DS 37: Poster II: Focused electron beam induced processing for the fabrication of nanostructures (focused session, jointly with O); Nanoengineered thin films; Layer properties: electrical, optical, and mechanical properties; Thin film characterization: structure analysis and composition (XRD, TEM, XPS, SIMS, RBS,..); Application of thin films

Time: Thursday 15:00–17:00 Location: Poster E

DS 37.1 Thu 15:00 Poster E

FEBIP on organic layer modified Ag(111) — •Patrick Wintrich, Florian Vollnhals, Johannes Zirzlmeier, Hans-Peter Steinrück, and Hubertus Marbach — Lehrstuhl für Physikalische Chemie II and Interdisciplinary Center for Molecular Materials (ICMM), Friedrich-Alexander- University Erlangen-Nuremberg, Egerlandstr. 3, 91058 Erlangen

Electron Beam Induced Deposition (EBID) has attracted increasing interest in the last few decades for the fabrication of nanosized structures. In our investigation of EBID with $Fe(CO)_5$ on an Ag(111) surface, we observed autocatalytic growth of iron structures on the whole surface, even without electron irradiation. Herein, we show that the initial decomposition can be inhibited by preadsorbing a layer of porphyrin molecules on the Ag(111); consequently, on this surface well-defined Fe nanostructures can be produced via EBID with $Fe(CO)_5$.

In analogy to the recently introduced EBISA process [1], we also can use the electron beam to locally decompose the porphyrin layer with the electron beam and thereby activate selected areas on the surface for the autocatalytic growth of $Fe(CO)_5$. We therefore can apply two different fabrication routes for iron deposits on Ag(111). In both, the first step is the deposition of the porphyrin layer. Thereafter, we can either perform the conventional EBID process or we can use the electron beam for the local decomposition of the porphyrin layer followed by the autocatalytic growth of $Fe(CO)_5$ at the activated areas.

This work was supported by the DFG through grant MA 4246/1-1.

[1] M.-M. Walz et al., Angew. Chem. Int. Ed. 49 (2010), 4669

DS 37.2 Thu 15:00 Poster E

Fabrication of Titanium Oxide Nanostructures by Electron Beam Induced Deposition — •Michael Schirmer, Florian Vollnhals, Marie-Madeleine Walz, Thomas Lukasczyk, Hans-Peter Steinrück, and Hubertus Marbach — Lehrstuhl für Physikalische Chemie II, Universität Erlangen-Nürnberg, Germany

In electron beam induced deposition (EBID) a focused electron beam is employed to locally dissociate adsorbed precursor molecules resulting in a deposit of the nonvolatile fragments. Usually, metalloorganic compounds are used as precursors for the fabrication of metalic deposits. Herein, we explore the potential of using tetraisopropoxide (TTIP) as precursor for the fabrication of TiOx nanostructures via EBID in ultra high vacuum. We demonstrate that the initially carbon contaminated deposits can be transformed to pure TiOx nanocrystalites via certain post treatment procedures [1]. Furthermore, we expanded the EBID technique towards the fabrication of layered nanostructures by the consecutive use of $Fe(CO)_5$ and TTIP. Thereby first, a clean iron line was deposited, which was then selectively covered with a thin capping layer fabricated from TTIP [2]. Interestingly, the ultra-thin capping layer prevents the oxidation of the iron structures, even under ambient conditions. From a more general point of view, the stepwise application of two or more precursors in EBID opens up a novel pathway for tailoring the fabrication of nanostructures.

This work is supported by the DFG through grant MA 4246/1-2.

[1] M. Schirmer et al., Nanotechnology, 22 (2011) 085301; [2] M. Schirmer et al., Nanotechnology, 22 (2011) 475304.

DS 37.3 Thu 15:00 Poster E

Theoretical modelling of EBID precursors on a substrate — Kaliappan Muthukumar, Ingo Opahle, •Juan Shen, Harald O. Jeschke, and Roser Valenti — Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, 60438 Frankfurt am Main

Among the many unknowns in the microscopic processes underlying the electron beam induced deposition of nanostructures are the details of the adhesion of the precursor molecules on the substrate. The mechanism of adsorption for a single molecule will be the starting point for the simulation of the dynamical processes during the initial stages of the growth of a metallic nanodeposit. By means of density functional theory (DFT) calculations with and without inclusion of long range van der Waals (vdW) interactions, we have studied the interaction of tungsten hexacarbonyl $W(CO)_6$ and trimethyl methylcyclopentadienyl platinum ($MeCpPtMe_3$) as precursor molecules with partially hydroxylated and fully hydroxylated SiO_2 substrates corresponding to different experimental conditions.

DS 37.4 Thu 15:00 Poster E

New Developments in MAD Technique: Layer-By-Layer Growth of Thin Oxide Films and Superlattices — •Camillo Ballani[1], Sebastian Hühn[1], Markus Jungbauer[1], Markus Michelmann[1], Felix Massel[1], Oleg Shapoval[2], Alexander Belenchuk[2], and Vasily Moshnyaga[1] — [1]I. Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany — [2]Institute of Applied Physics, Academiei str. 5, MD-2028 Chisinau, Moldova

Metalorganic aerosol deposition (MAD) technique[1] was shown to be very advantageous in preparation of thin films of complex functional oxides, like cuprates, manganites, titanites. Due to their unique bulk and interfacial electronic/structural properties these strongly correlated oxides are recently in the focus of fundamental and applied research, including large scale research cooperation within the EU FP 7 Framework. We report here further MAD developments toward the in-situ growth control via optical ellipsometry and atomic layer deposition (MAD-ALD). The results on the structure and magnetotransport of individual layer-by-layer grown thin films (LSMO, BSTO) as well as of superlattices (LCMO/PCMO, LBMO/LMO, LCMO/BTO) will be presented and discussed with the main focus on the optimization of colossal magnetoresistance and artificial multiferroic behavior by means of electronic and/or structural interface engineering. Financial support from EU FP 7 IFOX (interfacing oxides) is acknowledged. [1]Appl. Phys. Lett. 74, 1842 (1999).

DS 37.5 Thu 15:00 Poster E

Gas phase aggregation cluster source for composite material deposition — •Tilo Peter[1], Sven Bornholdt[2], Thomas Strunskus[1], Vladmir Zaporojtchenko[1], Holger Kersten[2], and Franz Faupel[1] — [1]Institute for Materials Science, Kiel, Germany — [2]Institute of Experimental and Applied Physics, Kiel, Germany

A method to create nanocomposites of Ag nanoparticles in a plasma polymer matrix with tailored optical properties is presented. A beam of Ag nanoparticles with tailored size distribution is created in a magnetron discharge gas aggregation cluster source and combined with a plasma polymerization process of Hexamethyldisiloxane in an Ar/O_2 atmosphere. This process will lead to incorporation of the Ag clusters into the plasma polymer and to formation of the desired nanocomposite material.Variation of size, distance and amount of the Ag nanoparticles allows to tune intensity and wavelength of the silver plasmonic resonance over a broad range. Thus optical properties can be engineered for a desired application. Characterization of the samples with a focus on optical properties was done by TEM, EDX and UV-Vis spectroscopy.

DS 37.6 Thu 15:00 Poster E

Work function measurements of sputtered TiO_2 in UHV ambience — •Sonja Urbahn, Rüdiger M. Schmidt, Alexandra Yatim, and Matthias Wuttig — I. Physikalisches Institut (IA) RWTH-Aachen University

Titanium Dioxide (TiO_2) is a material with unique properties which have led to various applications such as anti-reflective coatings or self-cleaning surfaces. In particular the latter is made possible by its outstanding photocatalytic activity. However, the underlying process behind this attractive feature is still sparsely investigated.

Thus it is the aim of the present work to correlate the structural features of reactively sputtered TiO_2 with its photocatalytic activity to be able to optimize future applications. Since self-cleaning implies the diffusion of photo generated charge carriers to the surface where they react with adsorbates, a change of the photocatalytic activity involves a change of the surface potential and thus of the work function.

We show data measured with a Kelvin probe in UHV-ambience and link the characteristic behavior under UV illumination with structural properties and specific deposition parameters. Additionally we compare the UHV measurements with previously performed experiments in air to gain a deeper insight into the influence of different atmospheres. Our data contribute to the understanding of the photocalytic properties on a microscopic scale.

DS 37.7 Thu 15:00 Poster E

Mode Shape and Dispersion Relation of bending Waves in thin Silicon Membranes — •Reimar Waitz[1], Stephan Nössner[1], Michael Hertkorn[1], Olivier Schecker[1,2], and Elke Scheer[1] — [1]Universität Konstanz — [2]now at: Robert Bosch GmbH

We study the vibrational behavior of silicon membranes with a thickness in the range of a few hundred nanometers and macroscopic lateral size. A piezo is used to couple in transverse vibrations, which we monitor with a phase-shift interferometer using stroboscopic light.The observed wave pattern of the membrane deflection is a superposition of the mode corresponding to the excitation frequency and several higher harmonics. Using a Fourier transformation in time, we separate these contributions and image up to the 8th harmonic of the excitation frequency. With this method we determine the dispersion relation of membrane oscillations in a frequency range up to 12 MHz. We develop a simple analytical model combining stress of a membrane and bending of a thin plate that describes both the experimental data and finite-elements simulations very well. We derive correction terms to account for a finite curvature of the membrane and for the inertia of the surrounding atmosphere. A simple criterion for the transition between stressed membrane and thin plate behavior is presented.

DS 37.8 Thu 15:00 Poster E

Analysis of process parameters for a DCMS process of a rotating ceramic ITO target — •Patrick Ries and Matthias Wuttig — Institute of Physics (IA), RWTH Aachen University

ITO is the most commonly used but at the same time rather expensive Transparent Conducting Oxide. This fact is due to the high Indium to Tin ratio of 90:10 that is necessary to obtain the best electrical conductivity. If it is possible to find another ratio with similar electrical properties but higher Tin content, this would be of great industrial relevance. To accomplish this goal and to check the hypothesis an in-house developed serial co-sputtering system is employed. The tool consists of a rotating primary cathode and up to two secondary cathodes for co-sputtering processes. The process parameters of a DC-sputtered ceramic ITO target installed on the primary cathode are analyzed and correlations with the thin film properties, especially the resistance and the transmittance are shown. The resistance behavior upon changing the Tin content via a co-deposition process from a secondary cathode will be presented.

DS 37.9 Thu 15:00 Poster E

Single-crystalline $CaMoO_3$ and $SrMoO_3$ films grown by Pulsed Laser Deposition in a reductive atmosphere — •Aldin Radetinac[1], Kei S. Takahashi[2], Lambert Alff[1], Masashi Kawasaki[2,3], and Yoshinori Tokura[2,4] — [1]Inst. für Materialwissenschaften, TU Darmstadt, Petersenstraße 23, 64287 Darmstadt, Germany — [2]Cross-correlated Materials Research Group (CMRG), RIKEN, Wako, Saitama 351-0198, Japan — [3]Inst. for Materials Research, Tohoku University, Sendai 980-8577, Japan — [4]Dep. of Applied Physics, University of Tokyo, Tokyo 113-8656, Japan

Single-crystalline thin films of $CaMoO_3$ and $SrMoO_3$ with a Mo^{4+} state perovskite structure have been epitaxially grown by pulsed-laser deposition from Mo^{6+} state ceramic targets [1]. Phase-pure films were obtained on nearly lattice-matched perovskite substrates using argon gas flow during the deposition. Transport properties of the films are consistent with those of paramagnetic and metallic phases, whereas the residual resistivities are far lower than those reported previously for films and bulk polycrystals. These results indicate that this growth method can be useful for exploring the interfaces and junction properties of 4d and 5d transition metal oxides that are unstable in a conventional oxidative atmosphere. This study was partly supported by the Japan Society for the Promotion of Science (JSPS) through its FIRST Program.

[1] A. Radetinac, K. S. Takahashi, L. Alff, M. Kawasaki and Y. Tokura, Appl Phys Express 3 (7) (2010)

DS 37.10 Thu 15:00 Poster E

Photocurrent in sputtered TiO_2 thin films: Investigation of the influence of the measurement ambient on the electronic properties in view of its photocatalytic activity — •Alexandra K. Yatim, Dominik Wagner, Azza Amin, and Matthias Wuttig — I. Institute of Physics IA, RWTH Aachen University, Germany

Titanium dioxide (TiO_2) is a material used in many products of our daily life. However, one of its most attractive qualities is its photocatalytic activity. Since TiO_2 furthermore provides a large refractive index and a high transmittance in the visible spectral region, it has become the material of choice in the fabrication of self-cleaning coatings in the architectural glazing industry. Interestingly, although products already exist on the market, little is known about the underlying mechanism governing the strong photocatalysis. Furthermore, there is no scientific consensus about the functional principle of the self-cleaning and pollution-decomposing effect of TiO_2-coated surfaces. These effects are based on the generation of electron-hole pairs by UV illumination. Although photocurrent measurements are a bulk-sensitive method due to the detection of all free photo-generated charge carriers in the film, the measurements show that the atmosphere has a decisive impact on the photocurrent. This is plausible since the photocatalytic self-cleaning implies the decomposition of adsorbates on the surface, which is accomplished by the diffusion of the charge carriers to the surface. These charge carriers then do not contribute to the current any more. In order to evaluate the influence of ambient air, the electronic processes in TiO_2 at different oxygen partial pressures have been analysed.

DS 37.11 Thu 15:00 Poster E

Controlling the properties of laser deposited polymer-metal nanocomposites close to the percolation threshold — •Felix Schlenkrich, Susanne Schlenkrich, and Hans-Ulrich Krebs — Institut f. Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Polymer-metal nanocomposites consisting of metal clusters embedded in a polymer are of interest for many applications, for instance in microelectronics or sensor technology. For sensors, most interest lies especially in the region close to the percolation threshold, where the film properties drastically change. Such nanocomposites were pulsed laser deposited at $248\,nm$ at fluences of 120 $\frac{mJ}{cm^2}$ in the case of polymers (Polymethyl methacrylate and Polycarbonate) and 4 $\frac{J}{cm^2}$ for metals (Ag, Cu). Enhancing the metal amount within these samples the transition from isolated metal clusters to closed metal layers was studied by electron microscopy and resistance measurements. In this contribution we discuss, how the structural and electrical properties of the composite films depend on the amount of metal deposited on the polymer, the reactivity between metal and polymer, hardness of the polymer, and electrical properties of the components. Then we concentrate on the region close to the percolation threshold, where the electrical conductivity is strongly influenced by the microstructure, and show, how the properties of the polymer/metal composite films can be controlled by heat treatments.

DS 37.12 Thu 15:00 Poster E

IR spectroscopic studies on the influence of Fe and Mg on the Si-O stretching vibration in Fe/Mg-Si-O systems — •Martin Wunder, Steffen Wetzel, and Annemarie Pucci — Kirchhoff-Institut für Physik, INF 227, 69121 Heidelberg

Fe-Mg silicates are among the most abundant minerals in space. Their IR spectral features strongly depend on the chemical composition and formation conditions. Therefore a thorough spectral analysis of the $10\,\mu m$ feature can reveal important information on the dust formation processes. Interfacial interaction effects are generally neglected in such analysis. In order to deepen the understanding of the origin of IR spectral changes, we performed in situ IR spectroscopic transmission measurements during the condensation of layers produced by evaporation of Fe, Mg and SiO under UHV conditions. Particularly we addressed the influence of elemental metal on the $10\,\mu m$ feature of silicates in our experiments. Details of the experimental setup and results from the measurements on multilayer structures and layers formed by co-evaporation will be presented. These measurements demonstrate a strong Fano-type interaction between the metal particles and the Si-O vibration. Furthermore a strong shift of the resonance frequency is observed for co-evaporation experiments.

DS 37.13 Thu 15:00 Poster E

Ink-jet printed conducting oxide nanoinks: processable at room temperature — •Falk von Seggern[1,2], Subho Dasgupta[1],

Robert Kruk[1], and Horst Hahn[1,2,3] — [1]INT, KIT, Eggenstein-Leopoldshafen, Germany — [2]Joint Research Laboratory Nanomaterials, TU Darmstadt and KIT, Darmstadt, Germany — [3]CFN, KIT, Karlsruhe, Germany

A printable grade of ITO-nanoink can offer solutions to a range of practical problems and issues in various important fields of interest which are generally referred under a common platform called *printable electronics*. Printing of ITO inks offer a fast and inexpensive way of producing large area transparent conducting oxide (TCO) films for various applications in this area. Additionally, the piezo-controlled drop-on-demand (DOD) ink-jet printing provides an easy and flexible method of patterning as an alternative for conventional photolithographic processes, although with considerable lower resolution.

We have produced a nanoink based on ITO nanoparticles which is stable over several weeks. This means that no significant agglomeration occurred within this period of time which is necessary to ensure a sufficiently long storage time of such dispersion-based inks. Furthermore, the ink shows nice and stable printing behavior which includes constant drop formation and no clogging of the nozzles etc. Finally, the properties of the printed film are characterized and preliminary results will be presented. We have used piranha treated polymer substrates (PEN) to facilitate the possibility of performing mechanical tests (tensile, bending etc.) in the future.

DS 37.14 Thu 15:00 Poster E

Thermal transformations in Cs_xC_{58} fullerides — •Seyithan Ulas[1], Daniel Löffler[2], Patrick Weis[1], Artur Böttcher[1], and Manfred Kappes[1] — [1]KIT, Institut für Physikalische Chemie, Karlsruhe, Germany — [2]BASF, Intermediates Research, Ludwigshafen, Germany

Monodisperse cluster films consisting of C_{58} fullerene cages have been fabricated by soft-landing of mass-selected C_{58} cations created by electron-impact induced fragmentation/ionization of C_{60} cages [1]. The doping of the C_{58} films by alkali metals leads to the formation of fullerides, Cs_xC_{58} [2]. The temperature resolved mass spectra taken during the sublimation of Cs_xC_{58} phase reveal three well distinguishable components, C_{56}, C_{58} and C_{60}. The new components, C_{56} and C_{58}, indicate the transfer of a C_2 unit from a C_{58} cage to an adjacent one, -[C_{58}]-[C_{58}]→C_{56}+C_{60} to be a process which competes with the breakage of the intercage bonds constituted by non-IPR sites (e.g. 2AP-2AP). The Cs doping raises the $C_{58} \rightarrow C_{60}$ conversion ratio from 0.04 for pristine C_{58} films up to 3.9 for a saturated Cs_xC_{58} phase. Consequently, sublimation of the saturated Cs_xC_{58} fullerides proceeds predominantly via C_{60} emission. The Cs_xC_{58} films survive the annealing procedure (up to 1100K) as a new conducting carbon phase constituted by chains of fused cages which exhibit interesting vibronic and mechanic properties.

[1] A. Böttcher, et al., PCCP 7, 2816 (2005).
[2] D. Löffler, et al. Phys. Rev. B 77,155405 (2008).

DS 37.15 Thu 15:00 Poster E

Thin C_{58} films on Au(111) — Noelia Bajales[1], Stefan Schmaus[1], Thoshio Miyamachi[1], Wulf Wulfhekel[1], Melani Stendel[2], Alexej Bagrets[2], Christian Seiler[2], Ferdinand Evers[2], Seyithan Ulas[3], Bastian Kern[3], •Artur Böttcher[3], and Manfred Kappes[3] — [1]KIT, Physikalisches Institut, Karlsruhe, Germany — [2]KIT, Institut für Theorie der Kondensierten Materie, Karlsruhe, Germany — [3]KIT, Institut für Physikalische Chemie, Karlsruhe, Germany

C_{58} cages have been deposited on the Au(111) surface by means of low-energy cluster beam deposition technique. The properties of thin C_{58} films have been studied by means of scanning tunneling microscopy, 4K-STM, elastic tunneling spectroscopy, STS, ultraviolet photoionization spectroscopy, UPS, and thermal desorption spectroscopy, TDS. In the very initial deposition stages the individual C_{58} cages occupy the elbows of the herringbone reconstruction preferentially. In contrast to highly symmetric C_{60} cages individual C_{58} cages exhibit internal asymmetric structures. Further film growth proceeds via formation of dimers and trimers which act as nucleation centers and govern the growth of 2D and 3D islands. Individual cages can not be desorbed from the surface, i.e. their estimated binding energy overcomes 3 eV. For coverages >0.5 MLE detectable emission of C_{58} cages peaked at 820 K has been observed. This desorption band reveals the thermal decomposition of the quasi-covalent intercage bonds, C_{58}-C_{58}. STS reveals highly asymmetric distribution of the local density of HOMO and LUMO states. For thick C_{58} films a gap of 1.2 eV has been derived.

DS 37.16 Thu 15:00 Poster E

Epitaxial growth of Bismuth on Si(557) — •Saddam Banyoudeh, Daniel Lükermann, Christoph Tegenkamp, and Herbert Pfnür — Leibniz Universität Hannover, Institut für Festkörperphysik, Abteilung ATMOS, Appelstr. 2, 30167 Hannover

Bismuth is a semi-metal with unique electronic properties such as a large carrier mean free path, a small effective mass and high surface conductivity. Because of these attributes Bismuth thin films are an attractive system to study finite size effects and quantum transport phenomena. In our experiment we have investigated the growth of ultra-thin Bi films in the range of 10 to 40 monolayers on different wetting layer phases of Bismuth on vicinal Si(557) by spot profile analysis low energy electron diffraction (SPALEED). The orientation and structure of the films strongly depends on the initial interface. Starting with the Bi-$\sqrt{3}$-α-phase (1/3ML) we obtain 6 domains of Bi(110) with its pseudo-cubic structure rotated by 60° against each other. On the initial Bi-$\sqrt{3}$-β-phase (1ML) rotationally disorderd Bi(110) was formed. But most interesting is the growth of Bi on the so called mixed phase (2/3ML). Here only two domains of Bi(110) where formed which are rotated by 13.5° with respect to the step direction of Si(557). The SPALEED analysis shows that these films are stepped and contain higher index facets.

DS 37.17 Thu 15:00 Poster E

Structural study of amorphous SiCN:H hard coatings — •Andrea Sendzik, Steffen Schulze, Marcus Günther, Frank Richter, and Michael Hietschold — Institute of Physics, Chemnitz University of Technology, Reichenhainer Straße 70, 09126 Chemnitz, Germany

The thin coatings were produced by PECVD. A series of samples has been prepared, differing in terms of gas composition. The composition of the films was determined by ERDA. So it comes out that the silicon to carbon ratio remains nearly constant, but the ratio of nitrogen to silicon strongly depends on the deposition parameters. The atomic structure was investigated by TEM. From diffraction patterns and EELS-spectra findings about the short-range order of atoms, the composition, and the chemical bonding were made. Particular on the basis of the EELS spectra the bonding structure can be seen to vary with the gas rates. Core-level loss spectra indicate that there is predominantly single bonding, with the tendency to multiple bonding with rising nitrogen content. To get more information about the atomic structure, we have calculated the radial distribution functions (RDF) from diffraction patterns. With the help of Gaussian peak fitting one can assign the peaks and identify the elemental bonds occuring in the amorphous coating. With the results from the EELS and the RDF we are able to present a first schematic structure model of the amorphous SiCN hard coatings.

DS 37.18 Thu 15:00 Poster E

Structure and thermal stability of laser deposited ZrO_2/Ti multilayers — •Sarah Hoffmann, Benedikt Ernst, Tobias Liese, and Hans-Ulrich Krebs — Georg-August-Universität, Göttingen, Germany

ZrO_2/Ti thin multilayer systems have important applications in X-ray optics, especially in the 'water window' regime (wavelengths: 2.3-4.4 nm) as X-ray mirrors and multilayer Laue lenses (MLLs) [1]. To increase the resolution of MLLs, which is defined by the thickness of their thinnest layers, it is necessary to prepare as small structures as possible. With regard to the structural stability of the layers a lower limit of the layer thickness can be determined. While using, the X-ray optic may be exposed to elevated temperatures so that a precise knowledge about the thermal stability of these multilayer systems is also required. Several measurement techniques like X-ray reflectometry (XRR including IMD simulations), X-ray diffraction (XRD) and transmission electron microscopy (TEM) were applied to study the structure after preparation and *in situ* the phase transformations of the components during heating. The observed results are discussed with respect to the processes occurring during annealing of the multilayers (structural changes, crystallization of the amorphous oxides, changes in the oxygen content of the layers,...).

[1] T. Liese, V. Radisch, and H.U. Krebs, Rev. Sci. Instrum. 81 (2010) 073710.

DS 37.19 Thu 15:00 Poster E

Influence of the deposition geometry on the microstructure of sputter-deposited V-Al-C-N coatings — Susan Darma[1], •Bärbel Krause[1], Stephen Doyle[1], Stefan Mangold[1], Sven

Ulrich[2], Michael Stüber[2], and Tilo Baumbach[1] — [1]ISS, Karlsruher Institut für Technologie — [2]IAM-AWP, Karlsruher Institut für Technologie

Multi-element hard coating materials such as V-Al-C-N are of great interest for many technological applications. Their mechanical properties depend on the composition and microstructure of the coating. In order to determine the optimum composition and deposition conditions of these complex materials, many samples are required. One powerful tool for reducing the number of experiments is based on the so-called combinatorial approach for thin film deposition: many different thin film samples can be realized simultaneously, exploiting the deposition gradient resulting from codeposition of several materials. We will present an X-ray diffraction study of the influence of the deposition geometry on the microstructure of V-Al-C-N coatings. The films were deposited by reactive RF magnetron sputtering from a segmented target composed of AlN and VC. Synchrotron radiation measurements where performed at the beamline PDIFF at ANKA. Significant texture changes were observed which can be attributed to the deposition geometry, as verified by calculations of the flux distribution. We conclude that codeposition can accelerate significantly the screening of new materials, under the condition that the desired property is not significantly influenced by the microstructural changes due to the deposition geometry.

DS 37.20 Thu 15:00 Poster E

Study of laser deposited W/Si multilayers for high-resolution transmission X-ray optics — •Christian Eberl, Florian Döring, Tobias Liese, and Hans-Ulrich Krebs — Institut für Materialphysik, Georg-August-University, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

High quality non-periodic W/Si multilayers were pulsed laser deposited (PLD) at 248 nm for the use as high-resolution transmission X-ray optics (multilayer Laue lenses) and studied by thickness monitoring, SEM, TEM, and X-ray reflectometry (XRR). Due to the large difference in melting point, the ablation threshold, deposition rate as well as droplet formation of the both components W and Si strongly differ. Furthermore, during deposition of W/Si multilayers thickness deficits up to 2 nm due to resputtering and WSi_2 interlayers occur. Thus, in order to ensure a defined deposition of high-quality multilayers, two distinct element specific sets of optimized preparation conditions had to be worked out. In this contribution, this process of optimization is described in detail and the underlying mechanisms are discussed, also in comparison with SRIM simulations.

DS 37.21 Thu 15:00 Poster E

Spray deposition of polymer thin films investigated by in situ muGISAXS — •Adeline Buffet, Jan Perlich, Matthias Schwartzkopf, Gerd Herzog, Mottakin M. Abul Kashem, and Stephan V. Roth — DESY, Hamburg, Germany

Over the past few years organic-based hybrid devices have attracted increasing interest in both academy and industry because of their potential for low-cost production and flexible device applications [1]. Recently, the novel technique of airbrush deposition was used in the fabrication of organic-based multilayer devices such solar cells [2]. This technique allows for performing rapid deposition of organic-based thin film showing high homogeneity over large areas [3]. We used the versatile technique of microfocus beam Grazing Incidence Small Angle X-ray Scattering (muGISAXS, [4]) to investigate in situ the formation of a polymer thin film on a flat silicon wafer during spray deposition. Given the high photon flux available at the MiNaXS beamline of the PETRA III storage ring at DESY (Hamburg, Germany) in situ investigation of the polymer thin film build-up and of the nanostructure growth kinetics could be achieved with an exceptional time resolution of 50 ms. [1] Kaune et al., Eur. Phys. J. E 26, 73-79 (2008) [2] Green et al., Appl. Phys. Lett. 92, 03330 (2008) [3] Buffet et al., Adv. Eng. Mat. Journal, 12, 1235 (2010) [4] Roth et al., Appl. Phys. Lett., 82, 1935 (2003)

DS 37.22 Thu 15:00 Poster E

Characterization of the ferecrystals $[(SnSe)_{1+x}]_m[MSe_2]_n$ (M= Ta, V) — •Corinna Grosse[1], Saskia F. Fischer[1], Ryan Atkins[2], Wolfgang Neumann[2], and David C. Johnson[2] — [1]Novel Materials, Humboldt-Universität zu Berlin, 10099 Berlin, Germany — [2]Department of Chemistry, University of Oregon, Eugene OR 97401-3753, USA

Ferecrystals are layered intergrowth compounds consisting of different types of nanolayers with in-plane crystallinity and cross-plane turbostratic disorder. Layered structures of WSe_2 prepared by the modulated elemental reactants (MER) method have exhibited the lowest thermal conductivity ever observed in a fully dense solid [1]. However, the structural and electronic properties of many ferecrystals are still unknown. In this study, the ferecrystals $[(SnSe)_{1+x}]_m[MSe_2]_n$ (M= Ta, V) were synthesized by the MER method. Structural investigations of $[(SnSe)_{1+x}]_m[TaSe_2]_n$ were made by (scanning) transmission electron microscopy. The structure of the SnSe and $TaSe_2$ layers was resolved and compared to that of the binary compounds. Respective TEM investigations of $[(SnSe)_{1+x}]_m[VSe_2]_n$ will be made. The in-plane electrical resistivity will be measured as a function of temperature and layer sequence (m and n) using the van der Pauw method. Since the complex nanostructure and small deviations in composition can critically influence the electrical properties, the structural investigations will be correlated to the results of the electrical measurements.

[1] C. Chiritescu, D. G. Cahill, N. Nguyen, D. C. Johnson et al., Science 315, 351 (2007).

DS 37.23 Thu 15:00 Poster E

Shallow donors in rf plasma deposited ZnO:H thin films — •Jan M. Philipps, Jan Stehr, Achim Kronenberger, Angelika Polity, Detlev M. Hofmann, and Bruno K. Meyer — I. Physikalisches Institut, JLU Giessen, Germany

The rf-sputter deposition of ZnO using H_2 as a reactive gas allows modifying the carrier concentration of the films over more than six orders of magnitude. Electron concentrations from $5x10^{14}\,cm^{-3}$ up to $3x10^{20}\,cm^{-3}$ can be obtained by varying the H_2/O_2-ratio in the sputter gas. This makes the material attractive for applications such as TCO (transparent conducting oxides) or heatable windows. In order to investigate the properties of the incorporated donors we performed electron paramagnetic resonance experiments (EPR). In all samples the shallow donor resonance at $g \sim 1.96$ could be detected with similar signal intensity. This was somewhat unexpected since high carrier concentrations above the Mott limit ($\sim 5x10^{18}\,cm^{-3}$) should alter the resonance properties due to motional effects or electric shielding (skin effect). We found that high carrier concentrations have clear effect on the saturation behaviour of the EPR signals causing short relaxation times. The results will be discussed considering the polycrystalline structure of the films.

DS 37.24 Thu 15:00 Poster E

Surface plasmon resonances of Ag and Ag-Au nanoparticles embedded in thin glass surface layers — Manfred Dubiel[1], Jörg Haug[1], Martin Stiebing[1], Maximilian Heinz[1], and •Armin Hoell[2] — [1]Martin Luther University of Halle-Wittenberg, Institute of Physics, Von-Danckelmann-Platz 3, D-06120 Halle — [2]Helmholtz-Zentrum Berlin für Materialien und Energie, Institute of Applied Materials, Albert-Einstein-Strasse 15, D-12489 Berlin

Nano-sized metal particles embedded in glass are of great interest because of their potential application as non-linear material for photonic devices. By sequential high-dose ion implantation of Ag+ and Au+ ions as well as by ion exchange processes of Au-containing glasses metal nanoparticles have been formed in a surface-near region of the soda-lime silicate glass. The measurements of the surface plasmon resonances indicate the generation of homogeneous pure Ag and Au particles, of bimetallic Ag-Au particles or of core-shell structures. With it, the surface plasmon resonance could be adjusted between the resonance of pure Ag and Au nanoparticles by the variation of the composition of particles. In addition, surface plasmon resonances well above 600 nm were found which could be assigned to hollow nanoparticles.

The evaluation of the experimental data of the optical absorption spectra in combination with experiments of transmission electron microscopy and small angle X-ray scattering experiments allowed to explain the processes of nucleation and growth of such particles and to identify their compositions and structures. The optical changes have been examined for different penetration depths of particles.

DS 37.25 Thu 15:00 Poster E

Production and structural characterization of nanolayers of $LiNbO_3$ by wetchemical synthesis — •Doreen Eger, Emanuel Gutmann, Hartmut Stöcker, Erik Mehner, and Dirk-Carl Meyer — TU Bergakademie Freiberg, Inst. für Exp. Physik

There are many known applications of pyroelectrics. Some new ideas, e.g. disinfecting and biocatalytic surfaces, require thin pyroelectric layers on a substrate. A substance with high pyroelectric coefficient is lithium niobate. There, basic investigations of a new method for

manufacturing thin layers of lithium niobate are presented.

The thin layers are produced by dip coating of fused silica in a solvens of lithium niobate. Samples with different drawing speed and reaction temperature are manufactured. The resulting layers are characterized by reflected light microscopy (RLM), atomic force microscopy (AFM) and X-ray diffraction (XRD).

It is proven by XRD that the layers consist of lithium niobate. AFM and RLM show that samples with low drawing speed become so thick that clefts are formed.

Therefore, the manufacturing of nanolayers of lithium niobate with dip coating is possible and reasonable. For an optimization of process parameters for deposition of a defined layer thickness more improvement of the method is necessary, e.g. adding a wetting agent or a conditioning step of the substrate.

DS 37.26 Thu 15:00 Poster E

Production and structural characterization of nanolayers of Ruddlesden-Popper phases $SrO(SrTiO_3)_n$ with n=1, 2 und 3 — •Diana Karsch, Emanuel Gutmann, Hartmut Stöcker, Erik Mehner, and Dirk-Carl Meyer — TU Bergakademie Freiberg, Inst. für Exp. Physik

The strontium titanate Ruddlesden-Popper phases (STO-RP) represent ordered compounds of strontium oxide and strontium titanate with prominent piezoelectric, dielectric and photocatalytic properties. Two different methods for manufacturing nanolayers consisting these compounds are analyzed.

The first method follows the citrate route while the second aimes at additional networking using a modified Pechini route. The prepared sols were characterized by their molecular structure with magnetic resonance spectroscopy and regarding their wetting behavior with viscosity measurements. The films, produced using both methods with different process parameters, were characterized by reflected light microscopy, atomic force microscopy, X-ray reflectometry, X-ray diffraction and spectroskopic ellipsometry.

It turns out that the modified Pechini route results in no additional networking. The annealed films possess a thickness of 75...180 nm and contain solely STO-RP phase $n = 1$ only by adapting the tempering parameters, all STO-RP phases $n = 1, 2$ and $n = 3$ occur together.

DS 37.27 Thu 15:00 Poster E

Strontium Titanate Thin Film Deposition – Structural and Electronical Characterization — •Florian Hanzig[1], Juliane Hanzig[1], Michael Franke[2], Hartmut Stöcker[1], Erik Mehner[1], Barbara Abendroth[1], and Dirk C. Meyer[1] — [1]TU Bergakademie Freiberg, Institut für Experimentelle Physik — [2]TU Bergakademie Freiberg, Institut für Elektronik- und Sensormaterialien

Strontium titanate is on the one hand a widely-used model oxide for solids which crystallize in perovskite type of structure. On the other hand, with its large band-gap energy and its mixed ionic and electronic conductivity, $SrTiO_3$ is a promising isolating material in metal-insulator-metal (MIM) structures for resistive switching memory cells. Here, we used physical vapour deposition methods (e. g. electron-beam and sputtering) to produce strontium titanate layers. Sample thicknesses were probed with X-ray reflectometry (XRR) and spectroscopic ellipsometry (SE). Additionally, layer densities and dielectric functions were quantified with XRR and SE, respectively. Using infrared spectroscopy free electron concentrations were obtained. Phase and element composition analysis was carried out with grazing incidence X-ray diffraction and X-ray photoelectron spectroscopy. Subsequent temperature treatment of samples lead to crystallization of the initially amorphous strontium titanate.

DS 37.28 Thu 15:00 Poster E

Preparation and characterization of Ge2Sb2Te5 phase change films on elastic substrates by pulsed laser deposition — •Hongbing Lu, Erik Thelander, Julia Benke, and Bernd Rauschenbach — Leibniz Institute of Surface Modification, 04318 Leipzig

Ge2Sb2Te5 (GST) thin films have attracted a great deal of interest as an active layer for data storage media due to its high switching rate and extremely good reversibility. Here we demonstrate the preparation of high-quality GST films on elastic polyimide substrates by pulsed laser deposition (PLD). The composition and chemical state of the films were investigated by energy dispersive x-ray spectroscopy (EDX) and x-ray photoelectron spectroscopy (XPS), respectively. The effect of annealing temperature on the crystalline nature of the films was also studied. As-deposited films were found to be amorphous. Crystalline phases with face-centered cubic and hexagonal structures appeared at 180 and 300 degrees, respectively. Importantly, no phase separation could be seen in the annealed films. Furthermore, reflectivity measurements were performed to characterize the as-deposited and annealed films, showing a high reflectivity contrast (up to 23%) between full crystalline and amorphous films. Our results indicate that PLD deposited GST film on polyimide substrate is a promising candidate for use in future flexible memory devices.

DS 37.29 Thu 15:00 Poster E

The ferroelectric transition in the phase-change material GeTe — •Franziska Schlich, Peter Zalden, and Matthias Wuttig — 1. Physikalisches Institut IA, RWTH Aachen University, 52074 Aachen, Germany

Phase-change materials can be cycled between the amorphous and the crystalline phase. This transition is accompanied by a significant change of the electrical resistance. The materials on the pseudo binary line between GeTe and Sb_2Te_3 are particularly suitable for memory devices. The meta-stable crystalline phase of $Ge_2Sb_2Te_5$ has a cubic symmetry and is characterised by atomic displacements and configurational disorder which leads to a localization of charge carriers and semiconducting properties. Also GeTe in its low temperature α-phase is claimed to have pronounced local distortions. Nevertheless in the literature two scenarios have been presented which can explain the transition to the cubic α-phase. One is based on a displacive transformation (Chattopadhyay et al.; J. Phys. C 20, p.1431, 1987) while the second one (Fons et al.; Phys. Rev. B 82, p.1431, 2010) utilizes an order-disorder phase transition.

Therefore we have investigated the phase transition of GeTe whose transition temperature is reported to depend critically on the stoichiometry. We have sputter deposited thin films of approx. 300 nm thickness and obtained $Ge_{53}Te_{47}$. X-ray diffraction (XRD) patterns which include information about the thermal and static disorder of the crystal lattice, have been recorded during heating. From these data we obtain important insight on the nature of the phase transition.

DS 37.30 Thu 15:00 Poster E

Spectroscopic Investigation of $LaAlO_3$ - $SrTiO_3$ Heterointerfaces — •Uwe Treske[1], Andreas Koitzsch[1], Martin Knupfer[1], Kathrin Dörr[2], and Bernd Büchner[1] — [1]IFW-Dresden — [2]MLU Halle-Wittenberg

In recent years epitaxial growth of transition metal oxides became possible and exotic phenomena were found at their interfaces. A prominent example is the formation of a high-mobility two-dimensional electron gas at the interface of $LaAlO_3$ grown on TiO_2-terminated $SrTiO_3$ substrates. Such heterointerfaces fabricated by pulsed laser deposition under various growth conditions were investigated with soft x-ray photoemission spectroscopy. We focused on stoichiometric aspects as well as in-gap states and differences in the core levels. Deviations from an abrupt interface without defects were found.

DS 37.31 Thu 15:00 Poster E

Ultra-thin TiO_x films on Pt(111): effect of the preparation parameters on the electronic and local structure. — •Mathias Glaser and Thomas Chassé — Universität Tübingen, Institut für Physikalische und Theoretische Chemie, Auf der Morgenstelle 18, 72076 Tübingen

Ultra-thin TiO_x films on Pt(111) are promising model systems for the investigation of catalysis and are well suited for the investigation of oxide-oxide interphases. Carefully controlled preparation conditions are necessary during reactive evaporation of Ti in an O_2 environment to obtain high quality films.

We investigated the electronic structure and the oxidation states of the different chemical elements of such ultra-thin films by x-ray photoelectron spectroscopy (XPS). The comparison of Ti2p core level spectra of different TiO_x films shows the influence of different preparation parameters like evaporation and substrate temperature.

In order to investigate the local structure we used electron diffraction methods. Some of the films show the same patterns described in literature [1] before but were prepared by using other preparation parameters.

[1] F. Sedona et al., J. Phys. Chem. 2005, 109, 24411-24426.

DS 37.32 Thu 15:00 Poster E

Texture analysis of MgO layers in MgO-CoFeB thin film systems by HRTEM — •Patrick Peretzki[1], Vladyslav Zbarsky[2], Marvin Walter[2], Henning Schuhmann[1], Filip Podjaski[1],

Markus Münzenberg[2], and Michael Seibt[1] — [1]IV. Physikalisches Institut, Georg-August-Universität Göttingen — [2]I. Physikalisches Institut, Georg-August-Universität Göttingen

Magnetic tunnel junctions (MTJs) consisting of two ferromagnetic amorphous CoFeB electrodes separated by a crystalline MgO tunnel barrier are good and well-studied candidates for industrial use of the tunnel magnetoresistance (TMR) effect for a variety of applications. Practical use requires a clearly defined nanostructure of the MgO barrier which is only a few monolayers thick and tends to crystallize in a textured grain structure. However, the exact influence of the degree of texturing on the MTJ behaviour, for example the TMR value or the mechanism of dielectric breakdown, is not clear. To clarify this, first steps were taken in developing a quantitative assessment of the MgO degree of texturing in several layer stacks with varying deposition temperature, layer order and thicknesses. Two approaches have been implemented and evaluated to quantitatively analyse the MgO layer texture from High Resolution Transmission Electron Microscopy (HRTEM) images obtained from the layer stacks. They use Fourier transform and Hough transform of the images, respectively. Results indicate a cumulative roughness effect in the stacks with layers having high degrees of texturing. We thank the DFG for funding through SFB 602.

DS 37.33 Thu 15:00 Poster E

Spatially Resolved MOKE Spectroscopy — •Peter Richter, Michael Fronk, Alexander Kopylov, Dietrich R.T. Zahn, and Georgeta Salvan — Semiconductor Physics, Chemnitz University of Technology, 09107 Chemnitz

The measurement of the magneto-optic Kerr-effect (MOKE) yields information on the magnetic properties of para- and ferromagnetic thin films and can be used to characterize them with regard to spin polarization. This helps to assess their potential for spintronic devices or for modern magnetic data storage. Since samples of such materials often show structures on the micro- and nanoscopic scale, the use of a divergent light source with a large spot size (*e.g.* a Xe-lamp) for spectroscopic MOKE measurements provides averaged information. This work presents the experimental realization of a MOKE setup which uses a supercontinuum white light source (λ = 450 to 1000 nm) to achieve a μm-scale resolution for spatially resolved spectroscopic MOKE measurements. This setup furthermore allows measurements in the polar and in the longitudinal MOKE geometry, with the latter allowing materials with in-plane magnetic anisotropy to be investigated. The layout of the new setup and important hardware parts are described in detail. Finally, exemplary spatially resolved spectroscopic MOKE measurements of cobalt and nickel micro-electrodes for spintronic devices are presented.

DS 37.34 Thu 15:00 Poster E

Investigation of local texture and crystallite size in thin FePtCu films via EBSD — •Nathanael Jöhrmann, Herbert Schletter, Christoph Brombacher, Manfred Albrecht, and Michael Hietschold — Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz

FePt shows a very high uniaxial magnetocrystalline anisotropy in its chemical ordered $L1_0$ phase. Therefore thin FePt films are a promising candidate to raise the storage density of magnetic storage devices. For such applications it is necessary to grow films with (001) texture. The addition of copper can improve the texture formation during annealing [1].

In this work a FePtCu alloy with 9 at.% Cu was investigated via electron backscatter diffraction. The film was prepared by magnetron sputtering of 0.6 nm Cu and 4.4 nm FePt at room temperature on a thermally oxidized Si(100) substrate, followed by rapid thermal annealing to 600 °C for 30 s. Because of the small observed crystallite sizes in a range of 10 - 100 nm it proved difficult to obtain good electron backscatter diffraction patterns. To improve spatial resolution, the acceleration voltage of the electrons in the scanning electron microscope was optimized. In another approach, the substrate was thinned from the back to a thickness of approximately 100 nm, to reduce the interaction volume of the primary electrons.

[1] M. L. Yan et al., J. Appl. Phys. 99, 08G903 (2006)

DS 37.35 Thu 15:00 Poster E

STM studies of epitaxial grown iron films on MgO(001) — •Christian Otte, Martin Suendorf, and Joachim Wollschläger — Barbarastr. 7, 49076 Osnabrück

Due to their electric and magnetic properties, ultra thin iron films are a considerable candidate for spintronic applications. Therefore, ultra thin epitaxial grown iron films were prepared on MgO(001) under UHV conditions and investigated using Scanning Tunneling Microscopy. Au contatcs were applied to the substrate via Molecular Beam Epitaxy (MBE) prior to film depostition in order to provide electrical contact to the film. The films were deposited by MBE using different depostition rates and substrate temperatures.

A strong depency between the growth of the films and the substrate temperature was observed which results in different kinds of growth mode, island shape and island size. A transition from *Volmer-Weber-growth* to *Frank-van der Merve growth* was observed with increasing substrate temperature.

DS 37.36 Thu 15:00 Poster E

Oxidation of iron films on MgO(001) — •Tobias Schemme, Martin Suendorf, Frederic Timmer, and Joachim Wollschläger — Barbarastr. 7, 49076 Osnabrück

The oxidation of ultrathin iron films on MgO(001) substrates was investigated by photoelectron spectroscopy and electron diffraction. First a layer of iron was deposited on the substrate using molecular beam epitaxy (MBE) at room temperature. The iron films were annealed several times in a thin oxygen atmosphere ($p(O_2) = 10^{-6}$ mbar). To determine the dependence of the annealing temperature on the oxidation process, the iron films were heated up to different temperatures (RT until 573 K). The stoichiometric composition and the structure of the iron oxide films were investigated by X-ray Photoelectron Spectroscopy (XPS) and Low Energy Electron Diffraction (LEED), respectively. Analyzing the Fe 2p and the Fe 3p signal, the iron oxide films show stronger oxidation at high temperatures. While the iron films were not completely oxidized to Fe_2O_3 after a few oxygen treatsments at low temperatures, the iron films annealed at higher temperatures showed full oxidation to stoichiometric Fe_2O_3.

DS 37.37 Thu 15:00 Poster E

Novel high-temperature films consisting of mass selected carbon clusters — •Artur Böttcher, Seyithan Ulas, Patrick Weis, and Manfred Kappes — KIT, Institut für Physikalische Chemie, Karlsruhe

Cluster beam deposition has been established as a method for preparation of monodisperse films consisting of tailored building blocks. We fabricated thick films via aggregation of small fullerene cages, C_n ($48 < n < 70$). Such carbon cages are created by electron-impact inducend ionization/fragmentation of IPR cages: C_{70}+ e→ C_{68}+C_2 → C_{66}+C_2 →... Film growth is governed by the formation of -C_n-C_n- oligomers interlinked by covalent bonds constituted by nIPR-nIPR bridges. All C_n films created are semiconducting with electronic and vibronic properties depending on the size of the C_n building blocks (IP, HOMO-LUMO-gap, valence band, etc.). The thermal stability of the C_n films can be related to the mean number of non-IPR sites in C_n cage. Some Raman bands confirm the role of the covalently stabilized oligomers as the species responsible for unique mechanical and thermal properties. The C_n solids exhibit mechanical properties comparable to graphite. Annealing the C_n solids up to 1100 K results in stable chains of fused C_n cages (HT-C_n solids).

DS 37.38 Thu 15:00 Poster E

The impact of phase segregation on the electrical properties of $GeTe_{1-x}$ $SnTe_x$ alloys — •Felix Lange, Hanno Volker, Peter Zalden, and Matthias Wuttig — 1. Physikalisches Institut IA, RWTH Aachen University

Phase-change alloys are a unique class of materials that can be reversibly switched between their amorphous and crystalline phase. This transition is accompanied by a significant change in physical properties such as reflectivity and electrical conductivity. Especially the current induced phase transition within nanoseconds [1] makes PCM valuable for non volatile RAM application.

The common PCMs are tellurium based chalcogenides with an average number of three p-electrons per atom in their outer electronic shell. Since the p-band is half-filled it is expected that these alloys develop a band-gap due to Peierls distortions resulting in a thermally activated charge transport. However, experimentally PCM are found to be degenerate semiconductors with carrier concentration in the range of 10^{20} $1/cm^3$. Edwards *et al.* [2] recently showed that it is favorable in GeTe to formvacancies on the cation site that shift the Fermi-level well inside the valence band.

This work focuses on the electrical properties of $GeTe_{1-x}SnTe_x$ al-

loys. Low temperature electrical conductivity data are interpreted in terms of phase segregation in crystalline $GeTe_{1-x}SnTe_x$ and amorphous Ge.

[1] G. Bruns *et al.*, Appl. Phys. Lett. **95**, 043108 (2009)
[1] Edwards *et al.*, Phys. Rev. B **73**, 045210 (2006)

DS 37.39 Thu 15:00 Poster E

Preparation and Characterisation of LIPON thin films — •Susann Nowak, Frank Berkemeier, and Guido Schmitz — Westfälische Wilhelms-Universität Münster, Institut für Materialphysik, Wilhelm-Klemm-Str. 10, 48149 Münster

We present the preparation of LIPON (lithium phosphorous oxynitride, $Li_3N_x(PO_4)_{1-x}$) thin films by reactive ion-beam sputtering, and the characterization of the films by temperature-dependent electrochemical impedance spectroscopy (EIS), X-ray diffraction (XRD) and transmission electron microscopy (TEM). Despite LIPON is widely discussed as a suitable electrolyte for all solid-state thin film batteries, there are only a few publications reporting on films that exhibit a thickness below 1 μm. Therefore, in this work we investigate the properties of LIPON films with a thickness between 50 and 500 nm. Ion beam sputter deposition results in amorphous LIPON layers, as observed by XRD and TEM. Temperature dependent measurements of dc-conductivity by EIS give a conductivity of $5 * 10^{-7}$ S/cm at 30°C and an activation enthalpy of (58 ± 2) kJ/mol, and hence allow to operate the LIPON films in all-solid state batteries at room temperature, with a reasonable charge/discharge performance. Additionally, thin film batteries have been prepared by depositing a LIPON layer between two metallic electrodes (e.g. Pt and Ag). It is shown that during the first cycle of cyclic voltammetry measurements, electrochemically active interface regions are formed, serving as anode and cathode, respectively, and thus forming a complete electrochemical thin-film cell, which is further investigated by means of EIS and TEM.

DS 37.40 Thu 15:00 Poster E

Towards circularly polarized (sub-) femtosecond XUV pulses for ultrafast pump-probe experiments — •Jürgen Schmidt[1], Alexander Guggenmos[2], Michael Hofstetter[2], Soo Hoon Chew[1], Mihael Kranjec[1], and Ulf Kleineberg[1] — [1]LMU München, Physik-Department, Garching — [2]MPQ für Quantenoptik, Garching

Circularly polarized (CP) XUV radiation has been demonstrated to be a useful probe for the experimental investigation of electronic effects in magnetic materials such as magnetic circular dichroism, spin-polarized photoemission, magneto-optical Kerr-effect and others. On the laboratory scale, High Harmonic (HH) gas jet sources which inherently provide coherent and ultrashort linearly polarized XUV pulses in the subfs domain, suitable to study ultrafast dynamics, have emerged. In our setup we aim at incorporating in-house fabricated broadband transmission multilayer phase shifters into a laser driven 10kHz repetition rate HH Source in the 50-70eV photon energy range. To our knowledge only little investigation on such polarizers intended for use in HH radiation has been made so far. We examine our phase shifters regarding tunability of energy range, phase retardation, transmission efficiency and spectral bandwidth. For this purpose we use a home-made XUV flatfield spectrometer and a multilayer mirror based polarization analyzer. Combining the expected CP pulses with our TOF-PEEM and ARPES spectrometer will pave the way towards time resolved measurements of exchange-coupled electron dynamics.

DS 37.41 Thu 15:00 Poster E

Multilayer zone plates for x-ray focusing fabricated by pulsed laser deposition — •Florian Döring, Christian Eberl, Tobias Liese, and Hans-Ulrich Krebs — Institut für Materialphysik, University of Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

X-ray microscopy in the soft and hard regime is a highly useful technique for biological and materials sciences, polymer research, colloidal science and even earth science. One alternative approach for two-dimensional x-ray focusing is to prepare non-periodic multilayer structures. They can be designed in zone plate geometry by depositing high quality non-periodic multilayers on wires according to the Fresnel zone plate law. For this, ZrO_2/Ti and W/Si multilayers with high optical contrast in the soft and hard x-ray region, respectively, were pulsed laser deposited (PLD) at 248 nm. In this contribution, the growth of multilayers on flat and curved surfaces (studied by electron microscopy after focused ion beam preparation) is compared, and the fabrication steps of different zone plate structures are presented.

DS 37.42 Thu 15:00 Poster E

Atomically precise deposition control of multilayer mirrors-towards attosecond water window experiments — •Alexander Guggenmos[1,2], Michael Hofstetter[1,2], Ferenc Krausz[1,2], and Ulf Kleineberg[1,2] — [1]Ludwig-Maximilians-Universität München, Garching, Deutschland — [2]Max-Planck-Institut für Quantenoptik, Garching, Deutschland

Extending current attosecond technology to the water window range (300-500 eV) may not only enable the generation of ever shorter pulses; it will further allow for the investigation of the underlying electron dynamics of fundamental biological processes such as photosynthesis.

Only aperiodic multilayer optics can exhibit the required degree of freedom for the synchronization and tailored shaping of attosecond pulses in that energy range.

With typical layer thicknesses of less than 1 nm, atomically precise knowledge of the intrinsic built-up of the individual layers and atomically precise control over the deposition process is required. As will be shown, ion beam sputter deposition in combination with sophisticated measurement techniques succeeds the required precision and enables a statistical accuracy far beyond 1 Angstrom.

We will present results from these elaborate calibrations, which enabled the fabrication of even three and four material aperiodic attosecond water window multilayer mirrors. These mirrors pave the way towards taylor-made attosecond pulses in the water window spectral range.

DS 37.43 Thu 15:00 Poster E

Pulsed DC Magnetron Sputtered TiO_2 Layers Optimized for Photocatalytic Efficiency — •Bodo Henkel, Thomas Strunskus, Vladimir Zaporojtchenko, Stefan Rehders, and Franz Faupel — Institute for Materials Science, Kiel, Germany

Pulsed DC Magnetron Sputtering was used to produce highly photocatalytically active TiO_2 layers on quartz glass. For measuring photocatalytic efficiency, degradation of methylene blue in combination with in situ UV-vis measurement was used. UV LEDs with 365 nm wavelength were taken to irradiate the TiO_2 layer. The influence of various sputter parameters was examined as well as post annealing time and temperature. To indicate correlation to effective surface area, roughness and crystallinity, AFM and XRD measurements were done.

DS 37.44 Thu 15:00 Poster E

Functional thin films prepared by high power impulse magnetron sputtering — •Vitezslav Stranak[1], Harm Wulff[1], Robert Bogdanowicz[1], Henrike Rebl[2], Carmen Zietz[3], Zdenek Hubicka[4], Kathleen Arndt[5], Barbara Nebe[2], Rainer Bader[3], Andreas Podbielski[5], and Rainer Hippler[1] — [1]University of Greifswald, Institute of Physics, Felix-Hausdorff Str. 6, 17489 Greifswald, Germany — [2]University of Rostock, Biomedical Res. Center, Schillingallee 69, 18057 Rostock, Germany — [3]University of Rostock, Dept. of Orthopaedics, Doberaner Str. 142, 18057 Rostock, Germany — [4]Academy of Sciences of the Czech Republic, Inst. of Physics, Na Slovance 2, 180 00 Prague, Czech Republic — [5]University of Rostock, Dept. of Med. Microbiol., Virology and Hygiene, Schillingallee 70, 18057 Rostock, Germany

Antibacterial effect of thin titanium/copper (Ti-Cu) films in combination with growth of human osteoblastic cells on the surface is reported. Thin films were prepared by dual-High Power Impulse Magnetron Sputtering (dual-HiPIMS). The quality and properties of deposited films are influenced by internal plasma parameters (mainly by the energy of particles incoming to the growing film). The Ion Velocity Distribution Function (IVDF) was measured by a retarding field analyzer (RFA). It was found that films are copper rich with a density close to pure bulk Cu material (investigated by GIXD and XR techniques). This effect, together with larger domain size, results from the high energy of sputtered particles during HiPIMS pulses.

DS 37.45 Thu 15:00 Poster E

CO2-Methanation by Catalytic Conversion — •Klaus Müller, David Hoffmannbeck, Georg Kirner, Matthias Staedter, and Dieter Schmeisser — Angewandte PhysikII/Sensorik, BTU Cottbus, Konrad Wachsmann Allee 1, 03046 Cottbus

The utilization of CO2 as raw material is an important component of a program for CO2 reduction. A possibility is the production of methane. At a moderate temperature of around 350°C, hydrogenation of CO2 to methane is possible by the Sabatier reaction CO2 + 4H2 ->CH4 +2H2O. Prerequisite for an efficient kinetics of the Sabatier

reaction is the application and optimization of catalysts. In this contribution, we present investigations of Ru and Ni catalysts on different substrates. For Ru/Al2O3 catalysts, we found stable operation without degradation within 500 hours with a conversion rate of 80% at 350°C. For NiO/SiO2 catalysts, a conversion rate of 90% was found for temperatures of 350-405°C. We also show the investigation of cross sensitivities against SOx and NOx, which are typical contaminations of CO2, generated by the industrial oxyfuel process. In our work the morphology (REM, AFM, specific surface), chemical composition (FTIR, XPS) and phase composition (XRD) of the catalysts are characterized. In addition, we report on thermodesorption (TDS) measurements at atmospheric pressure to determine the amount of adsorbed CO2 under real conditions. The project is funded by the German Ministry of Research and Education (BMBF-GeoEn).

DS 37.46 Thu 15:00 Poster E

Thermal conductivity measurements of $(GeTe)_{1-x}(SnTe)_x$ phase-change alloys — •Kai Hugenroth, Karl Simon Siegert, Felix Lange, Roland Sittner, and Matthias Wuttig — 1. Physikalisches Institut IA, RWTH Aachen, 52064 Aachen

Phase-change materials (PCM) are a versatile class of materials with a broad range of applications, for instance as memory cells. For decades, PCM's were the standard material for optical data storage applications, such as CD-RW's and DVD-RW's. They are also promising for the development of electronic memories, such as Random Access Memory (PC-RAM), capitalizing on the rapid crystalline-amorphous phase-transition which occurs within nanoseconds.

This work focuses on the thermal conductivity κ of phase change materials, along the pseudo binary line from GeTe to SnTe [1]. κ is a central attribute for memory applications. Low thermal conductivities enable the design of very small memory-cells in the order of a few nanometers, thus allowing further miniaturization of mobile electronic devices. This is a highly important aspect, concerning feature sizes of alternative approaches, such as classic D-RAM or Flash-memory.

The measurements of κ are conducted at low temperatures from 40 K to 300 K, using the 3ω-method. A new measurement scheme for low temperatures is developed. The impact of different heater materials is taken into account, since deposition, adhesion and temperature stability as well as 3ω-compatibility are important aspects for successful analysis.

[1] D. Lencer et al. Nature Materials 7, 972-7 (2008).

DS 37.47 Thu 15:00 Poster E

Non-invasive measurement and control of the temperature of Pt nanofilms on Si supports — •Jan Philipp Meyburg[1], Ievgen Nedrygailov[1], Eduard Karpov[2], Eckart Hasselbrink[1], and Detlef Diesing[1] — [1]Fakultät für Chemie, Universität Duisburg-Essen, D-45117 Essen, Germany — [2]Department of Civil & Materials Engineering, University of Illinois, Chicago, IL 60607, USA

A direct, non-invasive thermometry method based on the temperature dependence of the in-plane electrical resistance of Pt nanofilms deposited on commercial n-Si (111) substrates was developed in order to study the water formation reaction. At the calibration stage, the entire sample was slowly heated by external means. Experiments were carried out for hydrogen−oxygen mixtures in different molar ratios and pressures in the range of 2−30 mbar. To ignite the hydrogen−oxygen mixtures the Pt nanofilm was directly heated up to 500 °C by passing an electric current through it. Both, surface-catalyzed heterogeneous and homogeneous gas-phase reactions were identified. During the reaction process the resistance of the Pt nanofilm was monitored. The temperature of the Pt nanofilm was calculated using the Callendar−Van Dusen equation which describes the relationship between the temperature and the resistance of Pt thermometers. The accuracy of the present method for dynamical temperature measurement is found to be significantly better than that of a standard approach using a Pt RTD sensor. The validity of this method for Pt nanofilms on silicon is discussed.