussed.

DS 22.4 Di 15:15 TU H110

New opportunities for RAS analysis of metal surfaces and thin films — •Peter Zeppenfeld, Lidong Sun, and Michael Hohage — Institut für Experimentalphysik, Universität Linz, Austria

During the last decade, reflectance anisotropy spectroscopy (RAS) has proven to be a powerful tool for the analysis of metal surfaces, in addition to its well established application to semiconductor surfaces and thin films. Various issues such as the adsorption and growth, surface restructuring and the morphological changes during ion sputtering or thermal treatment can be conveniently monitored in situ and in real time using the

RAS technique. Yet, the electronic structure and the associated optical properties of metal surfaces are quite different from those of semiconductors. This introduces new challenges for the understanding of the origin and the quantification of the RAS signals from metal surfaces, but it also offers new opportunities and applications. For instance, the presence of delocalized (free electron like) surface states on metal surfaces makes RAS an extremely sensitive tool for studying adsorption kinetics and ordering phenomena. On the other hand, bulk derived contributions to the optical anisotropy are sensitive to thin film and surface stress and can thus be used to characterize the growth mode and morphological changes of thin metal films through the associated characteristic strain/stress variations. Finally, we demonstrate that apart from morphological changes, RAS also allows to follow the evolution of the electronic band structure of a growing thin metal film in a layer by layer fashion.

DS 22.5 Di 15:30 TU H110

In-situ RAS study of para-sexiphenyl film growth on metal and oxide surfaces — •L.D. Sun[1], M. Hohage[1], Y. Hu[1], K. Maschek[1], P. Zeppenfeld[1], S. Berkebile[2], F.P. Netzer[2], and M.G. Ramsey[2] — [1]Institut für Experimentalphysik, Johannes-Kepler-Universität Linz, Austria — [2]Institut für Experimentalphysik, Karl-Franzens-Universität Graz, Austria

Para-sexiphenyl (P6P) is an aromatic molecule, which is classified as a wide gap organic semiconductor with an electronic band gap of 3.1 eV. The molecule which consists of a linear chain of six linked benzene rings gives a strong intrinsic electronic and optical anisotropy. This fact allows probing the orientation of the P6P molecules by monitoring the polarization dependence of the optical absorption. Reflectance Anisotropy Spectroscopy (RAS), on the other hand, is a powerful tool to study the lateral optical anisotropy and its evolution of the growing thin films and the substrate beneath. Here, we present our RAS in-situ investigation of P6P films growth on oxide ($TiO_2(110)$) and metal (Cu(110)) surfaces. The films have been prepared by physical vapour phase deposition in UHV under diverse conditions. Pronounced optical anisotropies arising from the optical absorption of P6P have been observed for the distinct films. In fact, based on the behaviour of the RAS feature contributed by the HOMO to LUMO transition of the P6P molecules, important information about the orientation and the conformation of the P6P molecules in the films can be obtained directly. Furthermore, the RDS is very sensitive to small quantities of P6P and therefore well suited for the investigation of the initial stages of P6P growth.

DS 22.6 Di 15:45 TU H110

Potential fluctuations in compensated $Cu(In,Ga)Se_2$ - A photoluminescence study — •Niklas Rega, Susanne Siebentritt, Juergen Albert, and Martha Lux-Steiner — Hahn-Meitner-Institut Berlin, Glienicker Str. 100, D-10405 Berlin

$Cu(In,Ga)Se_2$ is a compound semiconductor which belongs to the family of chalcopyrites. They are interesting materials for application(solar cells achieve efficiencies of 19.5%) and a fascinating topic for fundamental investigations due to their unique phase and defect behaviour. Intrinsic defects are doping the chalcopyrite. Therefore metal organic vapour phase epitaxy is used for the growth to ensure good composition control.
High efficiency $Cu(In,Ga)Se_2$ solar cells are fabricated under Cu-poor conditions, i.e. $[Cu]/([Ga]+[In]) < 1$. The photoluminescence (PL) spectra of $CuGaSe_2$ and $CuInSe_2$ films grown under Cu-poor conditions are characterized by a broad asymmetric luminescence. Temperature and power dependent PL measurements show that the broadening of luminescence is due to a donor-acceptor-pair (DAP) transition in the presence of locally fluctuating potentials due to compensation. Here we present a PL study on Cu-poor grown epitaxial $Cu(In,Ga)Se_2$-layers with varying [Ga]-content. The aim of this contribution is the quantification of the potential fluctuations in dependence of the [Ga]-content. The depth of the fluctuating potentials is estimated. For $CuGaSe_2$ we get a mean depth of 70meV and for $CuInSe_2$ of 20meV. The influence of fluctuations in the [Ga]-content, which causes a fluctuation of the band gap energy, has to be taken into account for $Cu(In,Ga)Se_2$.

DS 22.7 Di 16:00 TU H110

Photoluminescence Excitation Spectroscopy of highly compensated $CuGaSe_2$ — •Susanne Siebentritt, Alexander Zajogin, Niklas Rega, and Martha Lux-Steiner — Hahn-Meitner-Institut, Glienicker Str. 100, 14109 Berlin

The interest in $CuGaSe_2$ is twofold: it is an attractive absorber material for thin film tandem solar cells and it shows a unique behaviour concerning its native defects, which have very low formation enthalpies, concerning its phase behaviour and its grain boundaries. The material used in solar cells is grown under Cu-poor conditions. Previous work has shown that this material is highly compensated and shows spatial potential fluctuations. To investigate these fluctuations the absorption of the band tails needs to be measured. Since grain boundary free material today can only be obtained by epitaxy on GaAs no transmission spectroscopy is possible. Therefore the band tail absorption and its overlap with luminescence is investigated by PLE (photo luminescence spectroscopy). From the overlap the amplitude of the fluctuations is determined to at least 70 meV. The absorption spectra obtained by PLE depend strongly on the detection wave length. This is due to the fact that different detection wave lengths probe different depths of the fluctuations. Interestingly the same effect has been observed in $CuGaSe_2$ grown under Cu excess where no potential fluctuations are expected. A critical review of PLE as a measure for the absorption will be given together with a comprehensive analysis of the potential fluctuations in $CuGaSe_2$.

DS 22.8 Di 16:15 TU H110

VUV spectroscopic ellipsometry of cytosine and functionalized cytosine using synchrotron radiation — •Y. Suzuki[1], O. D. Gordan[1], S. D. Silaghi[1], A. Schubert[1], W. R. Thiel[1], C. Cobet[2], W. Braun[3], and D. R. T. Zahn[1] — [1]Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz, Germany — [2]Institute of Spectrochemistry and Applied Spectroscopy, D-12489 Berlin, Germany — [3]Berliner Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung mbH, D-12489 Berlin, Germany

DNA base molecules have potential as materials in organic electronics. However, there is so far only very little work on the properties of the DNA bases in the form of layers on inorganic substrates. Here we report on the optical properties, i.e. dielectric function, of cytosine and a functionalized variant, 1-allylcytosine, obtained by spectroscopic ellipsometry in the VUV photon energy range (4 - 9.5 eV). The samples were prepared by organic molecular beam deposition onto hydrogen passivated silicon substrates under ultra-high vacuum conditions. Typical thicknesses of the layers studied were in the range of 700-900 nm. The results reveal that the optical response changes significantly as a result of the addition of the functional group to the molecule, while density functional theory based ab-initio calculations predicted very similar absorption spectra.

DS 22.9 Di 16:30 TU H110

Characterization of $GaN/Al_xGa_{1-x}N$ quantum well structures by spectroscopic ellipsometry and photoluminescence — •U. Rossow, D. Fuhrmann, T. Retzlaff, N. Riedel, and A. Hangleiter — TU Braunschweig, Inst. f. Techn. Physik, 38106 Braunschweig; b.postels@tu-bs.de

In this contribution we combine the optical methods spectroscopic ellipsometry and photoluminescence (PL) to characterize $Al_xGa_{1-x}N$-layers, $GaN/Al_xGa_{1-x}N$ single and multi quantum-well (SQW, MQW) and GaN-AlN MQW structures. The QW structures are promising for various devices such as LEDs or lasers in the UV range. Challenges are on one hand the crystalline quality of $Al_xGa_{1-x}N$ as well as the high strain due to lattice and thermal mismatch in the heterostructures. On the other hand it turned out that thickness (quantum wells) and composition x_{Al} need to be carefully controlled in order to achieve reproducible emission wavelengths. To determine both parameters ellipsometry is usually thought to be the best choice. However, for the GaN SQW structures which are typically 1-3nm grown with $Al_xGa_{1-x}N$ barriers of typically $x_{Al} \sim 0.23$ we observe no contribution directly related to QW transitions. This is in contrast to GaN MQW structures where features appear in the spectra. All investigated samples show strong PL signals indicating that material quality is not the cause. It is likely that for such thin SQW structures the signal is too weak to be detected at room temperature (typical signal-to-noise ratio). The problem is even worse due to the fact that strong piezoelectric fields exist in the quantum wells and therefore spectral features tend to be weaker.

DS 23 Postersitzung I

Zeit: Freitag 16:00–18:30 Raum: Poster TU B

DS 23.1 Fr 16:00 Poster TU B

Properties of mid-frequency reactive sputtered ITO thin films — •Ronny Kleinhempel, Matthias Herrmann, Hartmut Kupfer, and Frank Richter — TU Chemnitz, Inst. f. Physik, 09107 Chemnitz

Indium Tin Oxide (ITO) films show a high transparency in the visible region and they also have a good electrical conductivity. A common but expensive technique to deposit ITO thin films is sputtering from a ceramic target. We used an alternative method to deposit ITO films with a high depostion rate by mid-frequency dual magnetron sputtering (4kW, sine wave) of a metallic target (In/Sn 90/10) in a reactive process (gas mixture Ar/O_2). The films were prepared at different O_2 flow rates at constant total pressure (0.4 Pa) in the transition range of the target. Spectral ellipsometry, XRD and four point measurements were applied to analyse the optical properties, the structure and the electrical resistivity. The resistivity decreases from $10^{-2}\ \Omega cm$ to less than $10^{-3}\ \Omega cm$ by increasing the O_2 flow rate. On the other hand at high O_2 flow rates the transparency starts to decrease. The optical properties are results of a Drude-Lorentzian double oszillator model which describes the absorption in the IR range as well as in the near UV range. Surface roughness and morphology were investigated by AFM and the chemical composition by ERDA and SIMS.

DS 23.2 Fr 16:00 Poster TU B

Statistical approach in description of electron emission from nanoparticles under femtosecond laser radiation — •D.A. Valdaitsev, A. Gloskovskii, S.A. Nepijko und G. Schönhense — Institut für Physik, Johannes Gutenberg - Universität, 55099 Mainz

Intense electron emission from Ag particle films deposited onto a Si substrate under 400 and 800 nm laser radiation has been investigated. The observed electron emission enhancement in a particle film with few-nanometer size can not be explained only by multiphoton photoemission occurring through particle plasmon excitation. We consider the effect of a deviation of the number of photons absorbed in one laser pulse by a given particle from its mean value. In the conditions where the mean statistical number N of absorbed photons is in the range of a few or even <1 per pulse the quantum character of energy absorption can not be ignored. This circumstance is found to play an important role for particles with sizes <10nm. In the consideration of the absorption by a particle of this size a statistical approach with N = 0, 1, 2,... has been used. It is demonstrated that taking into account the probability of each statistical event results in an increase of the electron emission due to anomalously high energy density in particles of few nm of size that have absorbed one or a few photons. In certain cases after the thermalization of the electron gas its temperature becomes high enough to give rise to thermionic electron emission. For example, for a particle of 2nm size the absorption of two 3eV photons leads to a transient electron gas temperature of 2000K. The probability to achieve the same temperature for a 5nm particle (absorption of 31 photons) is 25 orders of magnitude lower.

DS 23.3 Fr 16:00 Poster TU B

The conductivity of growing Pd-films at the percolation threshold — •Stefan Wagner, Olof Dankert, and Astrid Pundt — Institut für Materialphysik, Friedrich- Hund- Platz 1, 37073 Göttingen

The conductivity of sputtered discontinuous Pd-films at the percolation treshold will be investigated. For experimental studies an in situ 4 point measurement device is constructed to investigate the resistance under UHV conditions during sputtering. Thus, the device was implemented in an UHV sputter system. The resulting resistance curves are compared to the predictions of random resistor network theory and the underlying conduction mechanisms will be discussed.

DS 23.4 Fr 16:00 Poster TU B

Metallic nanowires and nanoparticles on facetted alumina templates — •C. Herweg[1], S. Sievers[2], M. Albrecht[2], U. Siegner[2], and H. C. Freyhardt[1] — [1]Institut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen — [2]Physikalisch-Technische Bundesanstalt, Bundesallee 100, D-38116 Braunschweig

Highly ordered facetted surfaces can be obtained by annealing of $\alpha - Al_2O_3\,(10\bar{1}0), (m-plane) \quad at \sim \frac{2}{3}\cdot T_m \quad (T_m:$ melting temperature$)$ in air. Transmissionelectronmicroscopy (TEM) reveals a periodicity of $\sim 300nm$ and a hight of $\sim 50nm$. The facets are found to be almost symmetric, comprising an angle of 17,6° with the original $(10\bar{1}0)$ surface. The surface morphology of the facets differs, crystallographically flat on one facet, nanofacted on the other one. These facetted substrates were used for the preparation of metallic nanowires by deposition of iron, cobalt and gold under shallow incidence with magnetron sputtering. The shadowing effect permits the preparation of well-defined, separated wires with a width of $\sim 100-150nm$ as will be shown by means of atomic force microscopy (AFM), magnetic force microscopy (MFM) and scanning electron microscopy (SEM). The nanowire length is determined by the undisturbed length of the underlying facet ($\sim 150\mu m$). A spheroidization instability of these wires upon annealing results in a pearl chain like ordered array of metal clusters. Magnetic characterisation by MOKE and SQUID confirm the morphological change from wires to separated particles. MFM shows that the particles can be remanently magnetized with external fields of different orientations.

DS 23.5 Fr 16:00 Poster TU B

Modifikation der strukturellen und magnetischen Eigenschaften von Permalloy-Schichten bei Cr-Implantation — •J. Fassbender, J. von Borany, K. Potzger, R. Grötzschel und A. Mücklich — FZ Rossendorf, Institut für Ionenstrahlphysik und Materialforschung, 01314 Dresden

Die magnetischen und strukturellen Eigenschaften von Permalloy-Schichten lassen sich gezielt durch Cr-Implantation modifizieren. Dazu wurde ein 20 nm Permalloy/5 nm Tantal/SiO_x/Si Schichtsystem mit 30 keV Cr-Ionen im Dosisbereich zwischen 2×10^{15} und 2×10^{16} Ionen/cm^2 implantiert. Daraus resultiert ein Implantationsprofil mit einer mittleren Konzentration an Cr innerhalb der Permalloy-Schicht von 1 bis 10 %. Die Änderungen in der Schichtstruktur wurden mit Röntgenbeugung, Auger-Tiefenprofilanalyse, Rutherford-Backscattering und Querschnitts-Transmissions-Elektronenmikroskopie untersucht. Neben der eigentlichen Implantation wird schon bei relativ kleinen Ionendosen eine Durchmischung der Grenzfläche zwischen Permalloy und Tantal beobachtet. Mit steigender Ionendosis diffundiert Tantal zunehmend an die Oberfläche des Schichtstapels. Diese experimentellen Ergebnisse werden gut durch TRIDYN-Simulationen beschrieben [1].

[1] Transport and Range of Ions (Dynamic): W. Möller, W. Eckstein, Nucl. Instr. and Meth. B 2, 814 (1984).

DS 23.6 Fr 16:00 Poster TU B

Magnetic metal-polymer nanocomposite films prepared by co-sputtering from two magnetron sources — •Christian Pochstein[1], Ulrich Schürmann[1], Henry Greve[1], Michael Frommberger[2], Vladimir Zaporojtchenko[1], Eckhard Quandt[2], and Franz Faupel[1] — [1]Lehrstuhl für Materialverbunde, Technische Fakultät der CAU Kiel, Kaiserstr. 2, 24143 Kiel, Germany — [2]Forschungszentrum caesar, Ludwig-Erhard-Allee 2, 53175 Bonn, Germany

Recent efforts to develop soft magnetic films have focused on inorganic nanostructured materials sputter deposited as thin films. In this work we studied the physicochemical properties of films, which were synthesized by co-sputtering of magnetic metals and polymers from two different magnetrons. TEM micrographs of the composite films show that they consist of metal nanoparticles embedded in a polymer matrix. The chemical structure of the composites was characterized by using XPS and EDX. The magnetical properties of the composites with different metal concentrations were investigated via VSM measurements.

DS 23.7 Fr 16:00 Poster TU B

Approach to doping of epitaqxially grown c-BN films - first results — •H. Yin, X.W. Zhang, H.-G. Boyen und P. Ziemann — Abteilung Festkörperphysik, Universität Ulm, D-89069 Ulm

In addition to hard coating applications, cubic boron nitride (c-BN) is also considered as a starting material for high-temperature electronic applications. In order to use c-BN for such a purpose, a high structural quality of the corresponding samples as well as the incorporation of appropriate dopants appears necessary. To approach this goal, heteroepitaxial c-BN films were grown by ion beam assisted deposition (IBAD) on (100) oriented diamond single crystals at high temperatures (∼1000°C) and doped by either post-implantation of Sulfur using medium energy ion implantation (50-100keV) or by co-deposition of Silicon during film growth using a multi-layer concept with sufficiently small modulation length to ensure homogeneous doping. Implantation of the Sulfur is found to reduce the mobility of the charge carriers by means of defects which, even after post-heat treatment of the ion-irradiated samples at high temperature, could not be annealed out fully as determined by FTIR. Co-deposition of Silicon during film growth, on the other hand, maintains the quality of the epitaxial film to a large extent suggesting this approach to be superior to post-implantation.

DS 23.8 Fr 16:00 Poster TU B

Untersuchung des Abscheideprozesses von Nanokristallinen Diamantschichten über Optische Emissionsspektroskopie und Massenspektroskopie — •Nicolas Wöhrl, Alexei Poukhovoi und Volker Buck — AG Dünnschichttechnologie, Universität Duisburg-Essen, Universitätsstr. 3-5, 45141 Essen

Mit Hilfe einer MW-CVD Plasmaquelle wurden nanokristalline Diamantschichten abgeschieden. Dabei wurde die Zusammensetzung des Plasmas bei Variation der Prozessparameter mittels Optischer Emissionsspektroskopie und Massenspektroskopie untersucht. C_2-Dimere gelten als mögliche Precourser für das Wachstum von Nanokristallinen Diamantschichten [1]. Mit Hilfe der Optischen Emissionsspektroskopie wurde daher insbesondere der Anteil an C_2-Dimeren im Plasma in Abhängigkeit von Prozessparametern wie Druck, Gaszusammensetzung und Gasfluss bestimmt. Es konnte gezeigt werden, dass die Wachstumsrate der Nanokristallinen Diamantschicht mit dem Anteil an C_2-Dimeren im Plasma korreliert. Neben der Optischen Emissionsspektroskopie, die detaillierte Informationen über die Konzentration der C_2 Radikale liefert, wurden massenspektroskopische Messungen zur Bestimmung der Plasmazusammensetzung während der Beschichtung durchgeführt.

[1] D. M. Gruen, Annu. Rev. Mater. Sci. 29 (1999) 211-259

DS 23.9 Fr 16:00 Poster TU B

Growth, microstructure and mechanical properties of carbon nanoflake spherules — •Naigui Shang, Thorsten Staedler, and Xin Jiang — Lehrstuhl für Oberflächen und Werkstofftechnologie, Insitut für Werkstofftechnik, Universität Siegen, Paul-Bonatz-Straße 9-11, D-57068 Siegen, Deutschland

Carbon based nanostructures including carbon nanotubes, nanofibers, nanocones, nanoparticles, nanoflakes and nanohorns etc. have received much attention recently due to their unique structures, novel properties and potential applications. As a novel structure, carbon spherules have been synthesized by microwave plasma enhanced chemical vapor deposition using a mixture gas of methane and nitrogen on the steel substrates. The as-deposited carbon spherules consist of a high density of interlaced carbon nanoflakes arranged in a radial mode from their cores. The size and density of the carbon spherules strongly depend on the deposition conditions. A possible growth mechanism of the carbon nanoflake spherules is presented based on the metal catalytic effect. Nanoindentation measurements of the individual carbon spherule with various loadings show that they have unique mechanical properties quite different from other carbon nanostructures.

DS 23.10 Fr 16:00 Poster TU B

New technique for mechanical characterization of coated and bulk materials — •Maksim Karniychuk[1], Thomas Chudoba[2], Volker Linss[2] und Frank Richter[1] — [1]TU Chemnitz, Institut für Physik, 09107 Chemnitz, Germany — [2]ASMEC Advanced Surface Mechanics GmbH, Bautzner Landstr. 45, 01454 Radeberg, Germany

Nanoindentation is one of the most important nondestructive methods for mechanical characterization of surfaces. During nanoindentation experiment only normal loads are applied. However, in practical cases both normal and lateral forces act together. Unfortunately, the results of scratch tests depend strongly on the conditions and a comparison is difficult. And nanoindentation alone cannot provide a comprehensive set of material parameters needed for simulation and optimization of protecting coatings. In order to overcome these problems a new Lateral Force Unit (LFU) was developed (ASMEC GmbH, Germany) and installed in a nanoindenter UMIS 2000 (CSIRO, Australia). The lateral force cycle is applied during the hold period of the normal maximum load. The first results of LFU test are the following: (1.) The LFU investigations allow the determination of the friction coefficient of the sample against diamond with high local resolution. (2.) The comparison of LFU and nanoindentation measurements allows the estimation of critical forces (lateral and normal) which lead to the onset of plastic deformation.

DS 23.11 Fr 16:00 Poster TU B

In-situ Messung von mechanischen Spannungen während des reaktiven DC-Magnetron Sputterns — •Robert Drese und Matthias Wuttig — 1. Physikalisches Institut A, RWTH-Aachen, 52056 Aachen

Beim reaktiven DC-Magnetron Sputtern treten oftmals hohe mechanische Spannungen auf, welche die Schichteigenschaften beeinflussen. Der genaue Mechanismus der Bildung dieser hohen Spannungen ist allerdings noch nicht im Detail verstanden, weshalb eine in-situ Apparatur zur Spannungsmessung während der Schichtdeposition konstruiert wurde.

Diese Anlage, die mittels der Methode der Substratkrümmung arbeitet, wird ebenso vorgestellt wie Ergebnisse der Spannungsmessungen an verschiedenen Metallen und Oxiden, darunter Zr/ZrOx, Zn/ZnOx, TiOx und Nb/NbOx, bei denen Spannungen sehr unterschiedlicher Größe beobachtet werden. Ein Modell der Erklärung sowohl dieser Unterschiede als auch der Evolution der mechanischen Spannungen wird vorgestellt.

DS 23.12 Fr 16:00 Poster TU B

Stress evolution during and after sputter deposition of Cu/Co bi-layers — •Mirela Pletea, Winfried Brückner, Horst Wendrock, and Rainer Kaltofen — Leibniz-Institute for Solid State and Materials Research Dresden, P.O.Box 270116, D-01171 Dresden

The stress evolution during and after growth of Cu/Co bi-layers sputtered onto Si (100) substrates as a function of the individual layer thickness is reported. The stress was determined by means of in-situ wafer curvature measurements using a novel set-up based on the optical two-beam deflection method. Our earlier investigations and literature results showed that a transition from hcp to fcc structure of Co layers takes place with decreasing Co layer thickness and with the growth of Co on (fcc) Cu thin film. Therefore, we investigate (i) the stress evolution at Cu/Co interface with the change of the structure of Co layer with different thicknesses (between 5 and 100 nm) and (ii) the effect of the underlayer thickness on the stress evolution and microstructure state of Cu/Co bi-layers. The stress evolution of Cu and Co single thin films with different thicknesses is also investigated, for comparison. In order to correlate the microstructure development and stress evolution as a function of the individual layer thickness, microstructure investigations performed by XRD, SEM, EBSD and AFM are carried out.

This work was supported by DFG (Project SCHN 353/15-2).

DS 23.13 Fr 16:00 Poster TU B

Deposition of diamond-like carbon coatings using DC-arc method — •Oleksiy Filipov, Nicolas Wöhrl, Stephan Reuter, and Volker Buck — Thin Film Technology Group, Dept. of Physics, University of Duisburg-Essen, Universitätsstr.3-5, 45141 Essen, Germany

Diamond-like carbon (DLC) coatings are still the subject of interest during the past decades due to their unique properties that can be varied in an unusually large area - e.g. from conducting to insulating or from hydrophilic to hydrophobic as well as gradually changed in hardness, residual stress, roughness, etc. - and these properties can be varied by choosing suitable coating parameters. The DLC coatings are deposited on different substrates using DC-arc deposition method. As a carbon source, graphite electrodes are used and the films are deposited on polished (100) Si and glass substrates in a vacuum and hydrogen atmosphere at pressure in range from 10^{-3} to 10^{-4} mbar. The variation in deposition parameters such as working pressure, substrate bias and gas mixture is used to influence the main film properties.The bias was applied to substrate in pulsed modes. The deposition parameters were in-situ monitored. After deposition films were investigated using different analytical techniques, including SEM, SSIOD, Raman Spectroscopy, UV-IR Spectroscopy. It was shown correlation between process parameters and mechanical, structural and optical properties of obtained DLC films.

DS 23.14 Fr 16:00 Poster TU B

STM-investigation of a nanocluster Cu film on GaAs(110) — •J. Müller, M. Wenderoth, L. Winking und R. G. Ulbrich — IV.Physikalisches Institut, Universität Göttingen, D-37077 Göttingen

The low temperature deposition of Cu on GaAs(110) leads to atomically flat overlayers. This behavior has been explained in terms of the electronic growth model with a critical thickness of 5 monolayers (ML) [1][2]. Here, we report on investigations of Cu films on intrinsic GaAs(110) with coverages below the critical film thickness. At coverages of 1ML we observe nanoclusters with a typical cluster size of 5 nm. Their shape distribution is analyzed and interpreted in terms of a growth anisotropy. Further characterization was done by spatially resolved scanning tun-

nelling spectroscopy. We found metallic or sometimes semiconducting spectra on the clusters and semiconducting spectra on the bare substrate nearby. Different transport channels of the tunnelling charge carriers are discussed and linked to the STS-spectra. The work was financially supported by the SFB 602 TP A7.
[1] Z. Zhang, Q. Niu, C.-K. Shih, Phys.Rev.Lett. 80, 5381 (1998)
[2] J. Müller, M. Wenderoth, N. Quaas, T. C. G. Reusch, R. G. Ulbrich APL 85, 2220 (2004)

DS 23.15 Fr 16:00 Poster TU B

Growth of thin and atomically flat Fe-films on GaAs(110) — •L. Winking, M. Wenderoth, J. Müller, and R. G. Ulbrich — IV. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen

Room temperature deposition of thin metal films on GaAs(110) generally leads to a 3D cluster growth. In contrast it was shown for thin Cu- and Ag-films on GaAs(110) [1,2] that low temperature deposition and a subsequent annealing to room temperature results in epitaxial films with much larger correlation length of preferred thicknesses. We present an STM study of thin Fe films of different thicknesses ranging from a sub-monolayer coverage up to several monolayers, that were deposited at 80 K on in-situ cleaved GaAs(110). After annealing to room temperature these Fe films were investigated and show clear evidence for a 2D layer-by-layer growth. Our study demonstrates that this system as well follows the scheme of electronic growth as it was already shown for thin Cu- and Ag-films on GaAs(110).

This work was supported by the SFB 602 TP A7.

[1] Z. Zhang, Q. Niu, C.- K. Shih, PRL 80, 5381 (1998) [2] J. Müller, M. Wenderoth, N. Quaas, T. C. G. Reusch, and R. G. Ulbrich, APL 85, 2220 (2004)

DS 23.16 Fr 16:00 Poster TU B

Der amorph-kristalline Silizium-Heteroübergang: UV-Photoelektronenspektroskopie von Bandlücken-Zuständen — •Lars Korte und Manfred Schmidt — Hahn-Meitner-Institut Berlin, Abt. Silizium-Photovoltaik, Kekuléstr. 5, 12489 Berlin

Amorphes Silizium mit ca. 10 at% Wasserstoff (a-Si:H) findet Anwendung als Emitter in hocheffizienten Heterostruktur-Solarzellen. Als optimale Emitterdicke werden 5-10 nm gefunden. Die Optimierung der elektrischen Eigenschaften solch ultradünner Schichten erfordert Methoden mit Informationstiefen vergleichbar der Schichtdicke. Mit der UV-Photoelektronenspektroskopie (UV-PES) bei Anregungsenergien $h\nu = 4-7$ eV wird eine solche Informationstiefe erreicht. Wir haben sowohl die Zustandsdichteverteilung $N_{occ}(E)$ der besetzten Zustände in der a-Si:H Bandlücke und im Valenzband als auch die Lage des Ferminiveaus E_f bestimmt [1]. Da $h\nu$ und die kinetische Energie E_{kin} des Elektronenanalysators variabel sind, ergeben sich zwei Spektroskopie-Modi (UPS sowie "constant final state yield spectroscopy"). Außerdem kann die Gesamtzahl der aus der Probe austretenden Elektronen in Abhängigkeit von $h\nu$ gemessen werden ("total yield"). Diese Modi liefern in 1. Näherung jeweils $N_{occ}(E)$. Aus den verleibenden Unterschieden haben wir Informationen über das Matrixelement für die Anregung der Photoelektronen sowie über ihre Streuung auf dem Weg durch die Probe extrahiert. Unterschreitet die a-Si:H Schichtdicke die Informationstiefe, können wir im Spektrum Beiträge vom a-Si:H und vom kristallinen Si-Substrat separieren und daraus den a-Si:H/c-Si Valenzbandoffset bestimmen.
[1] M. Schmidt *et al.*, J. Non-Cryst. Sol. **338-340** (2004), 211.

DS 23.17 Fr 16:00 Poster TU B

Fabrication and characterization of modulation doped ZnO/Zn1-x MgxO:Al films — •Goetz Vollweiler, Klaus Ellmer, Thilo Glatzel und Ulrike Bloeck — Hahn Meitner Institut, Glienicker Str. 100, 14109 Berlin

ZnO/Zn1-xMgxO:Al multilayer films have been grown by magnetron sputtering on sapphire substrates with different orientations and on glass. With such modulation-doped multilayers we want to investigate if the carrier mobility of highly doped ZnO films, which is limited by ionized impurity scattering, can be increased. The thickness of the single layers has been varied from 3 to 200 nm. Crystallinity and orientation of the films were measured by X-ray diffraction. It has been proved that the multilayer films grow epitaxially on the single crystalline sapphire substrates. The modulation doping has been verified by secondary ion mass spectrometry, Kelvin force microscopy on cross sections and by transmission electron microscopy. Depending on the thickness of the single layers, we found specific resistances up to $2{,}2 \cdot 10^{-3}$ Ωcm and mobilities up to 15 cm^2/Vs. The electrical parameters do not show a strong correlation with the structural film quality. This we ascribe to the decisive role of oxygen which leads to an almost full oxidation of the zinc oxide films, due to their low thickness. Furthermore, the stress in the films, which is caused by the large lattice mismatch between zinc oxide and sapphire contributes to a reduced mobility in these films.

DS 23.18 Fr 16:00 Poster TU B

Tailoring of the polymer surfaces with low energy ions: relevance to growth and adhesion of noble metals — •Sebastian Wille, Jurgita Zekonyte, Ulrich Schürmann, Vladimir Zaporojtchenko, and Franz Faupel — Lehrstuhl für Materialverbunde, Technische Fakultät der CAU, Kaiserstr.2, 24143 Kiel

Ion-polymer interaction induces different phenomena in the near surface layer of polymers and promotes its adhesion to metals [1]. Using XPS and TEM, polymer surfaces were examined after 1 keV ion-beam treatments with oxygen, nitrogen and argon ions in the ion fluence range from 10^{12} to 10^{16} cm^{-2} to clarify the following points: chemical reaction after treatment in vacuum and after exposition to air, identification of adsorption-relevant species for metal atoms, formation of cross-links in the outermost polymer layer. The early stages of metal-polymer interface formation during metallization play a crucial role in the metal-polymer adhesion. Therefore, the influence of the ion fluence and ion chemistry on the condensation of noble metals, film growth and peel strength were measured. The surface treatment with very ion low fluence improved the adhesion between copper and differect polymers by two orders of magnitude. The locus of failure changed at the same time from interfacial failure for untreated polymer surfaces to cohesive failure in the polymer for modified surfaces. [1] V. Zaporojtchenko et.al. NIM B, 2004 in press.

DS 23.19 Fr 16:00 Poster TU B

A new simple but rapid method to form aligned nanochannels — •Sebastian Wille, Michael Scharnberg, and Rainer Adelung — Lehrstuhl für Materialverbunde, Technische Fakultät CAU Kiel, Kaiserstr. 2, 24143 Kiel

To produce channels on the submicron- or nanometer scale is of interest for several technical applications like hydrophobic/hydrophilic interfaces for biotechnology or parallel electrical contacts for nanosized objects. Recently [1], we showed how well organized nanowires can be formed by using cracks made by thin film fractures as template. By producing the same aligned cracks in a thin film which has a low ion sputter rate, instead of deposition, we can remove material through the cracks. Nano-channels were fabricated, e.g. by the deposition of a carbon thin film on a gold coated Si or SiO$_2$ sample. Subsequent crack formation in the carbon layer by rapid cooling in liquid nitrogen and sputter etching to assign the cracks in the carbon layer to the subjacent Au-layer leads to the formation of insulating channels on the nanometer scale. In addition to electrical and nanoscopic characterisations we discuss the possible applications.

[1] Adelung et al., Nature Materials, Vol.3, 375 (2004)

DS 23.20 Fr 16:00 Poster TU B

Herstellung und Eigenschaften Titanoxid- und -nitridhaltiger a-C:H-Schichten mittels PIII&D — •Götz Thorwarth[1,2], Claus Hammerl[2], Marcus Kuhn[2], Walter Assmann[3] und Bernd Stritzker[1] — [1]Lehrstuhl für Experimentalphysik IV, Universität Augsburg, 86135 Augsburg — [2]AxynTeC Dünnschichttechnik GmbH, Am Mittleren Moos 48, 86167 Augsburg — [3]Sektion Physik der LMU München, Am Coulombwall 6, 85748 Garching

Die vorteilhaften Eigenschaften amorpher Kohlenstoffschichten lassen sich durch Modifikation der Schichtzusammensetzung mit Fremdelementen weiter verbessern und speziellen Anforderungen anpassen. Mittels der Plasmaimmersions-Ionenimplantation und -Deposition (PIII&D) wurden zu diesem Zweck a-C:H:Ti:O- und a-C:H:Ti:N-Schichten abgeschieden und charakterisiert. Der gewählte Prozeß erlaubte dabei weite Variationen der Ti/C- und Ti/O- bzw. Ti/N-Verhältnisse der Schichten. Die Ergebnisse einer Reihe struktureller (TEM, XRD, Raman-Spektroskopie) und anwendungsbezogener Untersuchungsmethoden (Nanohärte, Leitfähigkeit, Biokompatibilität) werden vorgestellt und diskutiert.

DS 23.21 Fr 16:00 Poster TU B

Abscheidung von technischen Magnesiumlegierungen mit Ionenstrahlzerstäubung — •Yvonne Bohne[1], Stephan Mändl[1], Bernd Rauschenbach[1], Dirk M. Seeger[2], Carsten Blawert[2] und Wolfgang Dietzel[2] — [1]Leibniz-Institut für Oberflächenmodifizierung, Leipzig, Germany — [2]Zentrum für Magnesiumtechnologie, GKSS Forschungszentrum Geesthacht GmbH, Germany

Magnesiumlegierungen sind vor allem im optimierten Leichtbau aufgrund geringer Dichte, ausreichender Festigkeit und des hohen Recyclingpotentials von zunehmender Bedeutung. Jedoch sind zur Erweiterung des Einsatzbereiches neue Legierungssysteme notwendig. Hier besitzen Plasma- und Ionenstrahltechniken ein hohes Potential insbesondere zur Erzeugung amorpher und nanokristalliner Schichten. Technische Magnesiumlegierungen (AZ91, AM50, AE42) wurden in einer UHV-Beschichtungskammer durch Ionenstrahlzerstäubung mit Ar-Ionen abgeschieden. Abhängig von der Ionenenergie (800-1200 eV) wurden Unterschiede im Korrosionsverhalten und in der Schichtzusammensetzung bzw. Struktur nachgewiesen. Die chemische Zusammensetzung der abgeschiedenen Schichten wurde mittels RBS/ ERDA und SIMS untersucht, während Morphologie bzw. Oberflächenrauhigkeit durch REM und AFM charakterisiert wurden. Gefördert durch die DFG im Rahmen des Schwerpunktprogramms 1168.

DS 23.22 Fr 16:00 Poster TU B

Comparison of low temperature nitrided austenitic and martensitic stainless steel — •Darina Manova, Stephan Mändl, Horst Neumann, and Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung, Leipzig, Germany

Nitriding of austenitic stainless steels with energetic ions between 1 and 50 keV at temperatures between 350 and 380 °C is a common process to obtain hard and wear resistant surface layers while retaining the corrosion resistance. In this temperature range, no CrN precipitates are formed, yet a fast nitrogen diffusion leads to a layer thickness of 1 - 10 μm within 1 hour. Furthermore, an anisotropic expansion of the austenitic lattice by 5 - 10% is observed.

Recent experiments show that a similar effect is observed in martensitic stainless steel, where the same process conditions result in an expanded martensite structure. The relative hardness increase of a factor of 3 - 4 is similar for both materials, thus the martensitic steels with an initial higher hardness retain its advantage after the nitrogen implantation. However, the nitrogen insertion leads to the same absolute wear resistance, i.e. the wear rate is decreased by 3 - 5 orders of magnitude for austenites and 1 - 2 orders of magnitude for martensites. It is argued that the build-up of compressive stress during the high-dose ion implantation may be responsible for the outstanding hardness properties of expanded austenite and expanded martensite, while the wear is independently determined by the nitrogen in solid solution.

This work was supported by EU/SMWA project 6204/947.

DS 23.23 Fr 16:00 Poster TU B

Nickelsegregation nach Sauerstoff-Ionenimplantation in NiTi — •Melanie Kitzing[1], Jürgen W. Gerlach[1], Mattias Schubert[2], Walter Assmann[3], Stephan Mändl[1] und Bernd Rauschenbach[1] — [1]Leibniz-Institut für Oberflächenmodifizierung, Leipzig, Germany — [2]Fakultät für Physik und Geowissenschaften, Universität Leipzig, Leipzig, Germany — [3]Beschleunigerlabor, Ludwig-Maximilians-Universität, Garching, Germany

Superelastische Formgedächtnismaterialien besitzen ein weites Anwendungsfeld in der Medizintechnik. Allerdings können bei NiTi negative Langzeiteffekte im Körper durch Nickelausdiffusion noch nicht ganz ausgeschlossen werden. In der natürlichen Oberflächenoxidschicht, die gleichzeitig als Diffusionsbarriere dient, findet sich nur eine partielle Nickelverarmung. Sauerstoffionenimplantation mit Plasmaimmersionsionenimplantation führt hingegen im Temperaturbereich von 250 bis 550 °C zu einer vollständigen Verdrängung des Ni aus dem Oberflächenbereich und der Bildung einer Rutilschicht aufgrund von strahlungsinduzierten Effekten, wie durch elastische Streuung mit schweren Ionen (ERDA) und Ramanspektroskopie nachgewiesen wurde. Mit steigender Temperatur findet man ein Wachstum der Kristallite sowie eine Tendenz den Ni-Konzentrationsgradienten durch thermische Diffusion wieder abzubauen.

DS 23.24 Fr 16:00 Poster TU B

Deposition dünner Titannitrid-Schichten mit hyperthermischen Teilchenstrahlen — •Andreas Wolfsteller, Jürgen W. Gerlach und Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung (IOM), Permoserstrasse 15, 04318 Leipzig

Eine höhere Flexibilität bei der konventionellen ionenstrahlgestützten Deposition von Metallnitrid-Schichten kann erreicht werden, indem die Metallkomponente nicht durch Verdampfen mit lediglich thermischen Energien angeliefert wird, sondern mit hyperthermischen. In dem vorliegenden Beitrag werden Ergebnisse zur Abscheidung von unter Verwendung zweier hyperthermischer Teilchenstrahlen hergestellten TiN-Schichten vorgestellt. Hyperthermische Stickstoff- bzw. Titanionen wurden mit einer Hohlanodenquelle bzw. mit einem DC-Vakuumbogenverdampfer erzeugt. Die TiN-Schichten wurden simultan bei konstanter Substrattemperatur von 750 °C auf Saphir(0001), MgO(100) und Quarzglassubstraten abgeschieden, um die Einflüsse der Ionenstrahlparameter auf das Schichtwachstum von denen des Substrats zu separieren. Als in situ-Messmethode wurde RHEED eingesetzt. Die chemische Zusammensetzung der Schichten wurde mit ERDA, sowie mit TOF-SIMS bestimmt. Die Untersuchung der kristallographischen Struktur und Textur, sowie der kristallinen Qualität erfolgte mit HR-XRD. RHEED und XRD-Polfigurmessungen zeigen, daß die Schichten im Falle von Saphir- bzw. von MgO-Substraten epitaktisch sind; im Falle von Quarzglas sind die Schichten polykristallin und weisen eine Vorzugsorientierung auf. Der Einfluss der Ionenstrahlparameter und der Substratsorte auf die kristalline Qualität der Schichten wird diskutiert.

DS 23.25 Fr 16:00 Poster TU B

Ionenimplantation beim reaktiven Sputtern — •Daniel Severin[1], Matthias Wuttig[1], Oliver Kappertz[2], Tomas Nyberg[2] und Soren Berg[2] — [1]1. Physikalisches Institut 1a, RWTH-Aachen, Deutschland — [2]Angstrom laboratory, Uppsala university, Sweden

Beim reaktiven Sputtern können viele Sputterparameter wie z.B. die Depositionsrate, die Schichtstöchiometrie und die Hysterese mit dem phänomenologischen Bergmodell sehr gut erklärt werden. Ein zentraler Parameter dieses Modells ist der Anteil der Targetoberfläche, der mit dem Reaktivgas reagiert ist. Dabei kommt es im Rahmen des Modells zu einer Chemiesorption der Reaktivgasmoleküle. Unsere Ergebnisse zum reaktiven Sputtern von verschiedenen metallischen Targets, unter anderem Hf, Ti, und W, zeigen jedoch zum Teil eine deutliche Abweichung von diesem klassischen Bergmodell. Dieses erklären wir mit einer Implantation von Reaktivgasionen unter die Targetoberfläche. Eine Erweiterung des Bergmodells, welche diese Implantation berücksichtigt, liefert eine gute Übereinstimmung mit den gefundenen Ergebnissen, wie z.B. der Sputterrate. Dabei ist der Einfluß der Ionenimplantation größer, wenn das Targetmaterial weniger reaktiv ist.

DS 23.26 Fr 16:00 Poster TU B

Deposition von TiO$_x$-Schichten durch reaktives Sputtern in einer DC-Magnetronentladung — •Stefan Wrehde[1], Marion Quaas[2], Hartmut Steffen[1], Harm Wulff[2] und Rainer Hippler[1] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Domstraße 10a, 17489 Greifswald — [2]Institut für Chemie und Biochemie, Ernst-Moritz-Arndt-Universität Greifswald, Soldmannstraße 16, 17489 Greifswald

In einem reaktiven DC-Magnetronplasma wurden unter verschiedenen Bedingungen TiO$_x$-Schichten abgeschieden. Dem Arbeitsgas Argon wurde Sauerstoff als Reaktivgas beigemischt. Die Parameter Druck, Entladungsleistung, Reaktivgasfluss, Vorspannung am Substrat und Betriebsmodus des Magnetrons (”balanced” bzw. ”unbalanced”) wurden variiert.

Die abgeschieden Schichten wurden mit Hilfe verschiedener Oberflächenanalyseverfahren (XPS, XRD) untersucht. Hierbei konnte festgestellt werden, dass sowohl der Betriebsmodus des Magnetrons als auch die Vorspannung am Substrat den Sauerstoffeinbau in die Schichten wesentlich beeinflussen.

DS 23.27 Fr 16:00 Poster TU B

Deposition and characterization of Ag clusters on a Si(100) substrate — •Ibrahimkutty Shyjumon[1], Manesh Gopinadhan[1], Marion Quaas[2], Harm Wulff[2], Christiane A. Helm[1], and Rainer Hippler[1] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Domstraße 10a, 17489 Greifswald, Germany — [2]Institut für Chemie und Biochemie, Ernst-Moritz-Arndt-Universität Greifswald, Soldmannstraße 16, 17489 Greifswald, Germany

Nano size Ag clusters are produced by direct current magnetron sputtering followed by gas aggregation. The charged clusters are directed and deposited on a Si(100) substrate which is biased followed by a lens system. Films prepared at different substrate voltage are analysed by AFM and GIXD methods. AFM results show a pronounced decrease in cluster height and some indication for an increase in cluster width for increasing substrate voltage that can be inferred as a clear indication of cluster flattening upon impact on the surface. This result is supported by GIXD results, where the measured interplanar spacing as well as linear thermal expansion coefficient points towards flattened clusters. Deposited films are futher analysed by XPS and UV-Visible absorption techniques to obtain the chemical composition and physical properties of the films.

DS 23.28 Fr 16:00 Poster TU B

Pulsed reactive sputtering of Indium Tin Oxide using the transition mode of the target — •Matthias Herrmann, Ronny Kleinhempel, Hartmut Kupfer, and Frank Richter — TU Chemnitz, Institut für Physik, 09107 Chemnitz, Germany

In recent years a variety of methods have been applied to prepare ITO films. Hence, the film properties show a strong dependence on the method. We have deposited ITO by pulsed reactive magnetron sputtering from a metallic target (90/10 InSn) in an $Ar\,/\,O_2$ mixture. A plasma emission signal is used to control the working range of the transition mode. This yields the deposition of transparent films in conjunction with a higher deposition rate compared to the oxide target mode. A feedback control loop is necessary for stabilising the setpoint. The ITO films have been prepared by dynamic deposition. It was found that the substrate carrier transport causes changes of the plasma emission signal. The process and plasma parameters were investigated by Langmuir double probes and characterisation of the substrate heating. For both, no significant dependence on the O_2 flow was found. Resistivity, refractive index and optical absorption were characterised by 4-point measurements and spectroscopic ellipsometry, resp.. They showed a strong dependence on the O_2 flow. The lowest resistivity is about $10^{-3}\Omega cm$.

DS 23.29 Fr 16:00 Poster TU B

Reactive sputtering of tungsten nitride: From deposition conditions to structure formation. — •Patrick Karimi, Daniel Severin, and Matthias Wuttig — 1.Physikalisches Institut , Lehrstuhl für Physik neuer Materialien RWTH Aachen, 52056 Aachen

Transition metal oxides and nitrides have attracted considerable interest in the past due to their wide ranging applications. Nevertheless the mechanisms of structure formation are not yet precisely understood. Previous investigations have shown some consistent trends on the structure of IVB-VIB transition metal oxides and nitrides, however no data on tungsten nitride have been available to support our predictions on the mechanisms of structure formation. In this work, tungsten nitride films have been prepared by DC magnetron sputtering under different N2/(N2+Ar) flow rate ratios. Structural investigation shows a mixed phase of W+W2N at flow rate ratios between 5

DS 23.30 Fr 16:00 Poster TU B

YBCO thin films prepared by fluorine-free polymer-based chemical solution deposition — •Claudia Apetrii[1], Heike Schlörb[1], Martina Falter[1], Irene von Lampe[2], Ludwig Schultz[1], and Bernhard Holzapfel[1] — [1]IFW Dresden, Helmholzstr.20, 01069 Dresden — [2]TU Berlin, Englischestr. 20, 10587 Berlin

We describe a chemical solution deposition (CSD) route towards inexpensive and environmentally friendly preparation of YBCO coated conductors. Stoichiometric amounts of Y-, Ba-, and Cu- nitrates were chosen as starting substances for the preparation of a polymer metal precursor solution. The starting substances and polyacrylic (or polymethacrylic) acid were dissolved in dimethylformamide (DMF), to obtain the precursor solution. The polymer metal precursor films were produced by spin coating of a stoichiometric solution onto $SrTiO_3$ single crystal substrate and then dried at 170°C in air. The heat treatment was performed in a tube furnace with a reaction temperature of 775°C. Good superconducting properties, with a inductively measured T_c of 90.4 K (ΔT_c=1.2 K) and J_c of 10^6 A/cm^2 at 77K, have been obtained on epitaxially grown YBCO films using the polymer-based precursors.

DS 23.31 Fr 16:00 Poster TU B

Structure and properties of polymer-fullerene composite films deposited by a combined process of thermal sublimation and plasma polymerization — •Andreas Kiesow[1], Andreas Kailer[2], Katrin Löschner[1], and Andreas Heilmann[1] — [1]Fraunhofer-Institut für Werkstoffmechanik, Heideallee 19, 06120 Halle — [2]Fraunhofer-Institut für Werkstoffmechanik, Wöhlerstraße 11, 79108 Freiburg

C60 fullerenes and WS2-fullerene-like molecules are known as promising material to improve the tribological properties of coatings. In order to integrate such nanoparticles in a polymeric matrix the fullerenes are sublimated concurrently to a plasma enhanced chemical vapour deposition (plasma polymerization). Silicon-containing hydrocarbons such as hexamethyldisiloxane were used as monomer. Transmission electron microscopy (also in cross section) and scanning electron microscopy were applied to investigate the microstructure of the films; in particular, the arrangement of the fullerenes within the polymer matrix. The film structure as well as the arrangement of the nanoparticles is influenced by the deposition parameters. FTIR and Raman spectroscopy give information about the chemical properties of the films deposited. The tribological characterization of the coatings were done in reciprocating ball-on-disc and flat pin-on-disc configuration. First results of the tribological tests are compared and discussed concerning friction coefficients, wear rates and mechanisms.

DS 23.32 Fr 16:00 Poster TU B

Herstellung und Charakterisierung von (BGa)As/(GaIn)As Nanoröhren — •Hendrik Paetzelt[1], Jens Bauer[1], Helmut Herrnberger[2] und Volker Gottschalch[1] — [1]Universität Leipzig, Institut für Anorganische Chemie, Linnéstraße 3, 04103 Leipzig — [2]Leibniz-Institut für Oberflächenmodifizierung e.V., Permoserstr. 15, 04303 Leipzig

Planare $A^{III}B^{V}$ Heterostrukturen mit definierten Spannungen werden in Verbindung mit dem materialselektiven Ätzen zur Herstellung von Nanoröhren, Mikroreaktoren und Aktoren verwendet. Wir studierten die Röhrenbildung an

$B_xGa_{1-x}As/Ga_yIn_{1-y}As$/AlAs/GaAs Schichtfolgen. Die Präparation der $B_xGa_{1-x}As/Ga_yIn_{1-y}As$-Nanoröhren verschiedener Dimension und Geometrie erfolgte aus MOVPE-Material. Als Quellen kamen Triethylbor, Trimethylgallium, Trimethylindium und Arsin zum Einsatz. Sowohl über die Bor- und Indiumkonzentration (x = 0 ...0.03 und y = 0 ...0.3) als auch über die Dicken der einzelnen Schichten wurden definierte Spannungsverhältnisse eingestellt. Die gemessenen Nanoröhrendurchmesser stimmen gut mit den durchgeführten Modellrechnungen überein. Die Rollenbildung an weiteren MOVPE-Schichtsystemen und die erzielten optischen Daten werden vorgestellt.

DS 23.33 Fr 16:00 Poster TU B

Epitaktische Eigenschaften von dünnen ZnO-Filmen auf (001) $SrTiO_3$ — •Matthias Karger und Meinhard Schilling — TU Braunschweig, Institut für Elektrische Messtechnik und Grundlagen der Elektrotechnik, Hans-Sommer-Straße 66, 38106 Braunschweig

Zinkoxid ist eines der aussichtsreichsten Materialien für transparente, leitfähige oxidische Dünnfilme. Filme hoher Qualität können mit verschiedensten Methoden auf den unterschiedlichsten Substraten abgeschieden werden. Wir präsentieren Untersuchungen zum Wachstum von undotierten und mit Al-dotierten ZnO-Filmen, die bei Substrtattemperaturen zwischen 600 °C und 850 °C mittels Pulsed Laser Deposition auf TiO-terminiertem $SrTiO_3$ (001) hergestellt wurden. Mit *in-situ* Hochdruck-RHEED konnte gezeigt werden, dass bei Substrattemperaturen ab etwa 800 °C die Filme eine sehr polykristalline Struktur annehmen. Filme, die bei Temperaturen zwischen 600 °C und 800 °C abgeschieden wurden, zeigen wenige RHEED-Oszillationen und im weiteren Verlauf der Deposition eine nahezu perfekte ($11\bar{2}0$)-Orientierung. Röntgenuntersuchungen untermauern die RHEED Ergebnisse zur Epitaxie und zeigen, dass es prinzipiell möglich ist, ZnO-Filme mit guter epitaktischer Qualität auf $SrTiO_3$ (001) aufzuwachsen. AFM Messungen ergeben Rauigkeiten zwischen 3 nm und 5 nm (rms).

DS 23.34 Fr 16:00 Poster TU B

Changes of structure and electrical properties of reactively sputtered WS_x-films by increased ion bombardment — •Stefan Seeger[1], Rainald Mientus[2], and Klaus Ellmer[1] — [1]HMI-Berlin, Glienicker Str. 100, 14109 Berlin — [2]OUT e.V., Köpenicker Str. 325b, 12555 Berlin

Polycrystalline WS_x-films with a good crystallographic quality ((00l)-texture) were prepared by reactive magnetron sputtering with radio frequency at 27.12 MHz from a tungsten target in a mixture of inert gases (Ar, Xe) and H_2S.
Systematic changes of the substrate voltage V_S from floating potential V_S= +20 V to an applied negative substrate voltage up to V_S=-100 V increases the positive ion bombardment, namely Ar^+ and Xe^+, and leads to a disturbed growth of the WS_x films. *In situ* energy-dispersive X-ray diffraction (EDXRD) technique at a synchrotron radiation source was used to study the growth of the WS_x-films.
In this work the influence of the applied substrate voltage, hence an increased ion bombardment on the growing films, is correlated to the crystal structure and the electrical and the optical properties of the sputtered WS_x-films.

DS 23.35 Fr 16:00 Poster TU B

Raman scattering investigations of friction induced changes in DLC coatings — •Dirk Spaltmann, Thomas Schneider, Klaus Witke, Klaus-Werner Brzezinka, and Mathias Woydt — Bundesanstalt für Materialforschung und -prüfung (BAM), D-12200 Berlin

Diamond like carbon (DLC) coatings are of increasing importance for industrial applications. Therefore, various DLC coatings on 100Cr6 steel discs were tested under dry slip-rolling conditions at initial Hertzian pressures of P0=1.0 GPa. Optical microscope images showed deformations of the samples and alterations in the colouring of the DLC coatings. In order to investigate these changes, Raman scattering spectroscopy was applied. Comparing the changes in the graphite (G) peak and the disordered graphite (D) peak of the Raman spectra taken of the virgin surface and of the surface after the slip-rolling test, a friction induced amorphisation of the coating, a rubbing-off of the coating or the formation of iron oxides could be observed. It depends on the type of DLC coating, which effect dominates.

DS 23.36 Fr 16:00 Poster TU B

X-ray interferometers for measuring spatial coherence and optical constants — •Wolfram Leitenberger, Ullrich Pietsch, and Tobias Panzner — Universität Potsdam, Am Neuen Palais 10, 14468 Potsdam, Germany

We have investigated the spatial coherence properties of X-rays in a large spectral range between 5 and 20 keV using different types of X-ray interferometers all known from classical optics (double pinhole interferometer and Fresnel bi-mirror). The experiments were done with a white X-ray beam of a bending magnet at BESSY synchrotron. For energy discrimination was used an energy dispersive solid state detector. The spatial resolution of a few micron was achieved by small pinhole apertures in front of the detector. From the measured high contrast interference fringes we could calculate the degree of spatial coherence and values of the index of refraction in the whole spectral range.

DS 23.37 Fr 16:00 Poster TU B

IR-transmission spectroscopical and SEIRA study of Ag nanoparticles on MgO(001) — •Fanzhen Meng, Daniel Seilbel, Andreas Priebe, Matthias Lust, Olaf Skibbe, Robert Lovrincic, Gerhard Fahsold, and Annemarie Pucci — Kirchhoff-Institut für Physik, Universität Heidelberg

Temperature and deposition rate have big effects on ultrathin films' morphologies. In this work we investigate Ag/MgO(001) grown at different temperatures (from 60 K to 500 K) and also with different deposition rates with in-situ IR spectroscopy. With liquid Helium cooling we get a smooth film morphology. IR transmittance spectra show that this film becomes conductive at about 1 nm thickness. At 500 K, we get a film with big and separated facets. At 40 nm deposited thickness we still have separated islands at this temperature. At room temperature and 100 K, with a higher deposition rate the percolation is shifted towards lower thickness. We calculated the transmission spectra with a Drude-type model and with an effective medium model.

We also exposed CO to these films at low temperatures (60 K and 100 K). CO-vibration peaks give different information when adsorbed on films grown at different temperatures. For example, we can not find any CO signal at 100 K and at 60 K on a film which was prepared at room temperature. At 100 K, we find a Boudouard reaction ($CO+CO=CO_2+C$) when exposure CO to films which were prepared at 400 K and 500 K.

DS 23.38 Fr 16:00 Poster TU B

Wachstum von YSZ-Schichten auf amorphen Substraten — •Jens Uhlig[1], M. Beck[1], F. Schmidl[1], J. Kräusslich[2], H. Wald[1] und P. Seidel[1] — [1]Institut für Festkörperphysik FSU Jena — [2]Institut für Optik und Quantenelektronik FSU Jena

Im Rahmen der Arbeit wird das Wachstum von Yttrium-stabilisierten Zirkonoxid (YSZ) auf amorphen Substraten nach Abscheidung mittels Pulsed Laser Deposition (PLD) untersucht. Dabei wird im speziellen auf die Abhängigkeiten von Sauerstoff/Argon Partialdruck, Temperatur, Abscheidungsrate, Teilchenenergie und Winkel, texturierendem Einfluß eines gerichteten Ionenstrahles sowie Ausheilungsprozessen eingegangen. Als Untersuchungsmethoden werden Röngtendiffraktometrie, Rutherford-Backscattering (RBS) sowie Raster-Elektronenmikroskop (SEM) angewandt.

DS 23.39 Fr 16:00 Poster TU B

Rare-earth scandate thin films as alternative gate oxides for microelectronic applications — •Tassilo Heeg[1], J. Schubert[1], M. Wagner[1], Y. Jia[2], L. Edge[2], D.G. Schlom[2], V.V. Afanas'ev[3] und Ch. Buchal[1] — [1]Institut für Schichten und Grenzflächen ISG1-IT, Forschungszentrum Jülich GmbH, 52425 Jülich — [2]Department of Materials Science and Engineering, Penn State University, University Park, PA 16802, USA — [3]Semiconductor Physics Section, K.U. Leuven, Celestijnenlaan 200D, B-3001 Heverlee

The rare-earth scandates ($ReScO_3$, where Re is a rare earth element) were recently proposed as candidate materials for the replacement of SiO_2 in silicon MOSFETs in either amorphous or epitaxial form. In this work we investigate the dielectric properties and structural perfection of epitaxial and amorphous $ReScO_3$ thin films. Epitaxial $LaScO_3$, $GdScO_3$, and $DyScO_3$ films with good crystalline perfection were grown by pulsed laser deposition (PLD) on epitaxial $SrRuO_3$-films to form metal-insulator-metal structures on $SrTiO_3$(100) substrates. High K-values - up to 26 - were measured for these epitaxial scandate films. Amorphous films were prepared by PLD directly on silicon substrates. Internal photoeffect and photoconductivity measurements were performed to analyze the bandgap of the scandates and their band offset to silicon. The growth was also performed at different temperatures to investigate the thermal stability of the scandates in contact with silicon. The films were characterized using Rutherford Backscattering Spectrometry to investigate diffusion processes between silicon and the scandate thin films.

DS 23.40 Fr 16:00 Poster TU B

Investigation of molecular thin films using TEM and electron diffraction — •Benjamin Graffel[1], Steffen Schulze[1], Oksana Dmytrenko[2], Ralph-Peter Krüger[3], and Michael Hietschold[1] — [1]Solid Surfaces Analysis Group, Institute of Physics, Chemnitz University of Technology, Germany — [2]Departments of Physics Shevchenko Kyev University, Ukraine — [3]BAM Berlin, Germany

We studied the crystalline structure of films from ball-shaped molecules using electron diffraction. We used both fullerenes and siloxane molecules for our experiments. The films were prepared by thermal vacuum evaporation of the material under high-vacuum conditions. The films have been found to be either of fine-crystalline structure with some crystallites reaching a size of up to 100 nm or of amorphous structure. The sublimation temperature was equal to 730 K in the case of fullerenes and about 570 K in the case of siloxanes. The crystallographic analysis from electron diffraction patterns suggested the dense packed structure of the fullerite C60-balls occurring in a stacking of hcp and fcc close packed planes parallel to the substrate surface. Furthermore the electron diffraction patterns provide us with intra-molecular structure data of the individual C60 and siloxane balls and can be understood in terms of the structure model of such balls.

DS 23.41 Fr 16:00 Poster TU B

STM, AFM und SEM Untersuchungen von selbststrukturierenden, organischen Schichten: Vom Mono- zum Multilagenwachstum von 1-Octacosanol auf unterschiedlichen Modellsubstraten. — •Alexander Hommes[1], Peter Broekmann[1], Klaus Wandelt[1], Kerstin Koch[2] und Wilhelm Barthlott[2] — [1]Institut für Physikalische und Theoretische Chemie der Universität Bonn, Wegelerstr 12, 53115 Bonn — [2]Nees-Institut für Biodiversität der Pflanzen, Meckenheimer Allee 170, 53115 Bonn

Das Kristallisationsverhalten von amphiphilen Molekülen auf unterschiedlichen Modellsubstraten wie HOPG, Mica und Siliziumoxid wurde, mit Hilfe verschiedener Rastersondentechniken (STM + AFM) und SEM, von der Monolage bis zum 3-D Kristall untersucht. Exemplarisch wird das Kristallisationsverhalten von 1-Octacosanol erklärt. Nur auf HOPG zeigt sich epitaktisches Wachstum. Die auf HOPG beobachteten kristallinen Strukturen gleichen denen auf natürlichen Blattoberflächen, da 1-Octacosanol auch Hauptbestandteil (60 m%) des epikutikularen Wachsgemischs auf Triticum aestivum (Weizen) ist. Diese Strukturen bestimmen maßgeblich die physikochemischen Eigenschaften dieser biologischen Oberflächen z.B deren Hydrophobizität (Lotus Effekt).

DS 23.42 Fr 16:00 Poster TU B

Growth mode analysis of thiophene based OFETs by atomic force microscopy — •T. Muck, J. Fritz, and V. Wagner — School of Engineering and Science, International University Bremen, D-28759 Bremen, Germany

Charge transport in organic field-effect transistors takes place at the organic/insulator interface. Thereby, only the first monolayers of the organic molecules have been found to be important for the device performance. Properties like growth mode, number and size of grains influence the transport behavior. Furthermore, optimized growth conditions are modified by the presence of source and drain electrodes in bottom configuration.

In this study we analyzed the growth of the thiophene derivatives dihexylquaterthiophene (DH4T) and dihexylsexithiophene (DH6T) on SiO_2/Si-transistor templates with gold electrodes in bottom configuration by atomic force microscopy (AFM). The organic films were deposited by organic molecular beam deposition (OMBD) in ultra high vacuum. Film thickness gradients from sub-monolayer to several monolayers were produced on the same sample via a motor driven shutter. At elevated substrate temperatures a layer-by-layer growth was observed.

We found, that in the region close to the gold contacts the organic molecules do not form an homogenous film due to a transport of molecules from the channel region towards the electrodes. Furthermore, on gold we observe upright standing molecules which implies an additional structural disturbance at the channel/electrode interface.

DS 23.43 Fr 16:00 Poster TU B

Growth of crystalline Rubrene films — •Daniel Käfer, Gregor Witte und Christof Wöll — Physikalische Chemie I, Ruhr-Universität Bochum, 44780 Bochum

Rubrene a commonly used dye has recently been demonstrated to also exhibit a remarkably high charge carrier mobility in single crystals [1] which favours its use for molecular electronics applications. However, the growth of crystalline thin films of rubrene has yet not been achieved. Here we report results of a growth study of rubrene films prepared by molecular beam deposition on gold and silicon oxide substrates. Whereas at room temperature rather amorphous films are obtained the size of rubrene crystallites increases with rising temperature but their size is found to be limited by competing dewetting, decreasing sticking coefficients, and finally the desorption of rubrene. An improved crystal growth is achieved by using a modified 'hot wall'-type deposition cell which allows operation under UHV-conditions but at much higher partial vapour pressure. The resulting crystalline films and large single crystallites were characterized by AFM and SEM.

[1] V.C. Sundar et al. Science 303, 1644 (2004)

DS 23.44 Fr 16:00 Poster TU B

Simultane Temperatur- und FTIR-Analyse bei der Plasmamodifizierung von Polymeroberflächen — •Jan Schäfer, Kristian Dittmann und Jürgen Meichsner — Institut für Physik, E.-M.-Arndt-Universität, Domstraße 10a, 17489 Greifswald

Eine Versuchsapparatur "Nevada" wird vorgestellt zur simultanen Analyse des Temperaturverhaltens und der Veränderung der molekularen Struktur von Polymerproben während der Wechselwirkung mit einem RF-Niederdruckplasma. Ein elektronisches Dreistufen-Kühlsystem ermöglicht aufgrund der Rückkopplung an den berührungslosen IR-Temperaturfühler eine hoch sensitive Temperatursteuerung der Probenoberfläche im Bereich von 258 K bis 373 K. Die Untersuchung von Polymerproben bei definierter Ausgangstemperatur sowie die Analyse des Temperaturverlaufes während der Plasmabehandlung im Zusammenhang mit einer in situ IR-Reflexions-Absorptions-Spektroskopie erlaubt es, elementare Prozesse bei der Veränderung der molekularen Struktur zu studieren. Ergebnisse zum grundsätzlichen Verhalten synthetischer Polymere wie Polypropylen (PP), Polymethylmetacrylat und Polystyren unter Plasmaeinwirkung werden präsentiert. Beispielsweise wird eine selektive Kondensation von organischen Dämpfen (z.B. Phthalate) auf der PP-Oberfläche und die Ausbildung einer dünnen modifizierten Oberflächenschicht während der Nachbehandlung im aktiven Sauerstoffplasma dargestellt.

DS 23.45 Fr 16:00 Poster TU B

Das neue Neutronenreflektometer NERO — •Vincent Leiner, Ursula Tietze, Dieter Lott und Andreas Schreyer — GKSS Forschungszentrum GmbH; Max-Planck-Str. 1; D-21502 Geesthacht

Mit NERO steht ab 2005 am Forschungsreaktor des GKSS Forschungszentrums in Geesthacht ein neues Neutronenreflektometer zur Untersuchung dünner Schichten, Grenz- und Oberflächen zur Verfügung. NERO arbeitet mit einem monochromatischen Neutronenstrahl mit einer Wellenlänge von 0.45 nm und erlaubt es, Reflektivitätsmessungen mit Großwinkelstreuung zu verbinden.

Sowohl magnetische Schichten als auch Systeme aus dem Forschungsgebiet der weichen Materie können an NERO untersucht werde.

Strahlzeit kann über das Antragsverfahren des GKSS Forschungzentrums beantragt werden. Informationen zum Antragsverfahren und Instrument finden sich bei http://genf.gkss.de

DS 23.46 Fr 16:00 Poster TU B

Selforganized nanostructuring of organic monolayers — •Michael Hirtz[1,2], Lifeng Chi[1,2], and Harald Fuchs[1,2] — [1]Physical Institute, University of Münster, Wilhelm-Klemm-Str. 10, 48149 Münster — [2]Center for Nanotechnology (CeNTech), Gievenbecker Weg 11, 48149 Münster

The Langmuir-Blodgett technique provides a powerful tool for the preparation of monomolecular layers with a controlled thickness and composition. In our laboratory extensive research effort has been devoted to the formation of self-organized nanostructures via the LB transfer of the fatty acid-type molecule DPPC (dipalmitoylphosphatidylcholine). The obtained patterns were studied by Atomic Force Microscopy. Here we present the formation of nanoscale stripe patterns of DPPC monolayers on a silicon substrate. The observed patterns, which were produced by the LB technique, were found to vary with transfer speed, area pressure and temperature as well as different substrates (silicon, mica). Ongoing research is aimed at elucidating the effect of different substrate treatments (e.g. RCA treatments, O2-Plasma) on the pattern formation. The different treatments change the surface energy of the silicon substrate and are therefore expected to have an influence on the pattern formation.

DS 23.47 Fr 16:00 Poster TU B

$BaTiO_3$ Schichten auf Si-Substraten für elektrooptische Anwendungen mit ZnO-Elektroden — •Thomas Lipinsky, Jürgen Schubert und Christoph Buchal — Forschungszentrum Jülich, 52425 Jülich

$BaTiO_3$ ist ein Material mit grossen elektrooptischen Koeffizienten und hoher Transparenz im sichtbaren- und nahen Infrarot-Bereich. In Dünnfilmtechnologie wurden bereits Mach-Zehnder Modulatoren auf MgO-Substraten hergestellt.

Mit dem Ziel der Integration von elektrooptischen Modulatoren auf Silizium werden hier die optischen und strukturellen Eigenschaften von $BaTiO_3$ auf Silizium und SoS-Substraten untersucht. Vor der $BaTiO_3$-Deposition wurden diese mit einer niedrigbrechenden optischen Isolationsschicht versehen. Die Schichten weisen eine Doppelbrechung von bis zu 0.01 auf, zeigen jedoch in Abhängigkeit der Depositionstemperatur eine kritische Schichtdicke, ab der sich beim Abkühlen der Schicht Risse ausbilden.

ZnO wird als transparentes Eletrodenmaterial für die elektrooptischen Modulatoren verwendet. Die direkt auf die wellenleitende $BaTiO_3$-Schicht aufgetrage ZnO-Schicht dient gleichzeitig zur Führung der Lichtwelle (Rippenwellenleiter). Durch den direkten Kontakt zum elektrooptischen $BaTiO_3$ reduziert sich desweiteren die benötigte Schaltspannung.

DS 24 Postersitzung II

Zeit: Dienstag 17:00–19:00 Raum: Poster TU B

DS 24.1 Di 17:00 Poster TU B

Nonlinear optical coefficients from first-principles calculations: Different numerical approaches — •Roman Leitsmann, W.G. Schmidt, P.H. Hahn und F. Bechstedt — Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany

Different numerical and methodological approaches for the ab initio calculations of the nonlinear optical response are used in the literature[1,2]. On the one hand, the formulas used are not easily seen to be equivalent. On the other hand, the numerical results even for well characterized bulk systems like GaAs do neither agree well with each other nor with experiment[3]. We revisit the derivation of the relevant expressions for the second harmonic generation (SHG) and show analytically the equivalence of the approaches[1,2] within the independent-particle approximation. In addition, we develope an approach to include excitonic effects in the SHG spectra over a wide energy range. Numerical results for bulk GaAs are presented which show the large influence of technical parameters on the final results.
[1] J.L.P. Hughes and J.E. Sipe, Phys. Rev. B 53, 10751 (1996).
[2] B. Adolph and F. Bechstedt, Phys. Rev. B 57, 6519 (1998).
[3] S. Bergfeld and W. Daum, Phys. Rev. Lett. 90, 036801 (2003).

DS 24.2 Di 17:00 Poster TU B

Surface optical anisotropy induced by water molecules adsorbed on Si(001): *First-principles* **calculations** — •Kaori Seino and Wolf G. Schmidt — Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Universität, Max-Wien-Platz 1, 07743 Jena, Germany

Water is a major component in the residual gas in most ultra-high vacuum apparatus. Water coadsorption therefore occurs on many Si(001) surfaces to a noticeable degree. The interaction of water with Si(001) surface has also been discussed in the context of type-C defects on Si(001) surfaces. Here we present reflectance anisotropy spectra (RAS) for water covered Si(001) surfaces calculated within the independent particle approximation. We mainly discuss two configurations: the dissociative adsorption (i.e. the formation of HO-Si-Si-H) and the oxygen insertion into the Si dimer (i.e. the formation of H-Si-O-Si-O). For low coverages we find essentially an attenuation of the RAS features typical for clean Si surfaces. For the saturation coverage of one molecule per dimer, however, dissociative adsorption and oxygen insertion into the Si dimer give rise to clearly different optical anisotropies.

DS 24.3 Di 17:00 Poster TU B

Anharmonic decay of optical phonons in III-V semiconductors at temperatures up to 1200 K — •Eugen Speiser[1], Torsten Schmidtling[2], and Wolfgang Richter[1,2] — [1]Department of Physics, University of Rome Tor Vergata, Via della Ricerca Scientifica 1, I-00133 Rome, Italy — [2]Institut für Festkörperphysik TU Berlin, PN 6-1, Hardenbergst. 36, 10623 Berlin, Germany

The anharmonic decay of optical phonons into lower frequency phonons is a fundamental process for energy relaxation in semiconductors. It manifests itself in the phonon linewidth which can be obtained from Raman scattering experiments. By measuring then the temperature dependence of the Raman linewidth the contribution of different decays processes can be tested. This has been done until now only for some elemental semiconductors. Comparable high temperature experiments on compound semiconductors have been rarely reported until now since their surfaces decompose and deteriorate easily at high temperatures. This surface deterioration leading to wrong results can be avoided by providing stabilisation of the volatile surface component by epitaxial stabilisation.

We have therefore combined a MOVPE(Metal Organic Vapour Phase Epitaxy) apparatus for III-V semiconductor growth with a Raman setup via a glasfibre to guide the inelastic scattered light from the sample inside reactor to the Raman spectrometer. We report first studies of the crystal anharmonicity done by Raman spectroscopy on stabilised GaAs and InAs surfaces at high temperatures. We will compare these results with literature data on the atomic mean square displacements obtained by x-ray diffraction.

DS 24.4 Di 17:00 Poster TU B

Optimisation of MOVPE growth of InN with spectroscopic ellipsometry — •M. Drago, C. Werner, T. Schmidtling, M. Pristovsek, U.W. Pohl, and W. Richter — TU-Berlin, Institut für Festkörperphysik, Hardenbergstr. 36, 10623 Berlin

Because of the poor quality of the available InN layers, fundamental properties of this material (i.e. the value of the bandgap energy) are still under discussion. Consequently, there is a strong demand to improve the InN epitaxial layers. We have grown InN on sapphire (00.1) in MOVPE, studying the dynamics of the processes and the optical properties with in-situ spectroscopic ellipsometry (SE). In this work we report on the effect of substrate preparation, nucleation layer thickness and different growth parameters. Our results led to an improved procedure where the temperature is increased after nucleation and V/III ratio is decreased down to 10000 during growth at 580°C. This allows growth rates as high as 350 nm/minute. The samples produced are presently among the best in the MOVPE niveau. The resulting mobility was 600 cm^2/Vs and the FWHM for the X-ray diffraction 2-θ scans in the 00.2 reflection was lower than 150 seconds.

DS 24.5 Di 17:00 Poster TU B

Origin of the optical anisotropy oscillations during the oxidation of Si(001) — •Frank Fuchs, Wolf G. Schmidt, and Friedhelm Bechstedt — Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany

The oxidation of silicon is both of great fundamental and technological interest. Despite decades of effort, the microscopic mechanisms of oxide growth are still under consideration. Recent experiments [1-4] indicate the high potential of Reflectance Anisotropy Spectroscopy (RAS) for the study of oxide growth on Si(001), where RAS could represent a powerfull supplement to conventional surface characterisation techniques.
Here we present the results of our ab initio study on the origin of the RAS oszillations measured during oxide growth. Our results demonstrate the relation of the RAS oscillations to the layer-by-layer oxidation of Si(001). The major contribution to RAS is found to result from the interface, while the RAS signal from the oxide-overlayer is found to vanish due to surface disorder. The progression of the local strain field accompanying the oxygen-insertion into Si-Si bonds at the interface is identified as the actual origin of the RAS oscillation.

[1] T. Yasuda *et al.*, Phys. Rev. Lett. **87**, 037403 (2001).
[2] T. Matsudo *et al.*, J. Appl. Phys. **91**, 3637 (2002).
[3] T. Yasuda *et al.*, Phys. Rev. B **67**, 195338 (2003).
[4] T. Yasuda *et al.*, Thin Solid Films **455-456**, 759 (2004).

DS 24.6 Di 17:00 Poster TU B

Comparative studies of interactions between intense pulsed laser and gold nanoparticles in water and toluene phases — •Zhangquan Peng[1], Thomas Walther[2], and Karl Kleinermanns[1] — [1]Institut für Physikalische Chemie und Electrochemie I, Heinrich-Heine-Universität Düsseldorf, 40225 Düsseldorf, Germany — [2]Center of Advanced European Studies and Research, Ludwig-Erhard-Allee 2, 53175 Bonn, Germany

Gold nanoparticles were surface-modified with a pH-sensitive monolayer of 4-aminothiophene (4-ATP) in water phase. By varying the pH value of the solution, nanoparticles could be quantitatively transferred into toluene phase in a two-phase (water/toluene) system. The nanoparticles in both water and toluene phase were irradiated by an intense pulsed laser at 532 nm. The products in solution were examined by transmission electron microscopy (TEM) and optical absorption spectroscopy. Besides, the effects of the presence of excess protecting ligands including 4-ATP and SH(CH2)8SH on the photo-fragmentation kinetics and product morphology have been studied. Experimental results showed that gold nanoparticles in toluene phase are more prone to be photo-fragmentated into small metallic clusters than in water phase, independent of the existence of protecting ligands. The dielectric and heat conduction properties of the solvents have been invoked to explain the observed phenomena.

DS 24.7 Di 17:00 Poster TU B

Optical anisotropy of clean and adsorbate modified vicinal Si(001) surfaces — •Regina Passmann[1,2], Matthias Wahl[1,2], Michael Gensch[1,3], Karsten Hinrichs[1], Patrick Vogt[2], Wolf Gero Schmidt[4], Wolfgang Richter[2], and Norbert Esser[1] — [1]ISAS - Institute for Analytical Sciences - Department Berlin, Albert-Einstein-Str. 9, D-12489 Berlin — [2]TU Berlin, Institut für Festkörperphysik, Hardenbergstr. 36, D-10623 Berlin — [3]Gesellschaft zur Förderung angewandter Optik, Optoelektronik, Quantenelektronik und Spektroskopie e.V., Rudower Chaussee 29, D-12489 Berlin — [4]Friedrich-Schiller-Universität Jena, Institut für Festkörperphysik und -optik, Max-Wien-Platz 1, D-07743 Jena

Reflectance anisotropy spectroscopy (RAS) is well suited to investigate the anisotropy of optical and electronical properties of solid surfaces. In agreement with ab-initio calculations the geometric and electronic structure of the surface can be determined. The optical anisotropy of the clean vicinal Si(001) surface and the modification in the optical anisotropy during adsorption of organic molecules was investigated. A model of the adsorption geometry for cyclopentene monolayers on the vicinal Si(001) surface could be verified. The sample was prepared under ultra high vacuum and characterised by RAS, XPS and LEED. Comparison with ab-initio calculation shows that cyclopentene most probably adsorbs via a cycloaddition reaction with the Si dimer [1].

[1] W.G. Schmidt, F. Fuchs, A. Hermann, K. Seino, F. Bechstedt, R. Paßmann, M. Wahl, M. Gensch, K. Hinrichs, N. Esser, S. Wang, W. Lu, J. Bernholc, J. Phys. C 16 (2004), S4323

DS 24.8 Di 17:00 Poster TU B

Multichannel RAS – a versatile means for fast in situ-measurements — •Ch. Kaspari, S. Weeke, F. Poser, M. Pristovsek, and W. Richter — Technische Universität Berlin, Institut für Festkörperphysik, Sekr. PN 6-1, Hardenbergstraße 36, D-10623 Berlin

Reflectance anisotropy spectroscopy (RAS) has become an important *in situ*-technique for the study of epitaxial growth of semiconductor surfaces and interfaces. However, for growth monitoring on a short time scale (order of seconds and below) one is usually restricted to transient measurements at one single photon energy.

We report on a special RAS setup that is designed to measure transients at multiple photon energies simultaneously in the spectral range between 1.4 and 5 eV. A variety of processes in III-V-MOVPE were investigated with this setup, e.g. oxide desorption and quantum dot growth.

DS 24.9 Di 17:00 Poster TU B

The dielectric properties of organic heterostructures compared to mixed layers — •Daniel Lehmann, M. Friedrich, A. Fechner, and D.R.T. Zahn — Institut für Physik, Technische Universität Chemnitz, Reichenhainer Straße 70, D-09107 Chemnitz, Germany

Zinc phthalocyanine (ZnPc) and fullerene C$_{60}$ are used in organic solar cells as p- respectively n-conducting materials. They can be deposited as individual layers in a heterostructur or as mixed (homogeneous or gradient) structures. The purpose of this work is to determine the differences in the optical properties of the various structures. ZnPc and C$_{60}$ were evaporated respectively coevaporated on silicon substrates using Organic Molecular Beam Deposition (OMBD) in ultra high vacuum. The layers were studied *ex situ* with Variable Angle Spectroscopic Ellipsometry (VASE). The dielectric properties were obtained by fitting the ellipsometric data. The differences in the optical properties of the distinct structures are discussed with regard to the application in solar cells.

DS 24.10 Di 17:00 Poster TU B

Influence of superlattice structure on the optical properties of organic materials — •Sascha Hermann, Ovidiu Gordan, Marion Friedrich, and Dietrich Zahn — Institut für Physik-Halbleiterphysik TU-Chemnitz, D-09107 Chemnitz, Germany

While the optical properties of inorganic superlattices are well known there is so far only very little work on organic superlattices. This work deals with the preparation and investigation of multilayered organic heterostructures. The organic superlattices of alternating layers consist of 3,4,9,10-perylenetetracarboxylic dianhydride (PTCDA) and copper phthalocyanine (CuPc). Samples were prepared by organic molecular beam deposition in high vacuum on H-passivated Si(111) kept at room temperature. Typical thicknesses of individual layers are in the range of 2.5-10nm. The samples were studied by spectroscopic ellipsometry in the range of 0.73 to 5eV and infrared spectroscopy (IR). The IR-results reveal that there is no chemical interaction between the constituents at the interface. The evaluation of the ellipsometry measurements however reveal that the optical response can not be described by superimposing the optical response of single layers. This suggests that there is electronic coupling between the orbitals of the PTCDA and CuPc at the interface.

DS 24.11 Di 17:00 Poster TU B

Applications of synchrotron infrared ellipsometry for analysis of small samples and heterogeneous films — •Michael Gensch[1,2], Katy Roodenko[1], Ullrich Schade[3], Arnulf Röseler[2], Ernst-Heiner Korte[1], Karsten Hinrichs[1], and Norbert Esser[1] — [1]ISAS - Institute for Analytical Sciences, Albert-Einstein-Str. 9, 12489 Berlin — [2]GOS e.V., Rudower Chaussee 29, 12489 Berlin — [3]BESSY, Albert-Einstein-Str. 15, 12489 Berlin

It was shown recently that the detection limits of infrared ellipsometry can be improved to monolayer sensitivity by use of appropriate measurement strategies and dedicated radiation sources such as synchrotron infrared beamlines [1]. Another question is if also biological or other samples with considerable spatial variations of the optical and chemical properties can be investigated with this method. The evaluation of the anisotropic optical constants [2] and of the structural parameters (e.g. molecular orientation) of such samples requires an understanding of the contributions due to deviations from the commonly applied layer models. This work shows that small and heterogeneous samples can be investigated with respect to thickness, structure and composition. It is outlined how different contributions such as roughness, varying thickness and chemical properties can be separated by applying the optical models, in particular if a highly brilliant source is used.

[1] M. Gensch, K. Hinrichs, U. Schade,A. Röseler, E.H. Korte, Anal. Bioanal. Chem. 376 (2003) 626. [2] K. Hinrichs, M. Gensch, K. Sahre, K.-J Eichhorn, N. Esser, U. Schade, A. Röseler, E.H. Korte, Appl. Spectrosc. 57 (2003) 1250.

DS 24.12 Di 17:00 Poster TU B

Raman identification of the in-plane axes of zincblende (100) surfaces: Basic principles and application to II-VI / III-V heterostructures — •T. Muck[1], J.W. Wagner[2], J. Geurts[2], and V. Wagner[1] — [1]School of Engineering and Science, International University Bremen, Campus Ring 8, D-28759 Bremen, Germany — [2]Physikalisches Institut, EPIII, Universität Würzburg, D-97074 Würzburg, Germany

We use the interference of deformation-potential- and Fröhlich-induced Raman scattering from LO phonons in zincblende materials to identify the in-plane axes of zincblende (100) surfaces and interfaces. This procedure, which allows e.g. to distinguish between the [011]- and the [0-11] direction, is demonstrated experimentally for n- and p-type GaAs(100). The main potential of the method is its application to heterostructures. Here it allows the unambiguous assignment of polarized Raman scattering features from surfaces and interfaces to their characteristic symmetry directions. Two examples are presented: (i) localized vibrations of CdSe monolayers, embedded in BeTe stacks, and (ii) vibration modes of Te dimers on clean (2x1) reconstructed BeTe(100) surfaces.

DS 24.13 Di 17:00 Poster TU B

Characterization of ruthenium dyes for organic solar cells with Raman and SERS micro-spectroscopy — •Carmen Pérez León[1], Lothar Kador[1], Bin Peng[2], and Mukundan Thelakkat[2] — [1]University of Bayreuth, Institute of Physics and Bayreuther Institut für Makromolekülforschung (BIMF), 95440 Bayreuth — [2]University of Bayreuth, Macromolecular Chemistry I, 95440 Bayreuth

Ruthenium(II) complexes containing polypyridyl ligands have been widely studied as potential photosensitizers in organic solar cells. Of particular interest is their use in dye-sensitized solar cells based on nanocrystalline films of TiO$_2$. We have investigated the new dye Ru-TPA$_2$ with amino ligands and the well-known N719 complex with thiocyanate moieties. The influence of the solvent on the adsorption of the complexes on colloidal nanoparticles and their spectroscopic properties have been studied. The electronic transitions of both dyes show solvatochromic shifts due to specific interactions of the ligands with the solvent molecules. The surface-enhanced Raman (SER) spectra of the dyes dissolved in water, ethanol, and acetonitrile were measured in silver and gold colloidal solutions. The results show that the dyes are adsorbed on the metallic nanoparticles in different ways for different solvents. Deprotonation, H-bonding, and donor-acceptor interactions seem to determine these different behaviors. Furthermore, experiments in which the dyes are adsorbed on TiO_2 were also performed, showing characteristics of the binding of the sensitizers to the semiconductor surface.

DS 24.14 Di 17:00 Poster TU B

Ellipsometric investigation of valence band and core level excitation in thin nitride films — •Munise Rakel[1], Christoph Cobet[1], Rüdiger Goldhahn[2], Karsten Fleischer[1], Wolfgang Richter[1], and Norbert Esser[3] — [1]Institute of Solid State Physics, TU Berlin, Hardenbergstr. 36, D-10623 Berlin — [2]Institute of Physics, TU Ilmenau, D-98648 Ilmenau — [3]ISAS Institute for Analytical Sciences Berlin, Albert-Einstein-Str. 9, D-12489 Berlin

The dielectric function of GaN and InN in hexagonal and cubic crystal structure has been measured in a spectral range from 3- 30 eV using ellipsometry at BESSY II. Hexagonal a-plane InN(11-20) and m-plane GaN(1-100) were used to access both the ordinary and the extraordinary part of the dielectric tensor. Especially for GaN, the m-plane is the more preferable surface for quantum well structures because of the absence of any polarization along the growth axis [1]. In addition, we determined the optical properties of cubic crystal nitrides to provide a critical test for the various theoretical models. We observed a strong optical anisotropy in the higher interband transitions and core level excitations of a-plane InN and m-plane GaN in dependence of the sample orientation. Above 15eV the optical spectra of GaN and InN are dominated by transitions between the 3d/4d atomic orbital and the conduction bands. We compared measurements at RT and 12 K using a closed cycle helium cryostate setup. Composition and temperature related energy shifts are reported for InN, GaN and AlGaN.

[1] P.Waltereit, O.Brandt et al.; 1. Selected Brief Reports; Paul-Drude-Institut Berlin

DS 24.15 Di 17:00 Poster TU B

Surface and layer properties of MOVPE-grown InN — •S. J. Simon[1], R. Ehlert[1], M. Drago[1], C. Werner[1], N. Esser[2], P. Vogt[1], and W. Richter[1] — [1]TU Berlin, Institut für Festkörperphysik, TU Berlin, Hardenbergstr. 36, 10623 Berlin — [2]Institute for Analytical Sciences, Department Berlin, Albert-Einstein Str. 9, 12489 Berlin

The formation of indium clusters/droplets and the incorporation of oxygen in InN films during growth is still an open question. Here, we study epitaxial InN layers with thickness between 20 nm and 350 nm MOVPE-grown on sapphire substrates using ammonia and trimethylindium as precursors. Atomic force microscopy images indicate closed layers and x-ray diffraction (XRD) confirms crystalline perfection of the films.

The InN samples are studied in Ultra High Vacuum after surface deoxidation by annealing at approximately 450°C. Surface and layer properties are investigated by soft x-ray photoemission spectroscopy (SXPS), scanning tunneling microscopy (STM) and scanning tunneling spectroscopy (STS). The formation of suspected In cluster or droplets in the films and the incorporation of oxygen is analyzed by SXPS. Variations of the fundamental bandgap energy are determined by STS.

DS 24.16 Di 17:00 Poster TU B

Influence of magnetic field on the growth of vanadyl phthalocyanine thin films on Si(111) substrates — •V. Kolotovska, G. Salvan, O. D. Gordan, C.C. Himcinschi, M. Friedrich, and D.R.T. Zahn — Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz

Research on materials like Vanadyl Phthalocyanine (VOPc) which exhibits large optical nonlinearity and ultra fast response is of great importance for the design of novel devices for optical applications. The device quality depends on molecular orientation, which can be influenced e. g. by a magnetic field during film growth. In this work VOPc films with thickness between 10-100 nm were grown on H-Si(111) substrates by evaporation in high vacuum. The substrates were kept in a homogenous magnetic field (up to 1.3 T) perpendicular to the sample surface. Spectroscopic Ellipsometry and Infrared Spectroscopy were employed for the characterisation of the optical properties and the molecular orientation. The molecules deposited without magnetic field are found to have a small tilt angle with respect to the substrate, while those deposited in magnetic field tend to orient with their C-rings parallel to the field direction, following the proposal in reference [1].

[1] T. Mori et al., Thin Solid Films 366 (2000) 279.

DS 24.17 Di 17:00 Poster TU B

Composition and thermal stability of thin functional oxidic (Pr, La, Y) and metallic (Ru, Ti) layers on Si and SiC substrates — •Andriy Styervoyedov, Ioanna Paloumpa, and Dieter Schmeisser — Angewandte Physik - Sensorik, BTU Cottbus, Konrad-Wachsmann-Allee 17, 03046 Cottbus, Germany

Thin Pr-, La- and Y- based oxide layers for applications as gate dielectric in metal-oxide-semiconductor (MOS) structures are investigated with x-ray photoelectron spectroscopy. The films with a thickness of around 2nm have been prepared on Si and SiC wafers by various chemical deposition methods based on nitrate solutions. In addition, we report on Ti- and Ru- based metal contacts prepared in the same way. The film composition is analysed and annealing steps in vacuum up to 900°C have been applied to test their thermal stability. The interface characteristics, surface composition and thermal stability of MOS functional multilayers have been studied and will be presented.

DS 24.18 Di 17:00 Poster TU B

Spectroscopic ellipsometry study of thin carbon films — •Pavel Tolstykh[1], Sviatoslav Shokhovets[2], and Gerhard Gobsch[2] — [1]BNTU Minsk, Skaryna Prosp. 65, 220027 Minsk, Belarus — [2]Institute of Physics, TU Ilmenau, PF 100565, 98684 Ilmenau, Germany

Spectroscopic ellipsometry studies of thin carbon films deposited on silicon and quartz substrates by sputtering of a graphite target using a Nd-glass pulse laser were carried out. We observed a strong dependence of the dielectric function of the films on deposition regimes such as substrate temperature and laser pulse energy during deposition, as well as annealing temperature and duration. The experimental data were analysed using reference dielectric functions for graphite-like and diamond-like carbon films. The results obtained indicate that structural properties of the films depend on deposition and thermal treatment conditions. In particular, the content of graphite phase increases with increasing substrate temperature and laser pulse energy. Further we compare properties of laser deposited carbon films to plasma deposited ones doped with copper and discuss regimes to grow films suitable for various applications.

DS 24.19 Di 17:00 Poster TU B

Thermisch aufgedampfte, epitaktische Eu:LuSc2O3-Filme auf alpha-Al2O3 — •Lutz Rabisch, Stefan Ehlert, Sebastian Bär und Günter Huber — Institut für Laser-Physik, Luruper Chaussee 149, 22761 Hamburg

Alpha–Al2O3 ist ein bewährtes Material für optische Anwendungen. In Kombination mit Sesquioxiden wie Lu2O3 oder Sc2O3 können kristalline, wellenleitende Schichtsysteme für vielseitige Anwendungen hegestellt werden.

Wir stellen Eu:(Lu/Sc)2O3–Schichten vor, die mit dem Elektonenstrahl–Verdampfungsverfahren auf Alpha–Al2O3 Substraten aufgebracht wurden. Die Substrate sind in (0001)–Richtung orientiert. Dadurch ist Gitteranpassung zu in $< 111 >$–Richtung aufwachsenden Schichten möglich. XRD und Oberflächen–XRD Messungen bestätigen, dass die Schichten epitaktisch aufgewachsen sind. Spektroskopische Untersuchungen zeigen, dass erst bei ultradünnen Schichten ($d < 10nm$) Abweichungen von der Symmetrie von Volumenkristallen auftreten. Im Gegensatz zu EBV–deponierten Y2O3–Schichten sind die (Lu/Sc)2O3–Schichten stabil, was Kristallstruktur und spektroskopische Eigenschaften betrifft.

DS 24.20 Di 17:00 Poster TU B

Reflectance anisotropy spectroscopy extended into the IR and VUV spectral range — •Matthias Wahl[1,2], Karsten Fleischer[1], Sandhya Chandola[1], Norbert Esser[2], and Wolfgang Richter[1] — [1]Technische Universität Berlin, IFP, Sekr. PN 6-1 Hardenbergstr. 36, 10623 Berlin — [2]Institute for Analytical Science, Department Berlin, Albert-Einstein Str. 9, 12489 Berlin

Reflectance anisotropy spectroscopy (RAS) is often used as tool to monitor anisotropic surface structures. With good understanding of these also molecular assemblies on surfaces are more and more analysed with RAS. Usual set-ups only operate in the visible spectral range (1.5 - 6 eV). We present new RAS systems which are extended into the infrared and also into the VUV regime to an effective range of (0.5-9 eV). Possible origins of RAS signatures are discussed, particularly a free electron like response from one dimensional metallic structures in the IR and also signatures arising from molecular adsorbates in the UV range.

DS 24.21 Di 17:00 Poster TU B

Laserablation von $Cu_2Ta_4O_{12}$-Filmen — •Robert Lux[1], Andreas Heinrich[1], Bernd Stritzker[1], Bernd Renner[2], Stefan Ebbinghaus[2] und Armin Reller[2] — [1]Institut für Physik, Experimentalphysik IV, Universität Augsburg, 86135 Augsburg — [2]Lehrstuhl für Festkörperchemie, Universität Augsburg, 86135 Augsburg

Materialien mit einer hohen Dielektrizitätskonstante erlauben Bauelemente mit kleineren Kapazitäten. An diesen besteht speziell im Bereich der mikroelektronischen Geräte ein hohes Interesse. In möglicher Kandidat für eine hohe Dielektrizitätszahl ist $Cu_2Ta_4O_{12}$ (CTaO). Aus diesem Grund wurden dünne Schichten von CTaO -in Koexistenz mit Ta_2O_5- mittels gepulster Laserablation auf Si(100) Substraten abgeschieden. Es zeigte sich, dass sowohl die kristalline Struktur, als auch die Oberflächenmorphologie der CTaO-Filme stark von Substrattemperatur, Sauerstoffdruck und Target-Substrat-Abstand abhängen. Des weiteren wurde festgestellt, dass sich vor dem eigentlichen Wachstum vom CTaO eine Ta_2O_5-Schicht bildet, auf der das CTaO in verschiedenen Orientierungen aufwächst. Wir berichten über Details der Filmdeposition und der Analyse der Filmeigenschaften mittels Rasterelektronenmikroskopie, Transmissionselektronenmikroskopie, Enegiedispersiver Röntgenanalyse und Röntgenbeugung.

DS 24.22 Di 17:00 Poster TU B

Growth and microstructure of polymer- metal composites prepared by pulsed laser deposition — •Johanna Röder, Jörg Faupel, and Hans-Ulrich Krebs — Institut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Polymer-metal composites have a wide range of applications. Heading towards new materials with tailored properties, understanding of growth behaviour is one of the main goals. Using pulsed laser deposition it is possible to prepare such different material classes as polymers and metals in a one-step process. Samples were prepared in an UHV chamber at room temperature using a KrF excimer laser at 248 nm. The matrix for later cluster growth was Polymethylmethacrylate (PMMA) or Polybisphenol-A-carbonate (PC). The polymers were analysed by FTIR and X-ray reflectometry. The embedded metal clusters consist of Ag, Cu or a combination of Ag/Cu or Ag/Nb, and were mainly characterized using TEM. Different scenarios such as the growth of pure Ag or Cu on PC or PMMA, and furthermore the influence of Cu or Nb acting as a seed for later cluster growth will be presented and discussed.

DS 24.23 Di 17:00 Poster TU B

Laser-induced periodic structures in plasma polymer films with embedded metal nanoparticles — •Katrin Löschner[1], Andreas Kiesow[1], Andreas Heilmann[1], Amin Abdolvand[2], and Gerhard Seifert[2] — [1]Fraunhofer-Institut für Werkstoffmechanik, Heideallee 19, 06120 Halle — [2]Fachbereich Physik, Martin-Luther-Universität Halle-Wittenberg, 06099 Halle

A laser-based method to generate grid-likely arranged line structures in thin organic films with embedded gold or silver nanoparticles is introduced. The films with a thickness of about 100 nm were deposited by alternating plasma polymerization of hexamethyldisilazane and metal evaporation to obtain a multilayer structure, i.e., all particles are arranged in one plane within the plasma polymer matrix. Irradiating these samples with linearly polarized, ultrashort (130 fs) laser pulses leads to the formation of periodically arranged, line-like areas with modified particle size and shape distribution. The films were irradiated with different laser wavelengths (800 nm, 400 nm, 528 nm, 266 nm). Transmission and scanning electron microscopy (TEM, SEM) were applied to analyze the microstructural changes. A linear dependency between the structure period and the wavelength used is observed. The direction of the particle lines correlates to the linear polarization of the laser pulses. The anisotropic structure modifications result in dichroitic film properties. The structure changes and the physical mechanism of the periodic formation are discussed.

DS 24.24 Di 17:00 Poster TU B

Abscheidung von ZnO mittels Pulsed Laser Deposition auf Saphir — •Martin Beck — Martin Beck Talstrasse 18 07743 Jena

Die Abscheidung von Zinkoxid mittels Pulsed Laser Deposition von Zink-Target und ZnO-Target auf Saphir (1-102) und Saphir (0001) wird untersucht. Die Abscheideparameter Substrattemperatur und Sauerstoffdruck werden variiert. Die Schichten werden mit Röntgendiffraktometrie, RBS sowie optischer Transmissionsmessung untersucht. Anhand des Cmin -Werts des RBS-Zinksignals und Leitfähigkeitsmessungen soll die Rolle von Zn-Interstitials für die n-Leitung von ZnO abgeschätzt werden.

DS 24.25 Di 17:00 Poster TU B

Mechanism of pulsed laser deposition of PMMA — •Erik Süske[1], Thorsten Scharf[1], Thomas Junkers[2], Michael Buback[2] und Hans-Ulrich Krebs[1] — [1]Institut für Materialphysik, Universität Göttingen, Friedrich Hund-Platz 1, 37077 Göttingen — [2]Institut für Physikalische Chemie, Universität Göttingen, Tammannstraße 6, 37077 Göttingen

Polymer thin films of sub-micrometer thickness of poly (methyl methacrylate) (PMMA), polytetrafluorethylene (PTFE) or polyethylene (PE) are attractive coating materials. Desirable hardness and wear resistance are mostly obtained by cross-linking polymer films. The pulsed laser deposition offers a versatile method to grow thin PMMA films which consist of two components, one fraction with a molecular weight well below that of the target material and a second fraction, which is cross-linked. Both, the molecular mass and the amount of cross-linking are tunable by the deposition parameters as substrat temperature and laser fluence which gives the opportunity to deposit films with excellent properties. In this contribution, the deposition mechanism of PMMA is discussed with respect to characteristics as microstructure, chemical composition and mechanical properties.

DS 24.26 Di 17:00 Poster TU B

Laser-carburizing of austenitic stainless steel — •Michael Kahle[1], Ettore Carpene[2], Salvatore Cusenza[1], and Peter Schaaf[1] — [1]Universität Göttingen, II. Physikalisches Institut, Friedrich-Hund-Platz 1, D-37077 Göttingen, Germany — [2]Dipartimento di Fisica, Politecnico di Milano, Piazza Leonardo da Vinci 32, I-20133 Milano, Italy

Austenitic stainless steel is still an interesting material. Its grand corrosion properties are superimposed by the poor wear properties. Laser plasma treatments in reactive atmospheres have gained a large potential for technical applications, especially for surface coatings. The work pieces can be covered with hard, resistant carbides whose amount and structure is dependent of the processing parameters: Gas-pressure, number of pulses and energy. The structural, mechanical and chemical changes of the carburized surfaces are investigated by means of Rutherford Backscattering Spectrometry (RBS), Conversion Electron / X-Ray Mössbauer Spectroscopy (CEMS/CXMS), Nanoindentation and X-Ray Diffractometry (XRD). The results such as phase formation, carbon incorporation, hardness and stress are presented. A comparison with magnetron-sputtered austenitic stainless steel will be given. The main focus is the supersaturated fcc-structure (expanded austenite).

DS 24.27 Di 17:00 Poster TU B

Herstellung dünner Cu_2O Schichten mittels gepulster Laserablation — •Kerstin Wätje, Andreas Heinrich und Bernd Stritzker — Universität Augsburg, EP IV, Universitätsstr. 4, 86135 Augsburg,

Die Methode der gepulsten Laserdeposition (PLD) erlaubt die Herstellung verschiedenster Materialen in Form dünner Filme. Ein aktuelles Forschungsgebiet stellt dabei die Optoelektronik dar.

Hierbei sind, z.B. für Wellenleiter, dünne Filme aus Cu_2O Gegenstand aktueller Forschung. In dieser Arbeit präsentieren wir die Herstellung von dünnen Cu_2O Filmen mit unterschiedlicher kristallographischer Orientierung auf $SrTiO_3$, Al_2O_3 und MgO Substraten. Mit der Methode der Laserablation ist es gelungen, dünne Cu_2O Filme mit unterschiedlicher kristallographischer Orientierung der Einheitszelle relativ zum Substrat herzustellen. XRD und TEM Analysen bestätigen ein verkipptes Wachstum von Cu_2O und sehr gute epitaktische Eigenschaften. Der Einfluss der Herstellungsparameter auf das Wachstum der Filme wird diskutiert.