DS 15: Poster Session

Time: Tuesday 15:00–17:00 Location: Poster B

DS 15.1 Tue 15:00 Poster B

The dielectric function of coronene studied by spectroscopic ellipsometry — •Daniel Lehmann and Dietrich R.T. Zahn — Chemnitz University of Technology, Semiconductor Physics, D-09107 Chemnitz, Germany

Coronene is a planar molecule and a promising candidate to be used as organic semiconductor due to its similarity to anthracene and pentacene. Especially for a possible use in organic light emitting diodes and organic solar cells the knowledge of the dielectric properties is crucial. We present the dielectric function of coronene thin films in the energy range from 0.73 eV to 5.00 eV. Several films with different thicknesses were grown in high vacuum on oxidized silicon substrates using organic molecular beam deposition and characterized *ex situ* by spectroscopic ellipsometry. The measured data of all samples were coupled to simulate the dielectric function using a mathematical model of summed Gauss functions to describe the optical response of the organic material.

DS 15.2 Tue 15:00 Poster B

Optical Properties of Spiro-linked Organic Thin Films — •Simona Silaghi[1], Till Spehr[2], Christoph Cobet[1], Christoph Werner[1], Josef Salbeck[2], Sven Peters[3], Walter Braun[4], and Norbert Esser[1] — [1]ISAS - Institute for Analytical Sciences, Department Berlin, D-12489 Berlin, Germany — [2]Institut für Chemie, Universität Kassel, D-34132 Kassel, Germany — [3]SENTECH Instruments GmbH, D-12489 Berlin, Germany — [4]BESSY-GmbH, D-12489 Berlin, Germany

Spiro-linked organic materials are very stable candidates [1] for organic optoelectronics and can be employed in charge transport and emitting layers of organic light-emitting diodes [2] as well as solid-state lasers [3]. Particularly, information about the effective refractive index is needed in the case of spiro-linked organic solid-state UV-lasers based on distributed feedback resonators [3]. Therefore, spectroscopic ellipsometry method is employed here in the energy range from 1.4 to 9.5 eV to extract accurate information about the optical properties of such spiro-linked organic thin films of Octo1 (2,2',4,4',7,7'-hexaphenyl-9,9'-spirobifluorene) and Octo2 (2,2',4,4',7,7'-hexakis(biphenyl-4-yl)-9,9'-spirobifluorene) grown on silicon substrates. [1] J. Salbeck, N. Yu, J. Bauer, F. Weissörtel, H. Bestgen, Synth. Met. 91 (1997) 209 [2] D. Gebeyehu, K. Walzer, G. He, M. Pfeiffer, K. Leo, J. Brandt, A. Gerhard, P. Stößel, H. Vestweber, Synth. Met. 148 (2005) 205 [3] T. Spehr, A. Siebert, T. Fuhrmann-Lieker, J. Salbeck, T. Rabe, T. Riedl, H.H. Johannes, W. Kowalsky, J. Wang, T. Weimann, P. Hinze, Appl. Phys. Lett. 87 (2005) 161103

DS 15.3 Tue 15:00 Poster B

IR mapping ellipsometry of ultrathin organic films on metallic and semiconducting substrates — •Dana Maria Rosu[1], Michael Gensch[3], Karen Kavanagh[4], Wenjie Li[4], Julia Hsu[5], Norbert Esser[1], Ullrich Schade[2], and Karsten Hinrichs[1] — [1]ISAS - Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Str. 9, 12589 Berlin, Germany — [2]Berliner Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung mbH, Albert-Einstein-Str. 15, 12589 Berlin, Germany — [3]DESY - Deutsches Elektronen-Synchrotron, Notkestr. 85, 22607 Hamburg, Germany — [4]Kavanagh Lab, Dept. of Physics, Simon Fraser University, 8888 University Dr., Burnaby, BC, V5A 1S6, Canada — [5]Sandia National Laboratories, Albuquerque, New Mexico 87185- 1120

An infrared spectroscopic ellipsometer is used for analysis of organic films on metals or semiconducting substrates. Monolayer sensitivity is achieved and lateral resolution was improved by utilizing the synchrotron mapping ellipsometer at BESSY II. IR synchrotron ellipsometry enables investigation of sample areas from 0.0625 mm^2 to 1 mm^2. The organic compound is identified by specific vibrational bands. Evaluation of measured spectra with optical models gives information about coverage and molecular orientation.

DS 15.4 Tue 15:00 Poster B

Light induced oxidative switching of anthracene monolayers — •Burkhard Stiller[1], Werner Fudiker[2], Fred Albrecht[1], Stephan Katholy[1], Torsten Linker[2], and Dieter Neher[1] — [1]Universität Potsdam, Institut für Physik, Potsdam, Deutschland — [2]Universität Potsdam, Institut für Chemie, Potsdam, Deutschland

We present studies on the reversible photooxygenation of anthracene monolayers. Dioxygen can reversibly be added to anthracene derivatives by the photoinduced self-sensitised formation of singlet oxygen affording the corresponding anthracene endoperoxides. A quantitative reconversion to the parent anthracene is achieved either by heating or irradiation with UV-light. Calculations suggest significant changes of the molecular geometry and the dipole moments of the used anthracene derivatives upon oxidation. This reversible light induced change of the molecular dipole moment was monitored on-line by Kelvin probe technique and ellipsometry on anthracene monolayers. We have further employed this approach to establish a new method for eversible light and air driven lithography.

DS 15.5 Tue 15:00 Poster B

Low temperature reflection anisotropy spectroscopy investigation of vanadyl phthalocyanine — •Michael Fronk, Björn Bräuer, Dietrich Zahn, and Georgeta Salvan — Chemnitz University of Technology, D-09107 Chemnitz, Germany

Magneto optical Kerr effect (MOKE) spectroscopy is often used to characterise metallic films but there are hardly any reports about investigations on organic layers. It would thus be interesting to prove whether MOKE spectroscopy is a suitable technique to detect magnetic phase transitions in organic materials. Here thin films of a paramagnetic metal phthalocyanine molecule, namely vanadyl phthalocyanine, are investigated. The films are grown on Si(111) by vacuum evaporation. The MOKE spectra are recorded in the spectral range from 1.5 eV to 5.5 eV with a home-made set-up that analyses the change in the polarisation state of the reflected light upon applying an external magnetic field perpendicular to the sample surface. In addition to MOKE, the optical anisotropy of the film can lead to a noticeable change in the polarisation state of the reflected light. The effect of the optical anisotropy, however, is independent of the applied magnetic field and in a first approach the two effects sum up. As a first step in this work the optical anisotropy of the films is investigated in the temperature range from 300 K to 7.5 K. With decreasing temperature all spectral features show slight changes in their relative intensity. The most pronounced changes are observed in the sub-structure of the Q band related feature when cooling down from 300 K to 100 K.

DS 15.6 Tue 15:00 Poster B

XPS and ARPES studies of azobenzene derivatives on HfS_2 — •Jaroslaw Iwicki, Susanne Kobelt, Christian Hamann, Kai Rossnagel, and Lutz Kipp — Institut für Experimentelle und Angewandte Physik, Universität Kiel, D-24098 Kiel, Germany

The light induced isomerization of switchable molecules is of potential importance for several applications, e.g., molecular electronics. In this study derivatives of azobenzene (phenylazobenzoic acid, disperse orange 3) were evaporated onto the layered material HfS_2 under UHV conditions. As a consequence of the weak bonding to the inert surface of HfS_2 the molecules do not deform and should retain their switchability. XPS and ARPES measurements were carried out at the BW3 beamline at HASYLAB with a Specs Phoibos 150 analyzer. XPS measurements confirm the adsorption of the azobenzene derivatives on the substrate and XANES and EXAFS reveal the adsorption geometry. ARPES, XANES and EXAFS data will be presented and discussed. This work is supported by the DFG Forschergruppe 353.

DS 15.7 Tue 15:00 Poster B

Preparation of organic thin films from solution on metal templates — •Stephan Wenzel, Norman Schmidt, George Tzvetkov, and Rainer Fink — Physikal. Chemie 2, Universität Erlangen, Egerlandstr.3,91058 Erlangen

The preparation of well ordered organic nanostructures is an interesting topic with respect to potential applications in photonic crystals. We have started with a comprehensive study to investigate the formation of well-ordered and well-oriented organic nanostructures using metallic microstructures on inert surfaces when the organic substance is deposited from solution. Emphasis is lying on the effect of reduced template sizes on the growth of particular crystallites upon slow evaporation of the solvent. We employed various molecular substances which are attractive for optical investigations. The formation of crystallites

is characterized in-situ by light microscopy and ex-situ by UV photoelectron emission microscopy (PEEM) and scanning transmission x-ray microspectroscopy (STXM). The latter is used to investigate the orientation of the microcrystallites from the linear NEXAFS dicroism which is accessible at the recently installed PolLux beamline at the Swiss Light Source. The project is funded by the BMBF under contract 05/KS4WE1/6.

DS 15.8 Tue 15:00 Poster B

Optical Investigation of Thin Photochromic Spiropyran Films — •Martin Schübbe, Michael Karcher, Celine Elsässer, Christoph Rüdt, and Paul Fumagalli — Freie Universität, Berlin, Deutschland

Photochromic molecules, such as spiropyrans, can be reversibly switched between two different states, a so-called spiropyran and a merocyanine state, using ultraviolet and visible light. Hence, they can be read and addressed by a light source and thus be used for optical devices. Although this switching behavior is established for a series of photochromic molecules in an isotropic environment like, e.g., solutions [1,2], little is known about thin organic films on surfaces.

Here, thin films of spiropyran derivatives with a thickness between 10 and 40 nm have been prepared using thermal evaporation in UHV on quartz, MgO(100), Si(100), Si(111) and Au-coated Si as substrates. The photochromism of the molecules has been studied using optical absorption spectroscopy in the UV-VIS range. The films on quartz and MgO substrates were measured in transmission, the films on Si and Au-coated Si substrates in reflection. Absorption spectra indicate 80 % reversible switching between the spiropyran and the merocyanine state induced by light irradiation. In addition, a setup for time-dependent absorption spectroscopy on a time scale of seconds is presented together with first experimental results.

[1] Berkovic et al., Chem. Rev., **100**, 1741-1753 (2000)
[2] Görner, PCCP, **3**, 416-423 (2001)

DS 15.9 Tue 15:00 Poster B

Electrospray Ionization Mass Spectrometry and Vacuum Deposition — Nicha Thontasen, •Stephan Rauschenbach, Yeliang Wang, Giovanni Costantini, Nicola Malinowski, and Klaus Kern — Max-Planck-Institut for Solid State Research, Nanoscale Science Department, Heisenbergstr. 1, 70569 Stuttgart

Scanning Tunneling microscopy offers an atomic scale view of functional molecules and nanostructures at surfaces. In case of large biological molecules or inorganic nanoparticles, their controlled deposition on well defined surfaces under ultra-high vacuum conditions is hindered by their low vapor pressure.

To overcome this limitation electrospray ionization, a soft ionization technique, is used to create an ion beam for soft vacuum deposition. The developed apparatus employs RF- and electrostatic ion optics to control the beam's properties such as energy, focusing and temperature. The ion beam, generated at ambient pressure, is guided through several pumping stages into high or ultrahigh vacuum.

Using time-of-flight mass spectrometry the composition of the beam can be characterized before deposition. The deposition of clusters, large molecules and proteins was demonstrated for high vacuum conditions. Current studies are focusing on the destruction free deposition of molecules and clusters, so called soft landing.

S. Rauschenbach, F. Stadler, E. Lunedei, N. Malinowski, S. Koltsov, G. Costantini, K. Kern, *Electrospray Ion Beam Depostion of Clusters and Biomolecules*, Small **4** (2006)

DS 15.10 Tue 15:00 Poster B

Layer-by-layer growth of Metal-Organic Open Frameworks on a Functionalized Organic Surface — •Osama Shekhah, Hui Wang, Thomas Strunskus, and Christof Woell — Ruhr University Bochum, Lehrstuh fur Physikalshe Chemie 1, Universitatsstr 150, 44780 Bochum

Using a novel layer-by-layer approach, Metal-Organic Open Frameworks (MOFs) based on benzenetricarboxylic acid (BTC) ligand and Zn(II)-ions were deposited on a COOH-terminated organic surface. The deposited layers were characterized using XPS, IRS, NEXAFS and AFM. AFM data showed the selective deposition of a BTC layer with a height of about 1.6 nm. XPS and IRS data showed the same increase in thickness per layer up to 8 layers. Considering AFM data and the fact that NEXAFS data reveal an orientation of the BTC-units which is mainly perpendicular to the surface, allowed to put a model, yielding a structure of almost vertical layers of the authentic Zn(II)-BTC MOFs which are interconnected as in the bulk structure by water molecules. Attempts to obtain a powder XRD pattern for MOFs with a thickness of up to 8 layers were unsuccessful, as expected for organic adlayers of small thickness. We could, however, successfully demonstrate the gas-loading properties of a 8-layer MOF by an exchange experiment where the water in the BTC-layer is repeatedly and reversibly exchanged by Ammonia. This layer-by-layer deposition of MOFs on organic surfaces opens up the possibility to synthesize completely new types of MOFs with compositions and structures not accessible by bulk synthesis routes.

DS 15.11 Tue 15:00 Poster B

Creation of microstructured poly(glycidyl-methacrylate) surfaces — •Viatcheslav Gruzdev, Anton Kiriy, and Manfred Stamm — Leibniz Institute of Polymer Research Dresden, Hohe Str. 6, D-10069 Dresden, Germany

Here we describe a novel method for fabricating of microstructured polymer brushes based on grafting of monocarboxylated end-functional polymers to the microstructured poly(glycidyl-methacrylate) (PGMA) anchor layer. To achieve desirable morphology of PGMA layer two methods were applied. In the first method solutions of PGMA in different solvents spin-coated onto Si-wafer form porous, chainlike or patched PGMA surfaces. Type and size of PGMA structures depends on used solvent, modification of a substrate, concentration of PGMA and used add-ons. Addition of 1-0.5 % (mass.) of 1,4-butandiol to solutions of PGMA greatly increases reproducibility of the method and gives possibility to obtain PGMA structures from different solvents. Second method is based on the phase separation of PGMA/PS blend in thin film. Upon spincoating, blend forms regions of PS and PGMA on the surface. Chemical or termical fixation of PGMA structures on the surface followed by extraction of PS gives structured PGMA surface. Lateral dimensions of PGMA structures in both methods were in the range of 100-500 nm. Microstructured polystyrene brush and bicomponent PS/P2VP brush have been prepared. Combination of scanning probe microscopy, ellipsometry and contact angle measurements was used to study surface properties and morphology.

DS 15.12 Tue 15:00 Poster B

Sensing investigations of tungsten oxide nano-particle thin films using Impedance Spectroscopy — •Tim Hülser[1,2], Hartmut Wiggers[2], Sonja Hartner[1], and Axel Lorke[1] — [1]Department of Physics, University of Duisburg-Essen, 47057 Duisburg, Germany — [2]Institute of combustion and gas dynamics, University of Duisburg-Essen, 47057 Duisburg, Germany

Tungsten oxide nanoparticles particles are synthesized in a low pressure premixed $H_2/O_2/Ar$ flame reactor using WF_6 as precursor material. The parameters can be adjusted to synthesize WO_x particles with $2.6 < x < 3$. Thin films of particles in the size range from 5 nm to 9 nm deposited on interdigital structures are investigated. Impedance spectroscopy on the as-prepared WO_x thin films have been performed under synthetic air and synthetic air with 1000 ppm NO or CO in the range from 553 K to 583 K. The overall impedance data reveal sensitivities of $S = 3.8$ for CO at 553 K and a maximum of sensitivity $S = 5$ for NO at 573 K. Fits of the overall impedance data using equivalent circuit reveal two contributions to the overall impedance which are assigned to grain-boundary contacts on the surface of each particle and a semi-conducting core conductivity. Furthermore, we have been able to calculate the sensitivity for both processes separately. From this investigation we show that the sensitivity of the grain boundary contribution in presence of CO exhibits values up to $S = 12$, much higher than the core sensitivity with $S = 2.6$ at 553 K. A similar behaviour is observed under the presence of NO.

DS 15.13 Tue 15:00 Poster B

Adsorption of CdTe nanoparticles on Poly(acrylic acid) brushes — •Smrati Gupta[1], Petra Uhlmann[1], Nikolai Gaponik[2], and Manfred Stamm[1] — [1]Leibniz-Institut für Polymerforschung Dresden, 01069 Dresden, Germany — [2]Technische Universität Dresden, Institut für Physikalische Chemie und Elektrochemie, 01062 Dresden, Germany

We report on the adsorption of amino functionalized CdTe nanoparticles on Poly(acrylic-acid) (PAA) polymer chains, tethered by one end to an underlying substrate in a polymer brush configuration. PAA brushes were prepared on silica substrate via *grafting to* method and 2-aminoethanethiol stabilized CdTe nanoparticles (2-4 nm) were prepared using the reaction between Cd^{2+} and NaHTe under specific reaction conditions. Functionalized particles were found to get adsorbed on the brushes by the physical interaction between carboxylic

groups of PAA polymer chains and amino groups of CdTe nanoparticles. Presence of CdTe nanoparticles on the polymer brushes was confirmed by the Atomic Force Microscopy (AFM), X-ray photoelectron spectroscopy (XPS) and Photoluminescence (PL) spectroscopy. Switching of the modified PAA brushes by changing the pH of surrounding media, explore the use of this system in the fabrication of the sensors.

DS 15.14 Tue 15:00 Poster B

The Growth of Carbon Nanotubes on Prestructured Substrates by Chemical Vapour Deposition — •Thomas Reichel, Mathias Steglich, and Bernd Schröter — Friedrich-Schiller-Universität Jena, Institut für Festkörperphysik, Max-Wien-Platz 1, 07743 Jena, Deutschland

Today, carbon nanotubes (CNT) with various parameters like diameter and length, with single or multi walls can be produced using arc discharge, chemical vapour deposition (CVD) and laser ablation methods. A controlled growth of carbon nanotubes with particular properties like chirality at predefined positions is a prerequisite to utilize CNTs in electronic or nanooptical devices. CVD is the favoured fabrication technique to grow CNTs directly on substrates with prestructured catalysts.

Our CVD system allows to grow nanotubes in a large temperature range up to 2000 K with different process gases and gas mixtures. The Fe or Ni catalyst is vacuum evaporated as a thin layer onto the silicon oxide substrate. The nanotubes are characterized by scanning electron microscopy, photoelectron and raman spectroscopy.

DS 15.15 Tue 15:00 Poster B

Magnetoelectrolysis of Co nanowire arrays grown in a track-etched polycarbonate membrane — Jaime Sánchez-Barriga[1,3], Manuel Lucas[2], •Florin Radu[3], Guillermo Rivero[1], Pilar Marin[1], and Antonio Hernando[1] — [1]Instituto de Magnetismo Aplicado (UCM-RENFE-CSIC), P.O. Box 155, 28230, Las Rozas, Madrid, Spain — [2]Technische Universität Berlin, Institut für Theoretische Physik, Hardenbergstr. 36, D-10623, Berlin, Germany — [3]BESSY GmbH, Albert-Einstein Strasse 15, D-12489, Berlin, Germnay

Arrays of Cobalt nanowires with a controlled length of 6 μm have been fabricated by electrochemical deposition into the pores of track-etched polycarbonate membranes with a nominal pore diameter of 30 nm. The magnetic properties of Co-deposited nanowires and the effects of a magnetic field applied during electrodeposition of the arrays have been studied. An enhancement of the mass deposition rate due to the presence of a 50 Oe magnetic field along the nanowire axis has been observed by measuring the experimental development of the current in the electrochemical cell during the fabrication process. X-Ray diffraction measurements reveal a different polycrystalline degree for each deposition configuration, indicating that the crystalline structure of the deposited material has been substantially modified. Magnetic measurements show a clear dependence of the anisotropy directions on the orientation of the magnetic field applied during the electrodeposition.

DS 15.16 Tue 15:00 Poster B

Surface plasmonic properties in swift heavy ion (SHI) treated Au, Ag, and Cu based polymer-metal nanocomposite films — •Venkata Sai Kiran Chakravadhanula[1], Christian Hanisch[1], Henry Greve[1], Dietmar Fink[2], Vladimir Zaporojtchenko[1], and Franz Faupel[1] — [1]Chair for Multicomponent Materials, Technical Faculty of CAU Kiel, Kaiserstrasse2, 24143 Kiel, Germany — [2]Hahn-Meitner-Institut, Department SF4, P.O.Box 39 01 28, Glienicker Str. 100, D-14109 Berlin, Germany

Surface plasmonic properties of polymer-metal nanocomposites has gained interest in the field of nanocomposites for optical applications. In the present work, various Au, Ag, and Cu based polymer-metal nanocomposites were prepared by employing a vapor phase co-sputtering technique. Irradiation was performed of these nanocomposites by 350 MeV Au ions with fluences of 1×10^{11}, 5×10^{10}, 2.5×10^{10} and 1.25×10^{10} at the HMI, Berlin. The characterizations of the optically functional nanocomposite materials were carried out by transmission electron microscopy, energy dispersive X-ray analysis, and UV-visible spectroscopy. The UV extinction spectra of the pristine samples show a sharp absorption maximum at the surface plasmon resonant wavelength according to their geometry and material properties. Depending on the variation in the SHI fluences, changes were observed in the microstructure and the optical spectra. These will be discussed in terms of ion material interactions.

DS 15.17 Tue 15:00 Poster B

Structural properties of cobalt implanted TiO_2 rutile films — •Numan Akdogan[1], Alexei Nefedov[1], Werner Becker[2], Rustam Khaibullin[3], Lenar Tagirov[3,4], and Hartmut Zabel[1] — [1]Institut für Experimentalphysik IV, Ruhr-Universität Bochum — [2]Institut für Physik mit Ionenstrahlen, Ruhr-Universität Bochum — [3]Kazan Physical-Technical Institute of RAS — [4]Kazan State University

Recently we have reported room temperature ferromagnetism (FM) and in-plane magnetic anisotropy of single-crystalline rutile structures after high dose Co implantation [1]. From the observation of in-plane magnetic anisotropy we concluded that FM in this system results from incorporation of Co ions in the TiO_2 lattice, but co-existence with Co nanoclusters could not be excluded. To clarify this situation we studied the structural properties of Co-doped (100)-oriented rutile TiO_2 single crystals for different implantation doses. Co ions implanted into rutile TiO_2 substrates with energy of 40 keV and implantation dose in the range of $0.25\text{-}1.50 \cdot 10^{17}$ ions/cm^2. The structural characterization was carried out using synchrotron radiation at the HASYLAB. The specular and off-specular reflectivity measurements probe the implanted Co density profile. In addition, with RBS the depth profile was determined and used for fitting the x-ray reflectivity data. This way a consistent and very good agreement of the fit to the x-ray reflectivity data could be achieved. - Partial support by SFB 491, by RFBR (grant 04-02-97505), and by TUBITAK (project 104T176) is acknowledged. N. Akdogan acknowledges a fellowship through IMPRS-SurMat. [1] N. Akdogan et al., J. Phys.: Condens. Matter. 17, L359 (2005)

DS 15.18 Tue 15:00 Poster B

A transmission electron microscopy study of TiO_2 thin films epitaxially grown on $SrTiO_3$ and yttria-stabilized zirconia substrates — •Andriy Lotnyk, Stephan Senz, and Dietrich Hesse — Max Planck Institute of Microstructure Physics

Anatase and mixed (brookite and anatase) TiO_2 thin films deposited on $SrTiO_3$ (STO) and yttria-stabilized zirconia (YSZ) substrates, respectively, by reactive electron beam evaporation were investigated using high-resolution transmission electron microscopy (HRTEM) and electron diffraction analysis (ED). HRTEM and ED insvestigations showed that epitaxial anatase thin films were grown on the (100)- and (110)-oriented STO substrates. The anatase thin films consist of grains with low angle grain boundaries showing a rather perfect microstructure of the films. Defects, such as misfit dislocations were found near the anatase/STO interface. The anatase films were transformed into a cubic structure similar to TiO when extensively exposed to the 400 keV electron beam. The crystallographic reason for the epitaxy between anatase films and a perovskite substrate is given. On the other hand, HRTEM insvestigations showed that a film deposited on (100)-oriented YSZ substrates at a substrate temperature of $600°C$ consist of mixed epitaxial anatase and brookite grains. (112) anatase twins were found in the film.

DS 15.19 Tue 15:00 Poster B

Time dependent desciption of thermal effects during transmission of electrons through thin solids — •Werner Koch[1], Frank Grossmann[1], Axel Rother[2], and Rüdiger Schmidt[1] — [1]Institut für Theoretische Physik, Technische Univeristät Dresden, 01062 Dresden — [2]Institut für Strukturphysik, Technische Univeristät Dresden, 01062 Dresden

As it has been shown by Schmidt[1], the coherence length of projectile electrons propagating in Transmission Electron Microscopes (TEM) is of the same order of magnitude as the target thickness. Therefore the modelling of the processes involved in high resolution microscopy by means of a plane wave approach seems too crude an approximation. The purpose of this project is to develop a method to describe this process by propagating localized electron wave packets. A comparison of the incorporation of thermal effects is given between a full ensemble average of independent simulations in frozen lattice approximation and the modelling via the Debye-Waller factor.

[1]: Schmidt, H. 1985: Fakultaet der Physik, der Eberhard-Karls-Universitaet zu Tuebingen, Diss.

DS 15.20 Tue 15:00 Poster B

Relaxation effects in NiMnSb-Half-Heusler thin films — •Andreas Stahl, Christian Kumpf, and Eberhard Umbach — Universität Würzburg, Experimentelle Physik II

Due to its unusual half-metallic properties the Half-Heusler alloy NiMnSb is an important material which may be utilized for the fabrication of spintronic devices. It can be grown in high crystalline quality on InGaAs/InP substrates, however, as for all heteroepitaxial systems mechanical stress is an important factor which influences crystalline quality, film growth, and magnetic properties. One example is a magnetic anisotropy which depends on the thickness of the Half-Heusler layer [1].

It turned out that the properties of the NiMnSb layers are strongly influenced by air. Therefore we present results from two series of samples, one with, the other without an amorphous Au/Ti cap layer. Reciprocal space mapping and x-ray reflectivity measurements were performed at the six-circle-diffractometer at BW2, HASYLAB, Hamburg. Structural properties like the critical thickness for pseudomorphic growth, relaxation, interface roughnesses, and the influence of the capping on these parameters are discussed.

[1] A. Koveshnikov et al.: J. Appl. Phys. **97**, 073906 (2005).

DS 15.21 Tue 15:00 Poster B

Roughness of laser deposited metal / metal oxide layered structures — •Tobias Liese, Andreas Meschede, Johanna Röder, and Hans-Ulrich Krebs — Institut für Materialphysik, University of Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

The roughness of laser deposited Ti/MgO and Ag/ZrO_2 layered thin films were investigated by atomic force microscopy (AFM) and X-ray reflectivity (XRR), which are sensitive on the surface and interface roughness, respectively. When depositing the metals, nucleation and island growth occur which first roughen the surfaces with increasing layer thickness. Then, coalescence and island zipping processes reduce the roughness again. Minimal roughness is reached, when the metal layers are just closed. In both systems, the deposition of the metal oxide leads to layer smoothing. The underlying growth processes for single and double layers as well as the reduction of roughness in multilayers are discussed.

DS 15.22 Tue 15:00 Poster B

In-situ surface sensitive X-ray investigations of quench condensed thin metal films — •Christian Markert, Dirk Lützenkirchen-Hecht, Sascha Gertz, and Ronald Frahm — Bergische Universität Wuppertal, Fachbereich C / Abteilung Physik, Gaußstraße 20, 42119 Wuppertal

We report of ultrahigh vacuum (UHV) experiments on ultra thin Au, Bi and Pb films (thickness less than 10 nm) deposited on atomically flat float-glass substrates which are held at cryogenic temperatures down to 10 K. For deposition temperatures below 100 K the formation of highly disordered or even amorphous metal films can be expected, because thermally activated diffusion of the ad atoms should be inhibited. An UHV chamber was constructed which is suited for grazing incidence X-ray experiments during the quench condensation of the metal films. Various X-ray methods were used for the in-situ investigation of the films growth and their structural evolution with the thickness and an subsequent annealing process. EXAFS (Extended X-ray Absorption Fine Structure) in reflection is used to study the local structure of the films. Furthermore specular and non-specular X-ray reflectivity measurements were performed to get information about the films density and surface roughness parameters (correlation length, hurst parameter etc.). In addition in situ resistivity measurements which are sensitive towards changes of the films microstructure were performed in parallel to the X-ray experiments.

DS 15.23 Tue 15:00 Poster B

Retardation correction for PEM based multi-channel reflectance difference spectroscopy — •Chunguang Hu[1,2], Lidong Sun[1], Michael Hohage[1], J. Flores-Camacho[1], Peter Zeppenfeld[1], and Xiaotang Hu[2] — [1]Institute of experimental physics, Johannes Kepler University Linz, Linz, Austria — [2]Key lab of precision measurement technology and instrument, Tianjin University, Tianjin, China

Reflectance difference spectroscopy (RDS) is a highly surface sensitive optical probe, providing information on the surface structure, morphology, and electronic properties. To realize the fast spectroscopy measurement, several photoelastic modulator (PEM) based multi-channel RDS systems have been developed [1, 2]. A general problem that arises in this type of RDS setup is the wavelength dependence of the PEM. Different from the more conventional setup, for a multi-channel RDS, PEM voltage must be held fixed while all the channels are detected simultaneously. As a result, the retardation of PEM is unequal for different wavelengths and the optimized condition is only fulfilled for a single wavelength. Consequently, a retardation correction is necessary for other wavelengths. Here, we introduce two generalized methods for the retardation correction in which the wavelength dependence of birefringence coefficient has also been taken into consideration. The result is compared with that reported in [1, 2].

[1] C. Kaspari et al, Phys. Stat. Sol. (b) 242, 2561 (2005).
[2] P. Harrison et al, Meas. Sci. Technol. 12, 2185 (2001).

DS 15.24 Tue 15:00 Poster B

Structural Properties of CoFeB/MgO Magnetic Tunnel Junction Multilayers — •Miriana Vadala, Alexei Nefedov, Gregor Nowak, Arndt Remhof, Kurt Westerholt, and Hartmut Zabel — Experimentalphysik/Festkörperphysik, Ruhr-Universität Bochum, Germany

The focus of the spintronics community is presently on CoFeB/MgO based Magnetic Tunnel Junctions (MTJs). Tunnel Magneto Resistance values above 200 % at room temperature with a crystalline MgO barrier have already been reported. Depending on the boron content, annealing at low temperatures, typically in the range from 270°C to 360°C, leads to a re- crystallisation of CoFeB. We present results from the characterization of different series of CoFeB/MgO multilayers grown on a Si/SiO_2 substrate, synthesized by ion beam deposition. Key parameters for MTJs are the single-layer thickness, the growth process of the oxide barriers, and the annealing temperatures. They rule the degree of re-crystallization of the CoFeB/MgO together with the interface roughness. Three different growth procedures for the MgO spacer layers have been tested. Polarized neutron reflectivity data confirm that reactive deposition provides the proper stoichiometry for MgO. From X-ray specular and transverse diffuse reflectivities we obtain the structural parameters, namely the layer thickness and the interface roughness. Although the layer thickness does not vary with the annealing procedures, the roughness slightly changes before and after annealing. Financial support provided through the EU-RTN *ULTRASMOOTH*, support by SFB 491 and by BMBF 03ZA6BC1 is acknowledged.

DS 15.25 Tue 15:00 Poster B

Speciation of carbonitride nanolayers — Olaf Baake[1], Peter Hoffmann[1], Andreas Klein[1], Wolfgang Ensinger[1], •Beatrix Pollakowski[2], Burkhard Beckhoff[2], Jan Weser[2], Gerhard Ulm[2], Nadeshda Fainer[3], Marina Kosinova[3], and Valentina Trunova[3] — [1]TU Darmstadt, Materials Science, Petersenstr. 23, 64287 Darmstadt, Germany — [2]Physikalisch-Technische Bundesanstalt, Abbestr. 2-12, 10587 Berlin, Germany — [3]Nikolaev Institute of Inorganic Chemistry SB RAS, 630090 Novosibirsk, Russia

The aim of this work is the determination of the chemical bonds character of novel and technologically relevant layered systems of boron and silicium carbonitrides. Carbonitrides are mainly produced by plasma-enhanced chemical vapor deposition processes with various kind of precursor materials. Having yet not fully understood the behavior of these materials there are still important questions like whether the produced carbonitrides are new materials with well-defined bonds or simply mixtures of carbide and nitrides.

For their speciation, methods like total reflection X-ray fluorescence combined with near edge X-ray absorption fine structure (TXRF-NEXAFS) and X-ray photoelectron spectroscopy (XPS) were employed. Both techniques can substantially contribute to the clarification of the chemical bond structure of the given carbonitride samples.

DS 15.26 Tue 15:00 Poster B

Rauigkeitsanalyse von Cäsiumoberflächen über die Auswertung der Autokorrelationslänge — •Armin Fubel[1], Martin Zech[1], Paul Leiderer[1], Jürgen Klier[1] und Valeri Shikin[2] — [1]Universität Konstanz, Fachbereich Physik, D-78457 Konstanz — [2]ISSP, 142432 Chernogolovka, Moskau, Russland

Cäsiumoberflächen, die bei tiefen Temperaturen durch abschreckende Kondensation erzeugt wurden, werden auf Nanometerskala mittels Rastertunnelmikroskopie untersucht. Es wird die Analyse der Oberflächenrauigkeit mit Hilfe der Auswertung der Autokorrelationsfunktion von den Cs-Oberflächen vorgestellt. Um die richtige Autokorrelationsfunktion zu extrahieren, zeigen wir die Bedingung für die laterale Auflösung von Rastersondenmikroskopie (RSM) im Allgemeinen. Dies wird durch ein 'numerisches Experiment' belegt. Darüber hinaus stellen wir einige Methoden vor, wie man höhere Ordnungen der Autokorrelationslänge ableitet, welche benötigt werden, um RSM Bilder mit nichtzufälliger Verteilung der Rauigkeitsamplituden auszuwerten.

Diese charakteristischen Größen der Autokorrelationsfunktion sollten die Schlüsselrolle in weiteren statistischen Berechnungen spielen, z.B. bei der Fragestellung, wie die Oberflächenrauigkeit das Benetzungsverhalten von flüssigem Helium, das auf der Cäsiumoberfläche adsorbiert ist, verändert.

DS 15.27 Tue 15:00 Poster B

Comparative study of PLD and sputtered $Pr_{0,68}Ca_{0,32}MnO_3$ films: Resistance switching effect at room temperature — •Julia Fladerer, Peter Moschkau, Sebastian Schramm, Christian Jooss, and Jörg Hoffmann — Institut für Materialphysik, Universität Göttingen

PCMO thin films were grown on $SrTiO_3$ substrates with an average thickness of 330 nm via ion-beam sputtering and pulsed laser deposition (PLD). A temperature series was carried out to be able to control polycrystalline and epitaxial growth. It was found, that initial resistivity and film strain could also be controlled this way. Both types of films were analysed in via SEM, AFM and x-ray and a systematic comparison of the lattice parameters, twinning and resistivity was performed. The remanent resistance change after applying positive and negative voltage pulses was analyzed at room temperature. In order to study the impact of different preparation techniques on the colossal electro- and magnetoresistance, temperature dependent resistance measurements at different current and magnetic fields are presented for selected samples.

DS 15.28 Tue 15:00 Poster B

Herstellung mittels PLD und Charakterisierung der kristallographischen Eigenschaften von $ZnO/YBa_2Cu_3O_{7-x}$-Schichtsystemen — •Robert Pietzcker, Veit Grosse, Gabriel Zieger, Frank Schmidl und Paul Seidel — Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Helmholtzweg 5, D-07743 Jena

Zinkoxid (ZnO) ist ein vielseitig einsetzbarer Halbleiter mit großer Bandlücke, dessen Leitfähigkeit durch Veränderung der Sauerstoffkonzentration um mehrere Größenordnungen variiert werden kann.

Im Rahmen der Untersuchung verschiedener Isolatoren für Hochtemperatur-Supraleiter-Dünnschichtsysteme wurden 200-1000 nm dicke ZnO-Schichten mittels PLD epitaktisch auf $YBa_2Cu_3O_{7-x}$ (YBCO)-Schichten auf $SrTiO_3$ (STO)-Substraten abgeschieden. Der Schichtherstellungsprozess wurde durch Variation des Sauerstoffdrucks (1 - 10 Pa) und der Substrattemperatur (200 - 550°C) auf Kristallinität und Oberflächenmorphologie optimiert.

Oberflächenanalysen mittels SEM und AFM ergaben glatte Schichten mit Rauhigkeiten um 8 nm. Mittels Röntendiffraktometrie wurde die Kristallinität der Schichtsysteme analysiert und Halbwertsbreiten der Rockingkurven von ZnO zwischen 1° und 6° ermittelt. Darüber hinaus wurde die Sauerstoffverarmung der YBCO-Schichten bei verschiedenen Abscheideparametern untersucht.

DS 15.29 Tue 15:00 Poster B

Characterisation of praseodymium-oxide films on Si(111) including SPALEED, XRD and GIXRD measurements — •Sebastian Gevers[1], Thomas Weisemoeller[1], Thomas Schroeder[2], Peter Zaumseil[2], Lars Boewer[1], Carsten Deiter[1], and Joachim Wollschlaeger[1] — [1]Fachbereich Physik, Universität Osnabrück, Barbarastrasse 7, 49076 Osnabrück, Germany — [2]IHP Microelectronics, Im Technologiepark 25, 15236 Frankfurt (Oder), Germany

Materials with high dielectric constants k offer great potentialities to improve performance of semiconductor devices. In this context the investigation of praseodymium-oxide films leads to a deeper understanding of fundamental aspects of heteroepitaxial growth of oxide films on Si(111). Object of this research are Si(111) samples on which Pr_2O_3 films of thickness $d \leq 10$ nm have been deposited. The oxide films were produced using MBE, so that the Pr_2O_3 films have hexagonal structure. Afterwards they were annealed in N_2 to form Pr_2O_3 films of cubic structure. Several investigation methods like SPALEED and AES as well as (GI)XRD were used. (GI)XRD investigations were performed at beamlines BW2 and W1 at HASYLAB(DESY). Throughout these experiments a complete transformation of the crystallographic phase from hexagonal-Pr_2O_3 to cubic-Pr_2O_3 (B oriented) could be observed. This can be attributed to the annealing process. The thickness of the crystalline part of the oxide film annealed at higher temperatures decreases. Therefore silicate is formed at the interface. SPALEED investigation shows a 4×4 reconstruction at the cubic phase.

DS 15.30 Tue 15:00 Poster B

Infrared in-situ analysis of solid-liquid interfaces — •Karsten Hinrichs[1], Katy Roodenko[1], and Jörg Rappich[2] — [1]ISAS - Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Str. 9, 12489 Berlin, Germany — [2]Hahn-Meitner-Institut Berlin GmbH, Abt. Silizium-Photovoltaik, Kekuléstr. 5, 12489 Berlin, Germany

Polarisation dependent Infrared (IR) spectroscopy and I-V measurements were used for monitoring the etching of silicon oxide and the electrochemical grafting of nitrobenzene on H passivated silicon surfaces. A new type of in-situ cell is presented which allows nanometer thickness sensitivity for investigation of inorganic or organic films at the liquid-solid interface. The spectra taken in the mid infrared spectral range were simulated within an optical model and the etch rate was determined quantitatively.

DS 15.31 Tue 15:00 Poster B

Determination of intrinsic stresses in thin films by nanoindentation — •Olena Chkhrai[1], Norbert Schwarzer[2], and Frank Richter[1] — [1]Chemnitz University of Technology, Institute of Physics, 09107 Chemnitz — [2]SIO - Saxonian Institute of Surface Mechanics, Am Lauchberg 2, 04838 Eilenburg

Intrinsic stresses often occur in thin films as a result of the complex formation of the thin film structure. It is well known, that such stresses may influence not only the mechanical behaviour of thin films but - via band-bending - also electrical and optical properties. Therefore, knowledge of mechanical film stresses is desired in many cases.

The aim of this work is to determine intrinsic stresses by means of nanoindentation. One of us (N.S.) has shown [1], that intrinsic stresses can be derived from nanoindentation data by combination of "pure normal"and mixed (normal + tangential) loading, in particular, when the concept of the "effectively shaped indenter"is used.

In order to compare this theory with experiment, a experimental setup was constructed which allows to vary the film stresses in a defined way and then to do nanoindentation. Indentation experiments were performed using a novel device (UNAT, Asmec GmbH) which allows to utlise both normal and tangential loads.

[1] N. Schwarzer: "Determining of intrinsic stresses in layered materials via nanoindentation: the question of in principle feasibility", http://archiv.tu-chemnitz.de/pub/2006/0018/index.html

DS 15.32 Tue 15:00 Poster B

Development of a new software tool to characterize mechanical properties in layered structures — •Ferenc Molnar[1], Norbert Schwarzer[2], Matthias Herrmann[1], and Frank Richter[1] — [1]Chemnitz University of Technology, Solid State Physics, 09107 Chemnitz, Germany — [2]Saxonian Institute of Surface Mechanics, Am Lauchberg 2, 04838 Eilenburg, Germany

For complicated film structures such as multilayered systems (up to 10 single layers) or films with a gradient Young's Modulus we are developing a new software tool named FILMDOCTOR. It allows us to analyse the elastic stress fields inside these structures under a great variety of loading conditions. The software is based on the theory of image loads, leading to a complete analytical solution of the contact equations for almost arbitrary mixed loading conditions of normal, lateral, tilting and rotating loads together with a specimen definition including intrinsic stresses or gradient Young's Modulus structures. With the help of the effective indenter model we are also able to calculate the Young's Modulus of very thin films even if we get an inelastic response of the specimen during indentation experiments. To verify the analytical calculations we employ FEM-Simulations and experiments with respect to typical loading and specimen conditions. Measurements were done using the Nanotester UNAT which allows to utilise both normal and lateral forces. Results of these comparisons will be shown in this work. Based on the obtained Young's Modulus we are able to calculate the stress fields during indentation such as the Von-Mises stress.

DS 15.33 Tue 15:00 Poster B

Investigations of the mechanical loss of tantala films between 5 and 300 K — •Matthias Hudl[1], Ronny Nawrodt[1], Anja Zimmer[1], Sandor Nietzsche[1], Wolfgang Vodel[1], Andreas Tünnermann[2], and Paul Seidel[1] — [1]Friedrich Schiller University - Institute of Solid-State Physics, Helmholtzweg 5, D-07743 Jena, Germany — [2]Friedrich Schiller University - Institute of Applied Physics, Albert-Einstein-Straße 15, D-07745 Jena, Germany

Mechanical losses in dielectric mirror coatings of interferometric gravitational wave detectors are a main issue for the proposed advanced

generation of gravitational wave detectors. Recent investigations have shown that the mechanical loss of the dielectric mirror coatings (tantala/silica stacks) is probably the main contribution to the detector noise. There are indications that among both coating materials tantala gives the major contribute to mechanical loss. Experimental details of a measuring setup and investigations of the temperature dependency of the mechanical dissipation in thin tantala films on different substrates are presented.

This work is supported by the DFG under contract SFB TR7.

DS 15.34 Tue 15:00 Poster B

Adhesion energy measurements by means of white-light microscopy and controlled-buckling technique — •Eugen Nikitin, Astrid Pundt, and Reiner Kirchheim — Institut für Materialphysik, Friedrich-Hund-Platz 1, 37077 Göttingen

Adhesion energies determine the attachment of different materials to each other and therefore, are rather important for multi-material stack designs. However, there is a lack of data in this field and existing data vary from each other depending on the method. This can be usually attributed to plastic deformation which accompanies the measurement process. In this contribution, two methods were used to determine adhesion energies between an adhering film (Nb) and a rigid substrate (PC). Both methods use film buckling upon mechanical stress to calculate the adhesion energy. For the first method, applying the theory of Gille and Rau, the cross-sectional buckle-morphologies of straight sided buckles were measured by using a white-light interferometer. The second method, the controlled-buckling-technique, uses the critical hydrogen concentration above which film buckling sets in.[1-2] It will be shown that the two methods give similar results. But, it results also, that the Gille-and-Rau-method is very sensitive to shape variations occurring from local plastic deformations. [1] A. Pundt, P. Pekarsky, *Buckling of thin Nb-films on polycarbonate substrates upon hydrogen loading* Scripta Mat. 48 (2003) 419-423. [2] A. Pundt, E. Nikitin, P. Pekarsky, R. Kirchheim, *Adhesion energy between metal films and polymers obtained by studying the buckling of the film*, Acta Mater. 52 (2004) 1579-1587.

DS 15.35 Tue 15:00 Poster B

Nanocrystalline Diamond films: Morphology, Spectroscopy and Nano-Structuring — •Frederik Klauser[1], Xianjie Liu[1], Norbert Memmel[1], Erminald Bertel[1], Doris Steinmüller[2], and Alexander Kromka[2] — [1]Institute of Physical Chemistry, LF University of Innsbruck, Austria — [2]rho-BeSt company, Innsbruck, Austria

Raman spectroscopy, atomic force microscopy (AFM), x-ray diffraction (XRD), x-ray photoemission spectroscopy (XPS) and electron energy loss spectroscopy (EELS) were used for the investigation of nanocrystalline diamond films, produced by a modified hot filament CVD method (rho-BeSt process). For diamond deposition, sample pre-treatment is essential to enhance the rate of primary nucleation. The primary nucleation density affects future film roughness and morphology as shown by Secondary Electron Microscopy (SEM) and AFM images. Using specific deposition conditions, the rate of secondary nucleation can be tuned, yielding different diamond crystallite sizes and textures. Grain sizes were determined from XRD peak profiles and AFM images. Depending on the deposition conditions, the films show particle sizes ranging from several hundreds of nanometers down to approximately 5 nm. The change of crystallite size can also be observed by Raman Spectroscopy. However, for the most fine-grained films the Raman signal is determined by the sp^2 carbon in the grain boundaries, due to its higher Raman cross section. XPS still shows the characteristic diamond loss features and reveals for all films an sp^2 content below 5 %. On Hydrogen-terminated surfaces, nanostructures were grafted using scanning probe methods.

DS 15.36 Tue 15:00 Poster B

Model Experiments concerning the transition from Nanocrystalline Diamond to Microcrystalline Diamond — •Nicolas Woehrl, Jutta Mack, and Volker Buck — Thin Film Technology Group, Dept. of Physics, University of Duisburg-Essen, Germany

Since over 40 years now diamond films are deposited. Though a lot of work has been done to elucidate the mechanism, the process of diamond deposition - especially the role of surface reactions - is still not fully understood. Because recombination of radicals at the substrate holder - and thus the design of the substrate holder - can influence the properties of the growing film, a mask (3 mm thickness) was introduced on top of the sample for systematical investigation of this effect. Using this experimental setup, a peripheral growth zone was discovered on the silicon substrates where a different form of diamond was growing. By SEM and Raman analysis of the peripheral zone it was found that the deposited film was nanocrystalline there, while it was microcrystalline at the centre. The dependence of the size of this peripheral zone on the substrate from process parameters such as pressure, gasflow and methane fraction in the process gas was investigated. Based on these experiments a model is proposed that explains the results by arguing with the depletion of hydrogen in the gas phase due to recombination effects at the side walls of the substrate holder.

DS 15.37 Tue 15:00 Poster B

Annealing behaviour of hydrogenated and oxidized nanocrystalline diamond — Maxim Eremtchenko[1], Jens Uhlig[1], Martin Finsterbusch[1], •Roland Koch[1], Anita Neumann[1], Syed Imad-Uddin Ahmed[1], Jose A. Garrido[2], Martin Stutzmann[2], and Juergen A. Schaefer[1] — [1]Institut für Physik und Institut für Mikro- und Nanotechnologien, Technische Universität Ilmenau, P.O. Box 100565, 98684 Ilmenau, Germany — [2]Walter Schottky Institute, Technical University Munich, Am Coulombwall 3, D-85748 Garching, Germany

Hydrogenated and oxidized Nanocrystalline Diamond (NCD) is a very promising material for future electronic, especially bioelectronic applications. In the past it has been shown that hydrogen, oxygen, and gases from the ambient environment as well as water can be responsible for causing drastic changes in surface conductivity and wettability (hydrophobicity, hydrophilicity), friction, wear, etc. In this contribution we have investigated differently prepared NCDs as function of the annealing temperature under ultrahigh vacuum conditions (UHV) with various electron spectroscopies like UPS and XPS as well as High Resolution Electron Energy Loss Spectroscopy (HREELS). We were able to identify the thermal stability of a number of different species at the interface, which are related to different characteristics of C-H, O-H, C-O, and C-C bonding. Finally, a carbonization of the interface appeared at higher annealing temperatures.

DS 15.38 Tue 15:00 Poster B

Measuring and tailoring the intrinsic stress in amorphous carbon films — •Oleksiy Filipov, Nicolas Woehrl, and Volker Buck — Thin Film Technology Group, Dept. of Physics, University of Duisburg-Essen, Universitätsstr. 3-5, 45141 Essen, Germany

Amorphous hydrogenated carbon a-C:H and non-hydrogenated a-C films are DLC materials characterized by attractive mechanical, optical and chemical properties. One of the biggest problems that affect the application of the DLC films is a very high compressive stress developed during the film deposition. Intrinsic stress is a critical parameter in thin film deposition and very important for different applications of DLC films especially tribological and biomedical coatings.

In order to adjust DLC films properties, they were deposited in UHV chamber onto different types of substrates such as a glass, polished Si(100) and steel by using PVD DC-anodic arc deposition method. The intrinsic stress in the deposited DLC films was measured ex-situ by determining the substrate curvature using SSIOD method. The variation in process parameters such as substrate bias and gas admixture is used to investigate the influence onto the intrinsic stress of deposited films. The plasma parameters were monitored during deposition by ion energy analyser and mass-spectrometer. The structural properties of the deposited DLC films, mostly sp^3/sp^2 ratio, were characterized by Raman Spectroscopy and by FTIR.

It is shown that the intrinsic stress in the DLC films can be varied in a wide range from compressive to tensile just by variation of the deposition parameters.

DS 15.39 Tue 15:00 Poster B

FEM Simulation of the Laser Plasma Interaction during Laser Nitriding — •Daniel Höche[1], Gerd Rapin[2], and Peter Schaaf[1] — [1]Universität Göttingen, II. Physikalisches Institut, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany — [2]Universität Göttingen, Institut für Numerische und Angewandte Mathematik, Lotzestrasse 16-18, 37083 Göttingen, Germany

Laser nitriding of materials is based on the interaction of short pulsed laser radiation with the treated material and the resulting laser plasma [1]. The process is very promising for the formation of surface coatings with superior properties. Due to the short interaction times and the thin surface films an experimental observation of the underlaying processes is very difficult. In order to access the basic mechanism, FEM simulations of laser heating, evaporation, plasma formation and expansion, plasma composition and interaction with the materials sur-

face have been performed. As a result, evaporation and expansion velocities, pressure balances and dissociation degrees have been derived. The results give a better insight into the physical processes and dependencies of the coating formation. In addition, the adsorption of nitrogen into the surface can be described as a function of process parameters. This finally allows an optimization of the coating formation. The numerical results are compared with experimental results obtained by FEL laser nitriding of titanium in nitrogen atmosphere [2].

[1] P. Schaaf. Progress in Materials Science 42 (2002) 1-161.
[2] D. Höche, M. Shinn, G. Rapin, E. Carpene, P. Schaaf. J. of Physics D: Applied Physics (2006) in print.

DS 15.40 Tue 15:00 Poster B

Influence of different halides and oxygen on BN thin film deposition — •Sarah Panowitz, Jens Matheis, and Achim Lunk — Institut für Plasmaforschung, Universität Stuttgart, Pfaffenwaldring 31, D-70569 Stuttgart

Cubic boron nitride (c-BN) is a material with various fields of applications due to its high hardness, chemical inertness and the possibility for p- and n-doping. c-BN can be produced by high-pressure-high-temperature process, plasma enhanced physical vapor deposition as well as by plasma enhanced chemical vapor deposition. With the last mentioned method c-BN films with low internal stress can be produced. Therefore modeling of the chemical route was performed with "CHEMKIN"to restrict the parameter compositions.

The contribution is divided into two parts. In part I deposition of boron nitride is calculated at conditions in thermodynamic equilibrium. In the equilibrium model we have studied the system B-N-H-X where X represents F, Cl, Br or O. While the flow B, N, H was kept constant according to experimental conditions the flow of the halides and oxygen was varied in a wide range. The formation of BN decreases sensitively going from bromine to fluorine. In the case of oxygen B_2O_3 will be produced additionally in a wide temperature range. Only in a small parameter range the formation of B_2O_3 can be prevented during BN deposition. Part II includes the comparison of the calculated results in the thermodynamical equilibrium with the experiments.

DS 15.41 Tue 15:00 Poster B

Spectroscopic ellipsometry study of thin diffusion barriers of TaN and Ta for Cu interconnects in integrated circuits — •Sukumar Rudra[1], Marion Friedrich[1], Sindu Louis[1], Ovidiu Gordan[1], Thomas Wächtler[2], and Dietrich Zahn[1] — [1]Chemnitz University of Technology, Semiconductor Physics, D-09107 Chemnitz, Germany — [2]Chemnitz University of Technology, Centre for Microtechnologies, D-09107 Chemnitz, Germany

The objective of this work is to study the optical and electrical properties of tantalum nitride and tantalum barrier thin films against the copper diffusion in integrated circuits using spectroscopic ellipsometry in the VUV and UV-Visible range. Single layers of tantalum nitride, bilayer of Ta/TaN and tri-layer of Cu/Ta/TaN were produced on Si (111) substrates with a native oxide layer using the technique of sputtering. The dielectric functions were modelled using effective medium approximation (EMA) and Drude-Lorentz model to obtain informations regarding film thickness, film composition, surface roughness, mean free path and electrical resistivity. It was observed that for the thicker layer of Ta on TaN, contribution of α-phase is higher than that of the β-phase of Tantalum. Depositions of Cu on Ta were also done using other techniques of chemical vapour deposition (CVD) and atomic layer deposition (ALD) at different temperatures and ambient. It was observed that a small change in deposition temperature give rise to a pronounced change in the dielectric functions and hence in the film morphology.

DS 15.42 Tue 15:00 Poster B

Band Bending Investigation of Ag/S-GaAs(100) Schottky Contacts by Raman Spectroscopy — •Steve Pittner and Dietrich Zahn — Chemnitz University of Technology, Semiconductor Physics, D-09107 Chemnitz, Germany

Raman spectroscopy is a powerful tool to study in situ the growth processes of Schottky contacts [1]. It also can be used to determine band bending changes in GaAs [1].

In this investigation the band bending changes of n-and p-doped GaAs are monitored a sulfur passivation with a S_2Cl_2 + CCl_4 (1:3) solution during the formation of a Ag/S-GaAs Schottky contact. The sulfur passivation changes the position of acceptor and donator levels in the band gap and the deposition of Ag on S-GaAs creates metal induced gap stats (MIGS) within the gap. The new charge distribution at the surface leads to change in the width of the depletion layer. This yields a change of the intensity of the longitudinal-optical phonon (LO-Phonon) in the depletion layer and the coupled Plasmon-LO-Phonon (PLP) mode in the bulk of GaAs. Thus the band bending can be calculated, using the ratio of both elementary Raman excitations [2].

This technique was used to determine the band bending induced by the sulfur passivation and the subsequent annealing process as by well as the formation of a Ag/GaAs Schottky contact for both n- and p-doped GaAs substrates.

[1] Salvan G., PhD. Thesis TU Chemnitz (2003)
[2] Geurts J. , Surf. Sci. Rep., 18, (1993), 1

DS 15.43 Tue 15:00 Poster B

Production and characterisation of bandwidth- and phase-optimised La/B_4C- and Cr/Ti-multilayer-mirrors for the reflection of ultra short XUV-pulses — •Stefan Hendel[1], Marc D. Sacher[1], Wiebke Hachmann[1], Ulf Kleineberg[2], and Ulrich Heinzmann[1] — [1]Department of Physics, Bielefeld University, 33615 Bielefeld — [2]Department of Physics, LMU Munich, 85748 Garching

The applicability of reflective optical components for the soft X-ray region depends upon the existence of multilayer-optics. In particular the optimisation of multilayers for the soft X-ray spectral range calls for new material combinations. For the photon energy range of about 180 eV Lanthanum (La) is favoured as the absorber material and Boroncarbide (B_4C) as the spacer material, for the region above 300 eV Chromium (Cr) and Titanium (Ti) are the preferred materials. Thin periodic layer systems of those materials with double layer periods of 3.5 nm (La/B_4C) and < 2 nm (Cr/Ti) have been produced by UHV Electron Beam Evaporation (combined with Ion Polishing) and Ion Beam Sputtering. The characterisation of the layer purity is done by ex-situ Sputter Auger Spectroscopy, whilst structural analysis is performed by X-ray Diffraction, Transmission Electron Microscopy and at-wavelength reflectivity measurements with Synchrotron radiation. A further goal is the production of aperiodic (chirped) multilayers which exhibit an optimised spectral bandwidth and spectral phase required for the reflection of ultra short soft X-ray pulses from High Harmonic Sources. We report on first experimental results as well as corresponding simulations.

DS 15.44 Tue 15:00 Poster B

The structure and composition of oxidized and reduced tungsten oxide films — •Christoph Rameshan, Simon Penner, Bernhard Klötzer, Xianjie Liu, and Frederik Klauser — Institut für Physikalische Chemie Universität Innsbruck, Innrain 52a, A-6020 Innsbruck

The structure, morphology and composition of pure WO_3 thin films deposited onto vacuum-cleaved NaCl(001) single crystals were studied at substrate temperatures up to 580 K and under different oxidative and reductive treatments in the temperature range 373-873 K by transmission electron microscopy (TEM), selected-area electron diffraction (SAED) and x-ray photoelectron spectroscopy (XPS). A transition from an amorphous structure obtained after deposition at 298 K to a more porous structure with small crystallites at the highest substrate temperatures was observed. XPS spectra reveal the presence of W_6^+ irrespective of the preparation procedure. Significant changes in the film structure were only observed after an oxidative treatment in 1 bar O_2 at 673 K, which induces crystallization of a monoclinic WO_3 structure. After raising the oxidation temperature to 773 K, the film shows additional reconstruction and a hexagonal WO_3 structure becomes predominant. This hexagonal structure persists at least up to 873 K oxidation temperature. However, these structural transformations observed upon oxidation were almost completely suppressed by mixing the WO_3 thin film with a second oxide, e.g. Ga_2O_3. Reduction of the WO_3 films in 1 bar H_2 at 723-773 K induced the formation of the β-W metal structure, as evidenced by SAED and XPS.

DS 15.45 Tue 15:00 Poster B

Optimization of optical properties of thermochromic VO_2 films — Ganhua Fu, •Jennifer Stiebich, Angelika Polity, Niklas Volbers, and Bruno Kurt Meyer — 1. Physikalisches Institut, Justus Liebig Universität Giessen

Vanadium dioxide shows a thermally induced semiconductor-metal phase transition at 68°C. Especially the related change in the optical properties enables many applications in infra-red light (IR)-switching or bolometric devices or as "intelligent"energy conserving window coating. For certain applications the transition temperature has to be

tuned and the transmittance in the visible and infra-red spectral range should be optimized. An appropriate way to achieve the required properties is doping. We studied a series of VO_2 layers prepared by radio frequency sputtering and doped by an additional solid in the target or by a reactive gas used in the deposition process. The optical switching properties were evaluated from wavelength and temperature dependent transmission measurements. The crystal structure of the films was studied by X-ray diffraction (XRD) and the composition of the layers was determined by energy-dispersive X-ray analysis (EDX) and secondary ion mass spectroscopy (SIMS).

DS 15.46 Tue 15:00 Poster B

First-principles characterization of charged oxygen vacancies in cubic HfO_2 — Stephan Kremers[1], •Jörg Neugebauer[2], Matthias Wuttig[1], and Blazej Grabowski[2] — [1]I. Physikalisches Institut (1A), RWTH Aachen, 52056 Aachen — [2]Max-Planck-Institut für Eisenforschung, GmbH Max-Planck-Straße 1, 40237 Düsseldorf

HfO_2 is a prominent candidate for applications necessitating the use of high-k dielectrics. It could e.g. replace SiO_2 layers in small-sized metal-oxide semiconductor devices (MOS). Thus the electrical and structural properties of HfO_2 have to be investigated. Using first principles methods, the properties of charged oxygen vacancies in cubic HfO_2 have been analysed, because they are probably one of the major traps contributing to charge trapping in HfO_2. Although the cubic phase is the high temperature phase, it is frequently found in HfO_2 thin films. With the help of supercell calculations the formation energy of differently charged oxygen vacancies in this phase are determined. This will help to understand the nature of defects in this material and consequently to understand the electrical properties. Differently charged states (-2, -1, 0, +1 and +2) of the defect systems have been relaxed with an optimisation algorithm and a bandstructure calculation of HfO_2 bulk has been performed. With these calculations we intend to study the nature of the defect levels in the band gap, e.g. whether they show negative-U behaviour. This can help to understand the electronic transport mechanism in HfO_2.

DS 15.47 Tue 15:00 Poster B

Polarization coupled response of ZnO-$BaTiO_3$ heterojunctions: A model approach — •Venkata Voora[1], Tino Hofmann[1], Matthias Brandt[2], Mathias Schubert[1], Michael Lorenz[2], and Marius Grundmann[2] — [1]Department of Electrical Engineering , University of Nebraska-Lincoln, Lincoln, Nebraska, USA — [2]Institut für Experimentelle Physik II, Universität Leipzig, Leipzig, Germany

Heterojunctions composed of wurtzite-structure ZnO and perovskite-structure $BaTiO_3$ are very interesting because of the observed ionic lattice charge polarization coupling at their interface, which bears large potential for future device applications. Here we report on polarization hysteresis measurements on ZnO-$BaTiO_3$ heterostructures with Pt front and back contacts deposited by pulsed laser deposition on (001) silicon substrate. The electrical data are analyzed using a physical model that accounts for the switchable spontaneous polarization of $BaTiO_3$ and the non-switchable spontaneous polarization of ZnO. In this model we have implemented a polarization dependent net-interface-charge driven depletion layer, which represents the experimentally observed rectifying behavior of the heterostructure. We find a good agreement between our model generated data and our experiment, and we identify switching voltages and their conditions for the incompletely polarized ferroelectric ionic lattice polarization. We use our model to predict design of such heterostructures for switchable resistance and memory device structures. The influence of physical model parameters on the ZnO-$BaTiO_3$ heterojunction characteristics will be discussed.

DS 15.48 Tue 15:00 Poster B

Functional oxide films patterned by soft-lithography — •Ole Fridthjof Göbel, Sajid Ullah Khan, Johan Evert ten Elshof, and David Hermanus Adrianus Blank — Inorganic Materials Science Group, University of Twente, the Netherlands

Soft-lithographic techniques, e.g. micromoulding in capillaries (MIMIC), have been applied to relief-pattern sol-gel precursor solutions for functional oxides such as TiO_2, $BaTiO_3$, or $CoFe_2O_4$. Subsequent heat treatment yields patterned oxide films, patterns being parallel lines or grids. The periodicities of the patterns amount typically a few micrometers. Unlike with standard micromoulding, with MIMIC the relief-patterned mould is in contact with the substrate before applying the precursor solution, such that the formation of a thin residue layer between the pattern features is avoided. Since, however, MIMIC is restricted to patterns with interconnected features, inverse MIMIC must be applied to create patterns of isolated features: In a first step, a negative image of the final pattern is created in a fully organic polymer (e.g. poly(urethane)) by MIMIC, yielding a grid-patterned film with pits, the bottom of which is the substrate. In a second step, the isolated pits in the polymer film are filled with the precursor solution. To improve the patterning process in MIMIC, the physical properties of the surfaces of the elastomeric moulds have been modified. Besides sol-gel precursors, also suspensions of TiO_2 nanoparticles have been used to reduce film shrinkage.

DS 15.49 Tue 15:00 Poster B

Deposition of Metal-Oxide Particles by Spray Pyrolysis — Alexandre Santos Abreu, •Matthias Knoll, Reinhard Tidecks, and Siegfried Horn — Universität Augsburg, Institut für Physik, Lehrstuhl für Experimentalphysik II, Universitätsstraße 1, 86159 Augsburg

Metal-oxide coatings play a key role in state-of-the-art applications in optics and as diffusion barriers. For these applications, an adequate adhesion of the coating, a sufficient thermal and mechanical stability, as well as an excellent chemical stability is necessary. Most properties of the coatings are affected by their morphology and by the growth of the interface layer.

Yttria and alumina particles and coatings were deposited using the Spray Pyrolysis method. For this purpose, an ultrasonically nebulised metal-salt-solution is disposed by a carrier gas into a tubular furnace, in which the oxidation to the metal-oxide takes place. Spherical particles arising during this process are deposited on a soda-lime glass-substrate in the furnace or in a glass-fiber-filter at the outlet of the furnace. By oxidising the aerosol on the soda-lime glass-substrate, thin metal-oxide-coatings can be fabricated. The deposited particles and coatings were investigated using SEM, XPS, XRD and TEM.

The growth of the coating and the deposition mechanism of the particles are influenced by several parameters. By varying these parameters (e.g. the concentration of the solution, the mass flow of the carrier gas, the furnace and substrate temperature), the morphology of the coatings could be controlled.

DS 15.50 Tue 15:00 Poster B

Nanoscaled surface structures on Silicon induced by low energy sputtering under different angles — •Raphael Niepelt, Klaus Jesiek, Kun Zhang, Carsten Ronning, and Hans Hofsaess — II. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen

The balance between surface roughening by sputtering and smoothing by atomistic diffusion leads to the formation of periodic nanoscaled ripples on surfaces upon ion irradiation. We investigated the surface morphology of Xe-irridiated Si(100) surfaces, using an ion energy of 2-5 keV under angles from 0° up to 85° and fluences between $2{\cdot}10^{16}\,\mathrm{cm}^{-2}$ and $1\cdot10^{18}\,\mathrm{cm}^{-2}$. Characteristic patterns were observed with different wavelengths for angles above 60°. Below this angle no ripples were detected, which is in contrast to existing literature. This discrepancy might be owing to different ion fluxes; therefore we will present first results obtained using a microbeam with varying fluxes over several orders of magnitude.

DS 15.51 Tue 15:00 Poster B

Ion induced self-organization on pre-patterned Si surfaces — Theresa Lutz, •Bashkim Ziberi, Renate Fechner, Dietmar Hirsch, Klaus Zimmer, Frank Frost, and Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung e. V., 04318 Leipzig

Due to the simplicity of the method, and the possibility to produce large-area nanostructured surfaces self-organization induced by low-energy ion beam erosion offers an alternative, simple and cost-efficient route for nanostructuring of surfaces. Especially the short-range order of the formed nanostructures can be quite high. However, usually this self-organization process lacks long-range order and positional control of the pattern. One possibility to improve this ordering is a appropriate choice of erosion conditions to achieve a long range ordering of the dot or ripple structures. Another possibility to influence the ordering of structures is by using pre-patterned substrates. In this way due to spatial limitations and guided by the lateral ordering of the pre-patterned templates the evolving topography shows an improved ordering. Additionally, an improved positional control can be achieved. In this work the fabrication principle also known as guided self-organization is applied to form ripple and dot pattern on pre-patterned Si surfaces during low energy ($\leq 2000\,\mathrm{eV}$) Kr^+ and Xe^+ ion beam erosion.

DS 15.52 Tue 15:00 Poster B

GISAXS and GID studies of ripple and dot pattern on Si and Ge surfaces by low-energy ion beam erosion — •Bashkim Ziberi[1], Frank Frost[1], Geradina Carbone[2], Till Metzger[2], and Bernd Rauschenbach[1] — [1]Leibniz-Institut für Oberflächenmodifizierung e. V. , 04318 Leipzig, Germany — [2]ID 01, ESRF, Grenoble, France

Low-energy ion beam erosion of solid surfaces is a very effective alternative approach for the generation of self-organized nanostructures. Under certain conditions, sputtering can produce well-ordered patterns, like ripples or dots on Si and Ge surfaces. In this contribution GISAXS (Grazing Incidence Small Angle X-ray Scattering) and GID (Grazing Incidence Diffraction) techniques are used to study the periodicity, ordering and lateral correlation of nanostructures formed by low-energy ion beam erosion on Si and Ge surfaces ($E_{ion} \leq 2000\,\mathrm{eV}$). While GISAXS gives information about structures on the surface, GID enables us to study the crystalline structure of nanostructures. The beam spot (along the sample) for the experiments was few millimeters in size. The measurements indicate the high lateral ordering of nanostructures and the strong correlation between the amorphous part of nanostructures and the crystalline interface. The results show that the ripple are aligned perpendicular to the incoming ion beam and the orientational ordering of ripples increases with increasing ion fluence. Further, the results demonstrate the asymmetric shape of ripples. Additionally, the long range hexagonal ordering of dots covering the whole sample surface as observed with atomic force microscopy is verified.

DS 15.53 Tue 15:00 Poster B

Modification of Solid Surfaces by Slow Highly Charged Ions — •Rene Heller and Stefan Facsko — Inst. für Ionenstrahlphysik u. Materialforschung, Forschungszentrum Dresden/Rossendorf, Dresden, Germany

Due to their high amount of potential energy highly charged ions induce various changes in morphology and electronic structure of solid surfaces. The potential energy which is the sum of the ionization energies of all removed electrons, is released on a very small localized area of a few nm^2 and in very short times of tens of fs. Hence the power density deposited into the surface can reach values of up to $10^{14}\,\mathrm{Wcm}^{-2}$ depending on the ions incident charge state. The changes in surface topology depend strongly on the electronic excitation in the surface which is the main reason for the big differences in the hillock formation on insulators and on conductors. Focus of our investigations is to observe the influence of the incident ions charge state, the kinetic energy and ion species on the hillock formation process for both kinds of materials.

We present systematic scanning probe microscopy studies of surface modifications induced by single ion impact. Insulating and conducting samples were irradiated with ions of argon ($q = 1 \ldots 16$) and xenon ($q = 1 \ldots 40$). The diameter and the height of the created nano structures were investigated in dependence on the ion charge state and the kinetic energy.

DS 15.54 Tue 15:00 Poster B

Modifizierung von medizinischen CoCr-Legierungen mit PIII — •Johanna Lutz[1,2], Antje Lehmann[2] und Stephan Mändl[2] — [1]Translationszentrum regenerative Medizin, Universität Leipzig, Leipzig — [2]Leibniz-Institut für Oberflächenmodifizierung, Leipzig

Stickstoffimplantation in CoCr-Legierungen mit hohen Fluenzen bei erhöhter Temperatur führt zur Ausbildung einer dicken Oberflächenschicht mit Stickstoffgehalten bis zu 30 at.%. Als Verfahren wurde die Plasmaimmersionsionenimplantation bei einem Hintergrunddruck von 0.1 bis 1 Pa bei einer Plasmadichte von etwa $5 - 10 \times 10^{10}\,\mathrm{cm}^{-3}$ verwendet. Unterhalb von 450 °C findet sich eine thermisch aktivierte Diffusion mit einer Aktivierungsenergie von ungefähr 0.6 eV. Für höhere Temperaturen beobachtet man jedoch eine Sättigung der Schichtdicke, unabhängig von Stickstofffluenz bzw. Behandlungszeit. Untersuchungen zur Menge des eingebauten Stickstoffs bzw. der Druckabhängigkeit legen den Schluss nahe, dass neben der Implantation eine erhöhte Stickstoffaufnahme aus der Gasphase vorhanden ist, die dann bei höheren Temperaturen die Prozesskinetik begrenzt.

DS 15.55 Tue 15:00 Poster B

Nitriding of Fe-Cr-Ni thin films by ion implantation — •Darina Manova and Stephan Mändl — Leibniz-Institut für Oberflächenmodifizierung, Leipzig

Nitrding of austenitic stainless steel is a process leading to the formation of thick modified layers by an unusual fast nitrogen diffusion, which is investigated and applied for many years. Additionall, a varying nitrogen diffusion by 4−5 orders of magnitude is reported in the literature, depending on the microstructure. However the investigations are performed predominantly on rolled samples or heavily distorted bulk samples. Here, thin Fe-Cr-Ni films with a thickness of 500 nm and more were synthesized using ion beam sputter deposition from an austenitic stainless steel target (AISI 304, respective DIN 1.4301). Low energy implantation and plasma immersion ion implantation were performed to insert the nitrogen ions into the films at different temperatures and ion energies. The modified layers were investigated by SIMS, TEM and XRD. The diffusion rate was calculated from SIMS measurements. The microstructural and phase composition changes were estimated from XRD and TEM measurements.

DS 15.56 Tue 15:00 Poster B

Controlled ion bombardment during sputter-deposition of thin films — •Evelyn Scheer, Dominik Köhl, Daniel Severin, and Matthias Wuttig — I. Physikalisches Institut, RWTH-Aachen, D-52056 Aachen

We present a setup that enables the in-situ bombardment of growing films with ions from a broad-beam ion source. An additional ion source has been mounted to an existing sputter-chamber such that simultaneous bombardment during deposition is possible at an angle of incidence of 45° with respect to the substrate normal. The ion source can be operated with various gases. This allows a detailed study of the film growth. Thereby the ion energy can be varied between 100 eV up to 2 keV with ion current densities of up to $100\,\mu\mathrm{A}/cm^2$.

Various techniques, such as x-ray diffraction, x-ray reflectometry, spectroscopic ellipsometry and electrical measurements, have been employed to investigate the effects of the bombardment. A correlation between film properties and the deposition parameters such as ion flux and ion energy provides the means for tailoring films with desired functionalities.

DS 15.57 Tue 15:00 Poster B

Structure modification of sputtered oxide films upon oxygen ion bombardment — •Christoph Angerhausen, Dominik Köhl, Daniel Severin, and Matthias Wuttig — 1. Physikalisches Institut IA, RWTH Aachen, 52056 Aachen, Germany

Tailoring the structural properties of transition metal oxides is often fundamental to produce films with specific, desired functionalities. Frequently for such applications sputtering is used as the deposition technique of choice. Upon reactive sputtering of many transition metal oxides the generation of negatively charged oxygen ions at the target surface is observed. These ions are accelerated in the cathode dark space and bombard the growing film. J. Ngaruiya [APL] has shown that the resulting bombardment of the growing film leads to modifications in various film properties, in particular in the resulting film structure. While the flux of negative oxygen ions is related to the oxygen partial pressure it can not be controlled independently. To circumvent this shortcoming, an ion gun was implemented into a sputter chamber. This enabled a controlled bombardment by oxygen ions with well defined energy and current density.

In this presentation the effect of the impact of oxygen ion bombardment on the growing film is demonstrated. The flux of negative oxygen ions from the target surface to the substrate has been shielded. Hence the film is only bombarded by oxygen ions from the separate ion gun. Examinations of the structure allow the definition of thresholds in ion energy and current density above which a significant modification of the film structure is observed.

DS 15.58 Tue 15:00 Poster B

Ni-Filme in reaktiven Plasmen — Marion Quaas[1], Oxana Ivanova[2], Christiane Helm[2] und •Harm Wulff[1] — [1]Institut für Biochemie, Universität Greifswald, Soldmannstraße 23, 17489 Greifswald — [2]Institut für Physik, Universität Greifswald, Jahnstraße 16, 17489 Greifswald

20 nm dicke Ni-Filme mit einer mittleren Domänengröße von 7 nm werden in einem Mikrowellen-Plasma (SLAN, 700 W) abwechselnd im Ar/H_2 und Ar/O_2 Gasstrom behandelt. Die chemischen Umsätze und die kinetischen Prozesse bei der Plasma-Wand-Wechselwirkung werden durch die Kombination von Röntgenreflektometrie, Röntgendiffraktometrie im streifenden Einfall (GIXD) und Rasterkraftmikroskopie (AFM) untersucht.

Drei verschiedene Prozesse lassen sich bei der Plasmabehandlung beobachten:

a) partielles Verdampfen und Kristallwachstum der Ni Teilchen im Ar/H_2 Plasma
b) Oxidation von Ni zu NiO im Ar/O_2 Plasma bis zu einem Massenverhältnis von 40/60 NiO/Ni
c) Reduktion von NiO im Ar/H_2 Plasma.

Der Reaktionsschritt a) ist irreversibel, die Oxidations- und Reduktionsprozesse können beliebig oft wiederholt werden. Die Reduktionsprozesse verlaufen wesentlich schneller als die Oxidationsreaktionen. Allerdings verläuft die erste Oxidation deutlich langsamer als die nachfolgenden. Die kinetischen Prozesse werden quantifiziert und diskutiert.

DS 15.59 Tue 15:00 Poster B

Deposition von TiN_x-Schichten durch reaktives Sputtern in einer DC-Magnetronentladung — •Stefan Wrehde[1], Marion Quaas[2], Robert Bogdanowicz[3], Hartmut Steffen[4], Harm Wulff[2] und Rainer Hippler[1] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Felix-Hausdorff-Straße 6, 17489 Greifswald — [2]Institut für Chemie und Biochemie, Ernst-Moritz-Arndt-Universität Greifswald, Felix-Hausdorff-Straße 4, 17489 Greifswald — [3]Department of Optoelectronics and Electronical Systems, Gdansk University of Technlogy, ul. G. Narutowicza 11/12, 80-952 Gdansk, Polen — [4]Institut für Niedertemperatur-Plasmaphysik, Felix-Hausdorff-Straße 2, 17489 Greifswald

In einem reaktiven DC-Magnetron-Plasma (Arbeitsgas Argon, Reaktivgas Stickstoff) wurden unter verschiedenen Bedingungen TiN_x-Schichten abgeschieden. Reaktivgasfluss, Entladungsleistung und Betriebsmodus des Magnetrons ("balanced" bzw. "unbalanced") wurden variiert. Die chemische Zusammensetzung und die Struktur der abgeschiedenen Schichten wurden mit Hilfe verschiedener Röntgenanalyseverfahren (XPS, GIXR, GIXD) untersucht. Hierbei wurde fest gestellt, dass vor allem der Betriebsmodus des Magnetrons wesentlichen Einfluss auf die Depositionsrate und den Stickstoffeinbau in die Schichten hat. Durch weitere Analyse mittels spektroskopischer Ellipsometrie (SE) und Fitten der hieraus erhaltenen Daten (optisches Modell mit Bruggemann-Näherung und Lorentzoszillator) konnten die Resultate der Röntgenverfahren bestätigt und um Informationen über die optischen Eigenschaften der Schichten erweitert werden.

DS 15.60 Tue 15:00 Poster B

The Influence of Cross-Magnetron Effect on the Functional Film Properties of ITO Thin Films — •Ronny Kleinhempel, Hartmut Kupfer, Thoralf Dunger, Thomas Welzel, Benjamin Graffel, and Frank Richter — Chemnitz University of Technology, Institute of Physics, D-09107 Chemnitz

For industrial applications reliable and lateral homogeneous properties of thin films are required. In the case of display applications of ITO films a high transparency and a constant low electric film resistivity are indispensable preconditions. Typically, these films are deposited by magnetron sputtering. This method, however, shows some inherent inhomogeneities in process properties. Using dual-magnetron sputtering and rectangular targets the Cross-Magnetron Effect (CME) occurs. This is an inhomogeneity of the plasma along the torus which results in an anomalous target erosion as well as modified film properties.

To characterise the CME more detailed the correlation between the distribution of the process parameters and the functional film properties was investigated. ITO films were deposited in a pulsed dual-magnetron discharge reactively from metallic In:Sn (90/10) targets in the transition mode. Statically deposited films show a lateral variation of the optical transparency and the electrical resistivity. The distribution could be correlated with results of plasma property and thermal load measurements. The investigations revealed that the main mechanisms influencing the film properties due to CME are the locally increased ion bombardment onto the growing film and the concentration of dissociated oxygen at substrate position.

DS 15.61 Tue 15:00 Poster B

The effect of target material and process parameters on the deposition rate of films grown by high power pulse magnetron sputtering — •Julia Dukwen, Kostas Sarakinos, Jones Alami, and Matthias Wuttig — Institute of Physics (IA), RWTH Aachen University of Technology, 52056 Aachen, Germany

High power pulsed magnetron sputtering (HPPMS) is a novel ionized PVD (IPVD) technique, in which a high degree of ionization of the sputtered material is obtained resulting in thin films with superior properties as compared to those achieved by other IPVD techniques, e.g. dc magnetron sputtering (dcMS). Moreover in HPPMS lower deposition rates (R_d) are obtained, in comparison to the dcMS ones, when a constant average target power is used. However, we have recently shown that at a constant average target current the HPPMS rates are equal to the dcMS rates up to a threshold peak target current (I_{Tp}) value. In this work we study the HPPMS and dcMS rates R_d for a number of materials (Cr, Cu, C) at a constant average target current and different I_{Tp} and target voltage (V_T) values. Time-resolved optical emission spectroscopy is employed in order to determine the plasma composition. It is shown that in the case of materials with a low ionization fraction (e.g. C) the HPPMS rates are higher by up to 40 % in comparison to the dcMS ones, at all deposition conditions. On the other hand, for materials with a high ionization fraction (e.g. Cr and Cu) the HPPMS R_d values are higher up to 10 % than the dcMS rates for $I_{Tp} < 10$ A and $V_T < 450$ V. A further increase of the I_{Tp} and V_T results in a drop of the HPPMS R_d values by up to 20 %.

DS 15.62 Tue 15:00 Poster B

Herstellung und Charakterisierung piezoelektrischer Zinkoxid-Schichten für Biochipanwendungen — •Kerstin Franziska Wätje[1], Jens Ebbecke[1], Jörg Lindner[2], Walter Assmann[3] und Achim Wixforth[1] — [1]Universität Augsburg, Lehrstuhl für Experimentalphysik I, 86159 Augsburg — [2]Universität Augsburg, Lehrstuhl für Experimentalphysik IV, 86159 Augsburg — [3]Beschleunigerlaboratorieum des MLL der LMU und TU München, 85748 Garching

Akustische Oberflächenwellen (SAW) finden unter anderem bei Hochfrequenzfiltern einen großen Anwendungsbereich; auch in der Biophysik werden solche Bauelemente zur gezielten Agitation bzw. Aktorik kleinster Flüssigkeitsmengen verwendet. Als Alternative zu piezoelektrischen Einkristallen, die zur Erzeugung von SAWs nötig sind, gilt polykristallines, c- Achsen-orientiertes Zinkoxid. Betrachtet wird die Deposition von ZnO-Schichten der optimalen Textur (002) auf Silizium- und Glassubstraten, wobei die Verfahren des RF-Magnetronsputterns und der gepulsten Laserablation gegenübergestellt werden. Der Einfluss der Prozessparameter auf die Schichteigenschaften wurde mit Hilfe von XRD, RBS, ERDA und TEM charakterisiert. Die resultierenden Unterschiede bezüglich Kristallinität und Schichtzusammensetzung werden hier dargestellt und diskutiert.

DS 15.63 Tue 15:00 Poster B

Electronic properties of amorphous and crystalline Germanium Bismuth Tellurides — •Michael Austgen and Matthias Wuttig — Institute of Physics (IA), RWTH Aachen University of Technology, 52064 Aachen, Germany

In data storage applications such as CD-RWs, DVD-RWs or DVD-RAMs phase change materials are already commercially used. The information is stored in bits which can be switched between the crystalline and the amorphous state by a short laser pulse. Desired physical properties of these non-volatile memories are high optical contrast. For future applications in electronic memories such as PC-RAM's the high electrical contrast is an alternative feature.

In this study two different Germanium Bismuth Tellurium alloys were investigated. Both have a low crystallization temperature and were partially crystalline deposited. This is indicative for a low activation barrier against crystallization and could lead to very fast crystallization phenomena at elevated temperatures. To prepare amorphous films substrate cooling was invoked. This enabled the preparation of amorphous films. Subsequently the properties of the amorphous and crystalline state were investigated employing a variety of techniques including x-ray diffraction, x-ray reflectometry, van der Pauw measurements as well as spectroscopic ellipsometry. From these data the suitability of were investigated. Germanium Bismuth Tellurides as ultrafast storage materials has been accessed.

DS 15.64 Tue 15:00 Poster B

Crystallization kinetics in amorphous Tellurium alloys used for phase change recording — •Tobias Sontheimer, Michael Klein, and Matthias Wuttig — Institute of Physics (IA), RWTH Aachen University of Technology, 52056 Aachen, Germany

Phase change materials perfectly meet all requirements expected from materials used for data storage. The long-term stability of the amorphous phase on the one hand and the ability to switch from one phase to the other within nanoseconds accompanied by a high change of reflectivity on the other hand paved the way to the commercial application of phase change materials in CD-RW, DVD-RW and DVD-RAMs. Even though various kinds of data storage devices based on these materials are commercially available neither their physical properties nor

their kinetic behavior are completely understood.

In this study, the nucleation and growth process of Tellurium alloys were investigated, driven by the ambition to gain a fundamental understanding of the phase transformation. Differential Scanning Calometry measurements and annealing experiments followed by ex-situ AFM-measurements, which are based on exploiting the density difference between the crystalline and amorphous phase, are among the characterization techniques employed in this investigation. This combination of methods allows us to track the time- and temperature-dependent nucleation and growth process and gain insight into the crystallization mechanism.

DS 15.65 Tue 15:00 Poster B

In-Situ Observation of Electron Stimulated Eching of SiO_2 and the Initial Stage of Thermal Desorption — •Oliver Senftleben, Tanja Stimpel-Lindner, Ignaz Eisele, and Hermann Baumgärtner — Universität der Bundeswehr München, Institut für Physik, Werner-Heisenberg-Weg 39, 85577 Neubiberg

Thermal desorption of SiO_2 under low oxygen partial pressure and elevated temperature due to the dissociation to SiO (g) is a well known process. Whereas electron irradiation causes dissociation of SiO_2 to elemental silicon and oxygen that partly desorbs. Combining these two processes leads to a very effective way for etching of SiO_2.

Therefore we investigated the etching effect on a thermally grown SiO_2 with a thickness up to 60 nm at temperatures between 700° and 900°C under electron irradiation in a UHV chamber. The etching process has been observed simultaneously via AES. The influence of temperature and carbon contaminations on the etching process can be shown.

We used this method to observe the initial stage of thermal desorption of SiO_2. Therefore a hole 300 μm in diameter was etched into a 60 nm thick SiO_2 layer right down to the silicon substrate which causes an inhomogeneity in SiO_2 thickness in the transition region. The initial stage of thermal desorption of SiO_2 can be observed very well utilizing this method.

DS 15.66 Tue 15:00 Poster B

Study of the carbon dioxide adsorption on silicon — •Daniela Lietz, Michael Paulus, Christian Sternemann, and Metin Tolan — Exp. Physics E1a/DELTA, University Dortmund

In order to investigate the adsorption of carbon dioxide on a silicon wafer, the layer thickness and roughness are determined in dependence of the CO_2−pressure via X-ray reflectivity. Due to the use of a high pressure cell the experiment has been accomplished at a photon energy of 27 keV at BL9 of the synchrotron radiation source DELTA. In order to observe different degrees of adsorption, the gas pressure was increased in 17 steps from 0 bar to 34.4 bar (near condensation pressure of CO_2). For each pressure step an X-ray reflectivity was recorded. The measured reflectivities are refined with the use of the effective density model. The layers thickness, roughness and dispersion were determined. The adsorption isotherm (layer thickness vs. pressure) shows the anticipated increase of layer thickness with rising pressure. From the adsorption isotherm the Hamaker constant was determined in order to qualify the amplitude of the interaction between substrate and layer on a microscopic scale. The roughness shows an increase with the thickness which is due to the interaction between the substrate and the surface which smoothes the layers surface especially at low layer thickness.