DS 31: Poster Session II

Time: Thursday 11:15–13:15 Location: Poster F

DS 31.1 Thu 11:15 Poster F

Morphology and crystallinity of $Sr_xCo_yO_z$ films at different growth conditions and stoichiometry — •Patrick Schöffmann[1], Sabine Pütter[1], Jürgen Schubert[2], Willi Zander[2], Markus Waschk[3], Paul Zakalek[3], and Thomas Brückel[3] — [1]Jülich Centre for Neutron Science (JCNS) at Heinz Maier-Leibnitz Zentrum (MLZ), Forschungszentrum Jülich GmbH, Garching — [2]Peter Grünberg Institut (PGI-9), Forschungszentrum Jülich GmbH — [3]Jülich Centre for Neutron Science JCNS and Peter Grünberg Institut PGI, JARA-FIT, Forschungszentrum Jülich GmbH

Strontium cobaltite ($SrCoO_{3-\delta}$) exists in two topotactic phases, depending on the oxygen content. $SrCoO_3$ is a ferromagnetic metal (T_C=305K) with perovskite structure while $SrCoO_{2.5}$ is an antiferromagnetic insulator(T_N=570K) with brownmillerite structure. Because of the multivalent Co states and high oxygen mobility it is a promising material for energy and information applications. [1]

We aim at growing thin films of $SrCoO_{3-\delta}$ by molecular beam epitaxy and filling the oxygen vacancies by oxygen plasma assisted annealing. Achieving a 1:1 stoichiometry by co-evaporation of Sr and Co requires tuning of the individual growth rates, which is not straightforward as there are three constituents with different sticking coefficients.

We present the effect of the growth conditions on the stoichiometry, crystallinity and morphology of $Sr_xCo_yO_z$ films on STO and requirements for $Sr_1Co_1O_{2.5}$ films. First results of decreased oxygen vacancies by annealing in a low pressure oxygen atmosphere are discussed.

[1] H. Jeen et al., Nature Materials 12, 2013

DS 31.2 Thu 11:15 Poster F

Understanding and controlling the growth of carbon nanowalls — •Sebastian Tigges[1,2], André Giese[1], Axel Lorke[1,2], and Nicolas Wöhrl[1,2] — [1]Universität Duisburg-Essen, Faculty of Physics, 47057 Duisburg, Germany — [2]Center for Nanointegration Duisburg-Essen, 47057 Duisburg, Germany

Carbon nanowalls (CNWs) exhibit exceptional thermal as well as electrical conductivity. Their surface area may be controlled simply by adjusting process parameters. This makes them especially attractive for application in sensors and energy technology. Extensive research has been undertaken to understand the complex mechanisms contributing to the growth of CNWs. The most important challenge is proper understanding of growth mechanisms to directly control morphology/structure. Here, we investigate the different CNW structures that are obtained by tuning process parameters such as temperature, substrate bias, flow rate of precursor gas, and pressure in our inductively coupled plasma enhanced CVD system. CNW structures of varying height, inter-wall distance and morphology are obtained. They are characterized and distinguished via scanning electron microscopy and Raman spectroscopy. Plasma characterization is done by optical emission spectroscopy and quadrupole mass spectrometry. Particularly Raman spectroscopy shows important variation in both defect density and defect type. Furthermore formation of different CNW structures is observed, which changes with residual time of the complex precursor molecule used as carbon source. This way a simple growth model is derived.

DS 31.3 Thu 11:15 Poster F

Influence of O_2/N_2 Gas Compositions on PECVD deposited Silicon Oxide Films — •Philipp Moritz[1,2], Simon Homann[1,2], Lisa Wurlitzer[1,2], and Wolfgang Maus-Friedrichs[1,2] — [1]Institute of Energy Research and Physical Technologies, Clausthal University of Technology, Leibnizstr. 4, 38678 Clausthal-Zellerfeld — [2]Clausthal Centre of Material Technology, Clausthal University of Technology, Agricolastr. 2, 38678 Clausthal-Zellerfeld

Plasma enhanced chemical vapor deposition (PECVD) is an established process to deposit solid coatings. We used PECVD with a tetraethyl orthosilicate (TEOS) precursor to coat titanium substrates with silicon oxide. In order to this the substrate was exposed to TEOS with a carrier gas mixture of O_2 and N_2. For the experiments a dielectric barrier discharge plasma was used under atmospheric pressure. It causes a reaction of the TEOS to form a solid film of silicon oxide.

To optimize the stoichiometry and morphology of the deposited coating the gas composition of O_2 and N_2 is varied. The total gas flow is kept constant. Investigations with X-ray photoelectron spectroscopy (XPS) and atomic force microscopy (AFM) show significant differences in the stoichiometry and morphology of the coatings dependent on the gas composition.

DS 31.4 Thu 11:15 Poster F

Preparation and characterisation of carbon-free Cu(111) films on sapphire for graphene synthesis — •Jan Lehnert, Daniel Spemann, M.Hamza Hatahet, Michael Mensing, Christoph Gruner, Patrick With, Philipp Schumacher, Annemarie Finzel, Dietmar Hirsch, and Bernd Rauschenbach — Leibniz Institute of Surface Engineering (IOM), Leipzig, Germany

This work presents an investigation of unwanted carbon formed on polycrystalline Cu(111) thin films. The goal is to obtain carbon-free Cu films as a substrate for controlled graphene synthesis. Cu films were prepared by ion beam sputtering at room temperature on c-plane Al_2O_3. These films had been thermally treated in a temperature range between 300 and 1020 °C. The crystallinity of the Cu films was studied by XRD and RBS/channeling and the surface was characterised by Raman spectroscopy, XPS and AFM for each annealing temperature. RBS measurements revealed the diffusion of the Cu into the Al_2O_3 substrate at high temperatures of > 800 °C. Furthermore, a cleaning procedure using UV ozone treatment is presented to remove the carbon contamination from the surface which yields essentially carbon-free Cu films that open the possibility to synthesise graphene with controlled number of graphene layers. On these Cu substrates, graphene was synthesised by carbon ion implantation and subsequent annealing. These graphene layers were transferred to a SiO_2/Si waver using a standard wet-chemistry approach. Raman and AFM measurements were performed to investigate the quality of the transferred graphene layers.

DS 31.5 Thu 11:15 Poster F

Ge_2Fe thin films grown by solid-phase epitaxy — •Samuel Gaucher[1], Bernd Jenichen[1], Michael Hanke[1], Achim Trampert[1], Holm Kirmse[2], Steven C. Erwin[3], and Jens Herfort[1] — [1]Paul-Drude-Institut für Festkörperelektronik, Berlin, Germany — [2]Humboldt-Universität zu Berlin, Berlin, Germany — [3]U. S. Naval Research Laboratory, Washington, D. C., USA

To grow an epitaxial semiconductor over a ferromagnetic metal, a solid-phase epitaxy (SPE) approach was recently developed, whereby amorphous Ge is crystallized slowly by annealing over Fe_3Si. It was realized that a sufficiently thin Ge layer would incorporate Fe and Si atoms to form an ordered superlattice, with 2D planes of Fe atoms interposed between tetragonal Ge formations. This crystal structure is understood as Ge_2Fe (with some Si on Ge sites), a compound that is not energetically stable as a bulk material. By growing Fe_3Si and Ge in the right proportions (1:3), it was possible to use SPE to achieve isolated single-crystalline Ge_2Fe films, directly on GaAs substrates, with thicknesses ranging from 8 to 20 nm. Ge_2Fe thin films are ferromagnetic at low temperature and show strong magnetocrystalline anisotropy, with thickness dependent coercivity on the order of 200 Oe along the easy magnetization axis. The material has a room temperature resistivity $\rho \sim 8 \times 10^{-6}\Omega$ m along the Fe basal planes, which decreases as a metal when temperature is lowered. Alike other thin Fe-Ge compounds, Ge_2Fe is a possible candidate to host topological magnetic skyrmions, among other interesting micromagnetic phenomena.

DS 31.6 Thu 11:15 Poster F

The impact of various substrate pretreatments on the growth of chalcogenide thin films — •Brigitte Baumkötter[1], Matthias M. Dück[1], and Matthias Wuttig[1,2] — [1]I. Physikalisches Institut (IA), RWTH Aachen University, D-52056 Aachen, Germany — [2]JARA-FIT, RWTH Aachen University, Germany

Phase change materials (PCMs) are remarkable due to a unique combination of optical and electrical properties featuring a strong contrast between the crystalline and the amorphous phase. These characteristics have been used for optical data storages for a long time and are now about to revolutionize the field of electronic non-volatile memories.

The microstructure of a thin film may influence its properties, and is therefore an obstacle for measurements of reproducible material properties. However, utilizing thin films is mandatory due to the strong disorder dependence of many PCMs, which cannot be easily repro-

duced in a single crystal. Due to the anisotropic structure of materials from the pseudo-binary line GeTe-Sb_2Te_3 (GSTs) orientation dependent measurements are of special interest. Especially infrared spectroscopy enables new insights on the effect of disorder, which induces a metal to insulator transition in several PCMs of this class.

Besides texture, two major requirements for optical measurements are a thick film of around 500 nm and a low surface roughness. Therefore, an optimized thick film with a strong texture and a smooth surface is necessary. As the substrate and its surface has a crucial influence on the structure of grown films, this study focuses on the influence of different substrate pretreatments on the film quality.

DS 31.7 Thu 11:15 Poster F

Nanocrack networks: a systematic approach for surface tailoring of sputter deposited oxide thin films — •Alexander Vahl[1], Jan Dittmann[1], Bodo Henkel[1], Oral Cenk Aktas[1], Thomas Strunskus[1], Suman Kumar Sharma[2], and Franz Faupel[1] — [1]Christian-Albrechts University at Kiel, Institute for Materials Science, Chair for Multicomponent Materials, Kaiserstr. 2, 24143, Kiel, Germany — [2]Department of Physics, Malaviya National Institute of Technology, Jaipur 302017, India

Surface roughness is a critical parameter for various thin film applications, influencing properties like wetting and catalytic performance. Thermally induced nanocrack network formation is an efficient tool to modify the surface of thin films. We report on the fundamental process of nanocrack network formation, showcased at the example TiO2 and Al2O3 thin films deposited by pulsed reactive DC magnetron sputtering. In case of TiO2, the amount of oxygen during the deposition process was found to be crucial for the formation of crystalline anatase seeds in the as deposited thin film. In a post deposition heat treatment step, the preexisting structural features densified and gave rise to a connected network of nanoscopic cracks. In case of Al2O3, independent of the oxygen content the thin film showed high resiliency against crystallization and accordingly no connected nanocrack network was observed.

DS 31.8 Thu 11:15 Poster F

B-site Ordering in La2CoMnO6 Films: Influence of Lattice Strain — •Philipp Ksoll[1], Christoph Meyer[1], Sven Esser[2], Vladimir Roddatis[3], and Vasily Moshneaga[1] — [1]Erstes Physikalisches Institut, Georg-August-Universität Göttingen, Deutschland — [2]Lehrstuhl für Experimentalphysik VI, Institut für Physik, Universität Augsburg, Deutschland — [3]Institut für Materialphysik, Georg-August-Universität Göttingen, Deutschland

Physical properties of double perovsikte (DP) with general formula A2BB'O6 (A=rare earth or alkaline earth metals: B/B' = Co/Mn, Ni/Mn, Fe/Mo) depend strongly on the degree of B-site ordering. To optimize and control the structure, magnetism and electrical properties we further developed the metalorganic aerosol deposition (MAD) technique to grow DP films in a layer-by-layer (LL) mode under a precise control of oxygen atmosphere during deposition process. Epitaxial films of the prototype DP La2CoMnO6 have been LL-grown on (111)-oriented SrTiO3, LaAlO3 and Al2O3(0001) substrates and characterized by global (x-Ray, SQUID, Raman) and local (TEM) techniques. The role of substrate-induced epitaxial strain on the B-site ordering is discussed. Further on, a half-metallic ferromagnetic Sr2FeMoO6 films with transition temperatures well above room temperature, Tc~450 K, will be obtained. Financial support by the DFG via projects Ro5387/3-1 and Mo2255/3-1 is acknowledged.

DS 31.9 Thu 11:15 Poster F

Well Ordered Iron Sulfide Layers on Au(111) — •Earl Davis, Giulia Berti, Helmut Kuhlenbeck, and Hans-Joachim Freund — Fritz-Haber-Institut der Max-Planck-Gesellschaft

The iron-sulfur world hypothesis of G. Wächtershäuser is an origin-of-life theory which proposes that early life may have formed at the surface of sub-marine iron sulfide compounds. This involves the activation of carbon dioxide to form simple organic molecules. Theoretical and experimental studies have shown that the mineral greigite (Fe_3S_4) should be active for this.

With the goal of CO_2 activation, our aim was to prepare ordered iron sulfide layers. We found that such a layer can be prepared on Au(111) by deposition of iron in an atmosphere of S_2 molecules which are produced by an electrochemical sulfur source. According to XPS, the layer is sulfur terminated, and STM shows a homogeneous, well-ordered surface with a hexagonal symmetry. The same symmetry is found in LEED patterns and the hexagonal lattice parameter fits to what is expected for Fe_3S_4(111). I/V LEED curves were measured in order to determine details of the structure. Additionally, initial reactivity experiments have shown that it is possible to hydrogenate the surface, which might offer routes to hydrogenation reactions.

DS 31.10 Thu 11:15 Poster F

Texture Optimization of Metastable $GeSb_2Te_4$ Thin Films — •Hannah Niehaus[1], Matthias M. Dück[1], Stefan Jakobs[1], and Matthias Wuttig[1,2] — [1]I. Physikalisches Institut (IA), RWTH Aachen University, D-52056 Aachen, Germany — [2]2 JARA-FIT, RWTH Aachen University, Germany

Phase-change materials (PCM) are already established in optical data storage technologies. Currently these materials are also introduced into the market for electronic data storage, since they offer an attractive portfolio of properties. A prominent representative of PCMs is the material $GeSb_2Te_4$ (GST), whose electronic properties are governed by disorder-induced effects. GST exists in two different crystalline phases: a rocksalt-like metastable structure and a stable hexagonal one, which is obtained at higher annealing temperatures. Furthermore, this material undergoes a metal-to-insulator transition (MIT) independent of this structural transition. In this study we optimize the texture of GST thin films in the metastable phase in order to enable the investigation of the influence of atomic disorder on the electrical behavior. The material is deposited via sputter deposition on various substrates. In the optimization process parameters such as gas pressure, temperature and power are varied. The structure and quality of the thin films are characterized by x-ray reflectivity (XRR) and diffraction (XRD) as well as atomic force microscopy (AFM). The texture of GST thin films was optimized successfully which now allows systematic investigations of the influence of disorder on the MIT.

DS 31.11 Thu 11:15 Poster F

Characterization and optimization of rf sputtered $LiCoO_2$ thin films by post thermal annealing — •Marcel Couturier, Fabian Michel, Philipp Schurig, and Angelika Polity — Justus Liebig Universität, 35392 Gießen

$LiCoO_2$ thin films have been grown by rf-magnetron-sputter-deposition on platinum coated quartz substrates. The films were annealed at 700 °C for several hours in different atmospheres such as vacuum or under flux of oxygen to create phases which are favorable for battery applications. For structural characterization X-ray diffraction and Raman spectroscopy were used. HT-$LiCoO_2$-films with (003)-orientation after annealing under flowing oxygen and Co_3O_4-films with (311)-orientation after annealing in a vacuum could be observed. Furthermore, the stoichiometry could be determined using X-ray photoelectron spectroscopy, revealing a weak lithium deficiency in the grown films. Additional parasitic lithium phases near the surface of the films could be observed by analysis of the Li 1s photoelectron signal. Scanning electron microscopy images have shown changes in the surface morphologies of the films after undergoing the heat-treatment. Grains have slightly increased their volume. Moreover the shape changes after the annealing process in comparison to the untreated samples.

DS 31.12 Thu 11:15 Poster F

Deposition and optimization of a $LiCoO_2$ cathode layer for battery applications — •Sebastian Leonard Benz, Martin Becker, Christian Reindl, Angelika Polity, and Peter J. Klar — Justus Liebig Universität, 35392 Gießen

This work is about the deposition and characterization of Lithium Cobalt Oxide (LCO) thin films, deposited by rf magnetron sputtering. Different sputter process parameters such as gas flux, sputter power, deposition time and gas composition were considered. In addition, the influence of the used substrate was investigated. Different materials like glass, sapphire and metals were used as substrates. The main aim was to optimize the growth parameters for battery applications of LCO. Mostly X-ray-diffraction (XRD), as well in Bragg-Brentano as in four-circle geometry, was used to characterize the crystal structure and especially the out-of-plane orientation of the deposited thin films. By varying the parameters mentioned above, a (012) orientation has been achieved. Moreover, scanning electron microscopy (SEM) has been used to characterize the surface morphology. Furthermore, Raman spectroscopy gave insights into the crystal structure.

DS 31.13 Thu 11:15 Poster F

Electrically conductive long term stable ultrathin Gallium/Gallium(hydr)oxide layers — •Sebastian Runde[1], Heiko Ahrens[1], Frank Lawrenz[1], Amal Sebastian[1], Stephan Block[2],

and Christiane A. Helm[1] — [1]Inst. f. Physics, Greifswald University, Germany — [2]Dept. for Biochemistry and Chemistry, Free University of Berlin, Germany

Single Gallium/Gallium(hydr)oxide Ga/GaOxHy layers were prepared by induced break-up after forced wetting. Multilayers were formed by repeating the deposition procedure. X-ray reflectivity shows a multilayer structure. The repeat unit consists of a Ga layer covered by a GaOxHy layer (thickness 2.9 nm). The multilayer thickness is proportional to the number of deposited layers. The multilayer-air roughness may be smaller than the substrate-multilayer roughness, which is attributed to the large surface tension of Gallium. The electric conductivity of a multilayer follows Ohm*s law. The sheet resistance decreases with the number of deposited layers. We suggest that induced break-up after forced wetting is an environmentally friendly way to produce large ultrathin conductive layers from fluid metals.

DS 31.14 Thu 11:15 Poster F

Interface tuning by metallic and insulting interlayers in manganite-titanite heterojunctions — •Stephan Melles, Birte Kressdorf, Joerg Hoffmann, Ulrich Ross, and Christian Jooss — University of Goettingen, Institute of Materials Physics, Friedrich-Hund-Platz 1, 37077 Goettingen, Germany

New photovoltaic materials like complex oxides allow for fundamental studies of new conversion mechanisms which have the potential to overcome current efficiency limitations. Their interfaces play a crucial role in controlling charge transfer and charge separation, and determine the current-voltage ($I-V$) characteristics of such systems. Here, we present studies on interface design of manganite-titanite heterojunctions which are prepared by ion beam sputtering of thin films of hole doped $Pr_{0,66}Ca_{0,34}MnO_3$ (PCMO) on electron doped single crystalline $SrTi_{0.9975}Nb_{0.0025}O_3$ (STNO) substrates. The junction displays a rectifying $I-V$ characteristic and a pronounced photovoltaic effect, involving polaronic excitations [1]. Preliminary results show that the sputter deposition of Cr interlayers can either modify the junction to an ohmic contact or modify the rectifying characteristic and enhance the photovoltaic effect, depending on thickness and preparation conditions. Consequently, we started to prepare wedge-shaped Cr interlayers, allowing for a systematic thickness dependent analysis. The growth mode of Cr layers is investigated by SEM and AFM studies and the change of cross plane current voltage characteristics is studied. The interfaces are characterized by transmission electron microscopy. Reference: [1] B. Ifland et al., New J. Phys. 19 (2017) 063046

DS 31.15 Thu 11:15 Poster F

Synthesis and characterization of transition-metal germanides — •Yufang Xie[1,2], Ye Yuan[1,2], René Hübner[1], Jörg Grenzer[1], Mao Wang[1,2], Manfred Helm[1,2], Shengqiang Zhou[1], and Slawomir Prucnal[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, Bautzner Landstrasse 400, D-01328 Dresden, Germany — [2]Technische Universität Dresden, D-01062 Dresden, Germany

Si was sufficient to fulfil the requirements of microelectronic industry for more than five decades. Further progress based on the miniaturisation of transistors is challenging. Therefore new materials and concepts are considered for the next generation of nanoelectronics. In this work, we present the formation of transition-metal germanides epitaxially grown on Ge wafer. Those materials have great promise for both the ohmic contacts to n-type Ge with extremely low specific contact resistivity and spintronics. The transition-metal germanides are synthesized by metal sputtering on Ge followed by millisecond range flash lamp annealing which is suitable for larger-area fabrication and compatible with CMOS technology. On one hand, orthorhombic NiGe whose contact resistivity is only around 1.2*10-6 Ω cm2, is beneficial for achieving high-performance Ge-based nano-electronic devices. On the other hand, cubic FeGe with B20 phase is a Skyrmion-carrier material attractive for spintronics. In summary, the epitaxial transition-metal germanides materials can be obtained by a novel epitaxial approach which provides insight to their technological usage.

DS 31.16 Thu 11:15 Poster F

Surface plasmon resonance investigation of gold nanoparticle aggregation on self-assembled monolayers — •Navid Khangholi, Alfred Kick, Mathias Lakatos, and Michael Mertig — Technische Universität Dresden, Dresden, Germany

A new sensor principle based on Surface Plasmon Resonance is developed using AuNPs functionalised with carboxylic groups (AuNP-COOH) immobilised on self-assembled monolayers (SAM). The immobilisation of AuNP-COOHs occurs electrostatically between a positively charged SAM and negatively charged AuNP-COOHs. This SAM consists of a thiolated pH-sensitive polymer, poly (2-vinylpyridine) with a terminal thiol group (P2VP-SH), as a supporting layer on the gold surface of the SPR chip. This polymer responds to the pH changes, e.g. swelling and shrinking in acidic or basic environments, respectively. Swelling of P2VP with AuNP-COOHs occurs between pH 2.3 and 1.7. This induces an enhanced decrease of the SPR signal compared to the P2VP layers without AuNPs. This larger decrease of the SPR signal is due to the increase of the distance between the AuNPs and the gold substrate.

DS 31.17 Thu 11:15 Poster F

Perturbed angular correlation studies of H^2 plasma treated rutile — •Dmitry Zyabkin[1], Juliana Schell[2], Ulrich Vetter[1], Robinson Santos[3], and Peter Schaaf[1] — [1]Chair materials for Electronics, Institute of Materials Engineering and Institute of Micro- and Nanotechnologies MacroNano®, Gustav-Kirchhoff-Str. 5, 98693 Ilmenau, Germany — [2]European Organization for Nuclear Research (CERN), CH-1211 Geneva, Switzerland — [3]Instituto de Pesquisas Energéticas e Nucleares, IPEN, Saõ Paulo, Brazil

Hydrogenated titania has recently attracted enormous attention due to its compelling features and extended application [1]. Nonetheless, the origin of the improved features has stayed uncertain as well as H_2 stability under elevated temperatures. We report on recent perturbed $\gamma\gamma$-angular correlation (PAC) studies of TiO_2:H rutile thin films using the probe ^{111m}Cd, which was implanted at the online isotope separator ISOLDE at CERN. The films were synthesized by reactive magnetron sputtering and deposited on Si and quartz substrates, followed by an annealing step at 1173K for 5 hours. The subsequent H_2 plasma treatment was performed at various plasma temperatures up to 663K. After implantation with typically around 10^{12} probe atoms the samples were transported to the PAC setup and kept at 481K, 531K or 581K during the measurements in vacuum. Time-correlated R(t) spectra were fitted against electric quadrupole interaction parameter sets corresponding to fractions of probe atoms in specific local defect configurations.
[1] X.Chen *et al.* Chem. Soc. Rev., 2015,44, 1861-1885

DS 31.18 Thu 11:15 Poster F

Rf magnetron sputtering of solid electrolytes for battery applications — •Fabian Michel[1], Martin Becker[1], Jaroslava Obel[2], Martin Finsterbusch[3], Jürgen Janek[4], and Angelika Polity[1] — [1]Institute for Exp. Physics I and Center for Material Research (ZfM/LaMa), Justus-Liebig-Universität, 35392 Gießen — [2]Departement Chemie, Ludwig-Maximilian-Universität, 81377 München — [3]Forschungszentrum Jülich GmbH, 52428 Jülich — [4]Institute of Physical Chemistry and Center for Material Research (ZfM/LaMa), Justus-Liebig-Universität, 35392 Gießen

Lithium based solid electrolyte thin films were produced via rf magnetron sputtering. An optimization of the physical properties, which are important for battery applications, was done by varying the deposition parameters. Consequently compositions of the films were investigated using different techniques like X-ray photoelectron spectroscopy (XPS), inductively coupled plasma optical emission spectroscopy (ICP-OES) and Rutherford backscattering spectrometry (RBS). To evaluate the samples conductivity investigations were performed by electrochemical impedance spectroscopy (EIS). A maximum increase in ionic conductivity was sought after as was to gain knowledge about the influence of the different elements and sputtering parameters of the solid electrolyte with respect to the ionic conductivity. To monitor the improvements made, results were compared with earlier findings of investigations on solid electrolytes.

DS 31.19 Thu 11:15 Poster F

Chemical ordering in epitaxial (La,Sr)$CoO_{3-\delta}$ thin films prepared by RF magnetron sputtering — •Marcel Urban and Wolfgang Donner — TU Darmstadt, Materials Science, Structure Research, Darmstadt, Germany

The (La,Sr)CoO_3 based perovskites (LSCO) show promising properties regarding the application in solid oxide fuel cells and gas separation membranes, like the remarkable electronic and ionic conductivity at intermediate temperatures (below 800 K). These properties may be further improved by inducing cation and oxygen vacancy ordering, as observed in strained thin films [1].

Here we show recent results from epitaxially grown LSCO thin films.

They were deposited on [001]-oriented $SrTiO_3$ single crystal substrates by means of radio frequency magnetron sputtering from a stochiometric $La_{0.5}Sr_{0.5}CoO_3$ target. The films were characterized *in situ* in terms of stoichiometry and surface structure by Auger electron spectroscopy and low-energy electron diffraction. Moreover, the crystal structure is examined by x-ray diffraction (XRD) using a four- circle single crystal diffractometer. Up to a thickness of about 50 unit cells the deposited films show a coherent, pseudomorphic growth whereas thicker films show an in-plane lattice relaxation. The coherent films exhibit Laue oscillations and a relatively small mosaicity. The deposition atmosphere can be used to tune the stoichiometry. In the next step, the induced ordering phase transition will be followed by in situ XRD during heat treatment of the films in different atmospheres.

[1] W. Donner et al., *Chemistry of Materials* 23.4 (2011): 984-988.

DS 31.20 Thu 11:15 Poster F

Melting and premelting behaviour of epitaxial thin films — •Constantin Wansorra and Wolfgang Donner — TU Darmstadt, Materials Science, Structure Research, Darmstadt, Germany

Despite the fact that melting of materials has been studied for more than a century [1], the melting behaviour of thin films is still topic of research [2]. Concerning bulk, it is now known that melting precursors [3] as the surface or grain boundaries are the reason for the absence of superheated solids. In thin films, the surface has a much higher impact on the properties of the material [4]. Therefore, research of their melting will produce a better understanding of high temperature stability and failure processes of the films.

We have prepared epitaxial films of low melting temperature metals on various substrates by Molecular Beam Epitaxy and studied structural changes near the melting temperature by reflection high-energy electron diffraction, scanning tunnelling microscopy and grazing incidence x-ray diffraction. We report on the changes in surface and interface roughness and the dewetting behaviour of the films. Furthermore, a technique of analysing the melting behaviour with x-ray diffraction is presented.

[1] Dash, *Reviews of Modern Physics* 71 (1999): 1737.
[2] Kahn, et al., *Springer Nature* 46 (2015): 3932.
[3] Rühm, et al., *Physical Review B* 68 (2003): 224110.
[4] Chen, et al., *Elsevier BV* 68 (2015): 97.

DS 31.21 Thu 11:15 Poster F

Direct observation of defect evolution in 2D single layer tungsten diselenide by low voltage high resolution transmission electron microscopy — •Robert Leiter, Yueliang Li, and Ute Kaiser — Electron Microscopy Group of Materials Science, University of Ulm, Albert- Einstein Allee 11, 89081 Ulm, Germany

Defects in two-dimensional transition metal dichalcogenides (TMDs) have received increasing attention in recent years due to their influence on their extraordinary mechanical, electrical, magnetic and optical properties. By controlled electron irradiation under the transmission electron microscope, such defects may tailor a material's unique properties. [1,2]

In this work, defect evolution in WSe_2 was observed in real time using our novel C_c- and C_s - corrected SALVE (Sub Ångström Low Voltage Electron microscopy) instrument [3] with atomic resolution. The combination of high time- and spatial resolution enabled the observation of many intermediate states, atom-by-atom and provides deeper understanding of its formation dynamics.

[1] Y.-C. Lin et al., Nat. Commun. 6, 6736 (2015)
[2] H.-P. Komsa and A. V. Krasheninnikov, Adv. Electron. Mater. 3, 1600468 (2017)
[3] M. Linck et al., Phys. Rev. Lett. 117, 076101 (2016)

DS 31.22 Thu 11:15 Poster F

Structural study of GaN nanostructures and thin films prepared by energy and mass selective ion-beam assisted MBE — •Andriy Lotnyk, Sören Herath, Philipp Schumacher, Michael Mensing, Jürgen W. Gerlach, and Bernd Rauschenbach — Leibniz Institute of Surface Engineering (IOM), Permoserstr. 15, 04318 Leipzig, Germany

GaN is a widely used semiconductor material for optoelectronic applications. In this work, GaN nanostructures and thin films were produced on 6H-SiC(0001) and Al2O3(1-102) substrates by using a system for energy and mass selective ion-beam assisted molecular-beam epitaxy (IBA-MBE). The nanostructures were produced in two steps. In the first step of the deposition process, Ga-droplets were deposited on 6H-SiC at elevated temperatures. In the second step, a post-nitridation process of Ga droplets by either monoatomic or polyatomic, hyperthermal nitrogen ions was used for the synthesis of GaN nanostructures. The characterization of GaN nanostructures by aberration-corrected scanning transmission electron microscopy showed the formation of cubic GaN. The detailed structural investigation revealed different types of defects forming during the growth of nanostructures. The results on microstructure of GaN thin film will be also presented and the influence of ion energies on the real structure of GaN nanostructures and thin films will be discussed.

DS 31.23 Thu 11:15 Poster F

A route to epitaxial growth of periodic metal nanostructure arrays — •Denise Erb[1], Gerald Malsch[1,2], René Hübner[1], Kilian Lenz[1], Jürgen Lindner[1], Stefan Facsko[1], Manfred Helm[1,2], and Jürgen Fassbender[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research, Dresden (Germany) — [2]Technical University Dresden, Institute of Solid State Physics, Dresden (Germany)

Epitaxial thin film growth on planar substrate surfaces is well-established for many materials. We show that it can also be feasible to grow nanostructures in an oriented manner on nanopatterned crystalline surfaces. Produced by a scalable procedure on large surface areas, such nanostructure arrays may find diverse applications in research and technology. On semiconductor substrates, nanoscale surface patterns with well-defined lateral periodicity form under low-energy ion irradiation via non-equilibrium self-assembly of vacancies and adatoms [1]. For appropriate process temperatures, the crystallinity of the substrate is retained during ion irradiation. When a material is then deposited onto the substrate by PVD under non-normal incidence, shadowing effects give rise to the formation of separated nanostructures [2], while a suitable lattice matching can induce epitaxial growth. In this contribution, we outline the patterning and growth procedure. As an example, we will present periodic Fe/Au nanostructure arrays and discuss their strongly anisotropic optical and magnetic properties. [1] X. Ou et al., Nanoscale 7, 18928 (2015) [2] Q. Jia, et al., Nano Research 15, 1 (2017)

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Scanning Tunneling Microscopy and Spectroscopy of thin films of Strontium Ruthenates — •Marion A. van Midden, Tjaša Parkelj, Jernej Mravlje, Rok Žitko, Matjaž Spreitzer, and Erik Zupanič — Jožef Stefan Institute, Ljubljana, Slovenia

Because the energy scales of charge, spin, lattice, and orbital degrees of freedom of 4d- and 5d- transitional metal oxides are comparable, they exhibit a wide range of distinct electronic and magnetic properties. In the case of perovskite type transitional metal oxides these materials are also extremely sensitive to perturbations and can therefore be tuned via nonthermal parametrs such as doping, pressure, and magnetic fields. Growing thin films allows us to introduce strain via lattice mismatch with the substrate and thereby tune the properties of the film.

The films of $SrRuO_3$ were grown on $SrTiO_3$ using Pulsed Laser Deposition. The back-pressure in the system is below 10^{-9} mbar, which enables growth with a relatively small concentration of impurities. Growth was controlled *in-situ* using Reflected High-Energy Electron Diffraction. Using an ultra-high vacuum (UHV) suitcase the samples were transported to an UHV system equiped with Low-Energy Electron Diffraction and a Nanonis Joule-Thomspon Scanning Tunneling Microscope. Topography and spectroscopy measurements were done on clean surfaces and in the vicinity of defects.

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Fe doping effect on the morphological, structural and photocatalytic properties of TiO2 thin layers — •fayçal bensouici[1], mustafa benyakhlef[1], mohamed bououdina[2], razika tala-ighil[1], mahdia toubane[1], and boudjemaa bouaouina[1] — [1]departement of physics,URMPE unite, UMBB university, 35000 boumerdes, algeria — [2]department of physics, college of science, university of bahrain, PO box 32038, kingdom of bahrain

Abstract: In this study, undoped and Fe3+ doped TiO2 thin films has been prepared via sol-gel method using the tetraethyl-orthotitanate as source of Ti and Fe(III) nitrate as source of Fe3+ doping. Scanning electron microscopy (SEM-EDX), X-ray diffraction (XRD), and UV*vis spectrum were employed to examine the effects of Fe element on morphology, structure, optical characteristics and photocatalytics behavior of TiO2 films. XRD patterns showed the presence of TiO2 anatase phases only, no other phase has been appeared. SEM image

confirm the nanometric grain size of all samples and a low decrease in band gap were we increases the Fe doping percentage. It is also observed that no enhancement in photocatalytics activities of Fe doped TiO2 thin films.

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Microstructure and mechanical properties of Mo2N/CrN multilayers deposited by DC magnetron sputtering — •BOUDJEMAA BOUAOUINA[1], CRISTOPHE TROMAS[2], DOMINIQUE EYIDI[2], CÉDERIC MASTAIL[2], ANNY MICHEL[2], SEDIK ELHAK ABAIDIA[1], and GRÉGORY ABADIAS[2] — [1]Département de physique, Unité de recherche URMPE, Université de Boumerdès 35000, Algerie — [2]Insitut Pprime, Department of Physics and Mechanics of Materials, Université de Poitiers-CNRS-ENSMA, 86962 Chasseneuil-Futuroscope, France

The multilayer films Mo2N/CrN were deposited by reactive magnetron sputtering at 600°C on Si substrates with different bi-layer periods λ ranging from 5 to 50 nm. The microstructure of the multilayer was investigated from X-ray diffraction and scanning electron microscopy (cross section images). Both films, Mo2N and CrN deposited at 600°C present a face centered cubic structure. As the bi-layer period was decreased, the grain size increases from 14 to 20 nm and are well crystallized with (200) preferred orientation. The nanohardness measurements show that the mechanical properties of Mo2N/CrN multilayers depend on the bi-layer period and the highest value of 29 GPa was obtained at the bilayer period of 10 nm.