DS 14: Poster

Time: Tuesday 17:00–20:00 Location: Poster E

DS 14.1 Tue 17:00 Poster E

Grain Boundaries Act as Solid Walls for Charge Carrier Diffusion in Large Crystal MAPI Thin Films — •Frank Schäfer[1], Richard Ciesielski[1], Nicolai Hartmann[1], Nadja Giesbrecht[1], Thomas Bein[1], Pablo Docampo[2], and Achim Hartschuh[1] — [1]Department Chemie und Center for Nanoscience (CeNS), LMU München, Deutschland — [2]School of Electrical and Electronic Engineering, Newcastle University, United Kingdom

Micro- and nanocrystalline methylammonium lead iodide (MAPI)-based thin-film solar cells today reach power conversion efficiencies of over 20%. We investigate the impact of grain boundaries on charge carrier transport in large crystal MAPI thin films using time-resolved photoluminescence (PL) microscopy and numerical model calculations. Crystal sizes in the range of several tens of micrometers allow for the spatially and time resolved study of boundary effects. Whereas long-ranged diffusive charge carrier transport is observed within single crystals, no detectable diffusive transport occurs across grain boundaries. The observed PL transients are found to crucially depend on the microscopic geometry of the crystal and the point of observation. In particular, spatially restricted diffusion of charge carriers leads to slower PL decay near crystal edges as compared to the crystal center. In contrast to many reports in the literature, our experimental results show no quenching or additional loss channels due to grain boundaries for the studied material, which thus do not negatively affect the performance of the derived thin-film devices.

DS 14.2 Tue 17:00 Poster E

2D Fluorescence Spectroscopy for Monitoring Photo-induced Degradation in Metal Halide Perovskite — •Alexandros Kiligaridis[1], Aboma Merdasa[2], Carolin Rehermann[2], Mojtaba Abdi-Jalebi[3], Jonas Stöber[1], Boris Louis[1], Marina Gerhard[1], Samuel D. Stranks[3], Eva L. Unger[1,2], and Ivan G. Scheblykin[1] — [1]Chemical Physics and NanoLund, Lund University, PO Box 118, 22100 Lund, Sweden. — [2]Young Investigator Group Hybrid Materials Formation and Scaling, Helmholtz- Zentrum Berlin fur Materialen un Energie GmbH, Albert-Einstein Strasse 16, 12489 Berlin, Germany — [3]Cavendish Laboratory, Department of Physics, University of Cambridge, JJ Thomson Avenue, Cambridge CB3 0HE, United Kingdom

One of the vital factors in one day achieving long-lifetime perovskite devices is tackling the obstacle of chemical instability observed in halide perovskites upon illumination and in combination with the presence of oxygen and/or water.

In a recent series of studies we employ a novel 2D fluorescence method to shed light to underlying degradation mechanisms and their correlation to external environmental factors. We use this method to spatially probe thin films as well as micro/nano-sized single perovskite crystals to produce excitation-emission matrices and utilize them as a type of degradation fingerprints. The diffraction limited resolution of the measurements enables the comparison between different morphological surface structures on thin perovskite film and their tendency to photo-degrade in various environments.

DS 14.3 Tue 17:00 Poster E

Electric field induced quenching of photoluminescence in individual CH3NH3PbX3 (X=I, Br) nanocrystals — Ruiyun Chen[1,2], •Jun Li[1], Alexander Dobrovolsky[1], Soranyel González-Carrero[3], Marina Gerhard[1], Vladimir Chirvony[3,4], Julia Pérez-Prieto[3], and Ivan Scheblykin[1] — [1]Division of Chemical Physics and NanoLund, Lund University, Lund 22362,Sweden — [2]State Key Laboratory of Quantum Optics and Quantum Optics Devices,Institute of Laser Spectroscopy, Shanxi University, Taiyuan 030006,China — [3]Instituto de Ciencia Molecular, Universidad de Valencia, c/Catedrático J. Beltrán, 2, Paterna 46980, Spain — [4]UMDO (Unidad de Materiales y Dispositivos Optoelectrónicos), Instituto de Ciencia de los Materiales, Universidad de Valencia, Valencia 46071, Spain

Metal halide perovskites have attracted lots of attention because of extraordinary performance of these solution-processed materials in optoelectronics. However, the even higher efficiency and much better stability are wanted for their practical applications. Therefore, a deeper physical understanding of the charge carrier dynamics and the ion migration in the perovskite semiconductors are required to overcome these limitations. Here, we found that the external alternating electric field(EF) quenches the photoluminescence(PL) of individual CH3NH3PbX3(X=I,Br) nanocrystals. After switching off the alternating EF, the PL intensity recovered within several minutes. However, constant EF showed very little quenching effect compared with alternating. The physical mechanism behind this will be discussed.

DS 14.4 Tue 17:00 Poster E

Compositional Variation in Inkjet-Printed Lead Halide Perovskite — •Hampus Näsström[1], Florian Mathies[1], Thomas Unold[2], and Eva Unger[1] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie, Young Investigator Group Hybrid Materials Formation and Scaling, Berlin, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie, Department Structure and Dynamics of Energy Materials, Berlin, Germany

Lead halide perovskites, APbX3, have recently proved an excellent absorber material for photovoltaic devices. Through variation of the cation, A, and halide, X, as well as mixing two or more of these, a huge variety of absorber materials are achievable. In this work, we present how controlled compositional variations within a sample of lead halide perovskite can be obtained via inkjet printing. Furthermore, we show how the variation in absorption, absolute photoluminescence and mobility throughout the sample can be correlated to the power conversion efficiencies of photovoltaic devices with the corresponding composition. This correlation provides us with a method for fast screening of potential absorber materials for photovoltaic applications without device manufacturing.

DS 14.5 Tue 17:00 Poster E

Lecker im Licht, Wie beeinflusst die Beleuchtung das Aussehen unserer Supermarktwaren? — Carolin Mantsch und •Thomas Grillenbeck — Ignaz-Günther Gymnasium Rosenheim

Mit allen möglichen Tricks versuchen Supermärkte die Kunden zum Kauf zu animieren. Das Licht wird an den Supermarkttheken gezielt eingesetzt, sodass Obst und Gemüse besonders frisch, knackig aussehen oder Fleisch besonders saftig, frisch erscheint. Frischwaren welken/reifen im Laufe der Zeit. Meine innovative Idee ist deshalb, die LEDs jederzeit genau an die Warenfarbe anzupassen. Tomaten, die mit der Zeit reifen, werden demnach zu Beginn stärker beleuchtet, als die gereiften Tomaten. Dafür habe ich einen LED-Lichtmischer (RBG) nachgebaut, damit sich daraus ein, auf den Reifegrad der Frischwaren, regelbarer Lichtmischer entwickeln kann. In meiner Arbeit wird gezeigt, wie ein Reflexionsspektrum entsteht und dass dieses in verschiedenen Methoden gemessen werden kann. Außerdem wurde mit einer aufgestellten Formel veranschaulicht, wie der Sinneseindruck im Auge entsteht und an einem Rechenbeispiel verdeutlicht, dass diese Formel im Rahmen kleiner Fehlerquellen ausführbar ist.

DS 14.6 Tue 17:00 Poster E

Fabrication of nanostructured oxides by focused electron beam induced processing — •Elif Bilgilisoy, Christian Preischl, Florian Vollnhals, and Hubertus Marbach — Lehrstuhl für Physikalische Chemie II, Friedrich-Alexander Universität Erlangen-Nürnberg, Egerlandstr. 3, D-91058, Erlangen, Germany

We explored techniques employing a highly focused electron beam in UHV for the controlled fabrication of nanostructured oxide surfaces. This can be done by electron beam induced local modification of the substrate such that it becomes active towards the decomposition of subsequently dosed precursor molecules, referred to as electron beam induced surface activation (EBISA)[1]. The initial deposits might grow autocatalytically upon prolonged precursor dosage already at room temperature in our UHV instrument. EBISA requires a surface that can be correspondingly activated by the electron beam. We could identify oxides like Si_xO_y and TiO_2 as suitable candidates [2, 3]. Thereby EBISA worked successfully with $Fe(CO)_5$ and $Co(CO)_3NO$ depending on the actual substrate partially with chemical selectivity. As activated sites we could identify reactive oxygen vacancies created through electron beam induced stimulated oxygen desorption. Along with the presentation of these results, we will also demonstrate first successful results on Cobalt oxide generalizing the EBISA process on oxides.

[1] Marbach, H., Applied Physics A, 117(3): p. 987-995 (2014).
[2] Drost, M., et al., Small methods, 1(6): p. 1700095 (2017).

[3] Walz, M.-M., et al., Physical Chemistry Chemical Physics, 13(38): p. 17333-17338 (2011).

DS 14.7 Tue 17:00 Poster E

Thin film investigations on the ferroelectric organic charge transfer salt TTF-Chloranil — •Lukas Keller and Michael Huth — Institute of Physics, Goethe University, Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany

Tetrathiafulvalene-chloranil (TTF-CA) is an organic ferroelectric below $T_C = 81\,\mathrm{K}$ [1] whose bulk properties have been studied in some detail [2]. However, very limited research has been done on thin films despite the strong dependence of the paraelectric to ferroelectric phase transition on strain which can most easily be tailored in thin film structures [3]. Moreover, the ferroelectric phase coexists with a dimerized spin chain for which it is so far unclear whether it shows long-range order.

Here we present recent results of the electrical and dielectric properties of TTF-CA thin films grown by molecular beam deposition. In particular we focus on the influence of the ferroelectric state of the layers on nearby metallic electrodes by way of surface scattering modifications. Furthermore, we present results on the the dielectric screening effect caused by the TTF-CA layer on the charge transport in a nano-granular metal layer in close proximity.

[1]: Torrance et al., Phys. Rev. Lett. 47, 24 (1981). [2]: Horiuchi et al., Chem. Lett. 43, 26 (2014). [3]: Huth et al., Mater. Res. Express 1, 046303 (2014)

DS 14.8 Tue 17:00 Poster E

Direct Write, Free Form 3D Nanomagnetism — •Lukas Keller and Michael Huth — Institute of Physics, Goethe University, Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany

3D nano-printing by focused electron beam induced deposition (FEBID) has matured to a level that highly complex and functional deposits are becoming available for nanomagnetics [1] and plasmonics.

Our pattern file generator program [2], which defines the electron beam movement at any time during the deposition, handles precursor dynamic related issues like proximity effects and corrects for height-dependent precursor coverage. The target geometry can be defined by hand or using powerful 3D software tools like "blender" [3].

Here we present a selection of successfully deposited magnetic 3D nano-structures, generated with our implementation of a pattern file generator, and some measured hysteresis loops of their magnetic stray field. We demonstrate that also 3D mixed material structures are available by combining ferromagnetic with paramagnetic 3D elements.

[1]: Scientific Reports 8, 6160 (2018)
[2]: Beilstein J. Nanotechnol., 9, 2581-2598 (2018)
[3]: https://youtu.be/v8s24WvGj9E

DS 14.9 Tue 17:00 Poster E

Magnetization Reversal of Individual Three Dimensional (3D) Fe-Co Nanostructures — •Mohanad Al Mamoori[1], Lukas Keller[1], Michael Huth[1], Christian Schröder[2], and Jens Müller[1] — [1]Institute of Physics, Goethe University Frankfurt — [2]Institute for Applied Materials Research, Bielefeld University of Applied Sciences

Three dimensional (3D) magnetic nanostructures are promising for future magnetic memory and sensing applications, in particular since more complex magnetic configurations become possible when expanding 2D nanomagnets to the third dimension. In [1,2], we have employed focused electron beam induced deposition (FEBID) to grow 3D nanomagnets in combination with a micro-Hall sensor acting as substrate and high-resolution detection device of small magnetic stray fields. We find that the magnetisation reversal propagates by multi-domain switching scenarios. In this presentation, firstly, systematic measurements of the magnetic stray fields of Fe-Co nano-cubes and -trees as a function of temperature and magnetic field applied at different angles, will be reported. Secondly, in order to gain further insights in the hysteresis loops, (irreversible) magnetic interaction effects and coercivity distributions, first-order-reversal curves (FORC) of these 3D nanomagnets supported by simulations of a simple macro-spin model, will be shown. Finally, an outlook to the future design of such structures towards the realization of 3D artificial spin ice architectures will be given. [1] L.Keller et al., *Sci. Rep.* **8** , 6160 (2018). [2] M. Al Mamoori et al., *Materials* **11**, 289 (2018).

DS 14.10 Tue 17:00 Poster E

The microscopic structure of ballistic graphene nanoribbons — •Markus Gruschwitz, Thi Thuy Nhung Nguyen, Herbert Schletter, Steffen Schulze, and Christoph Tegenkamp — Institut für Physik, TU Chemnitz, Germany

Epitaxial graphene nanoribbons on SiC were shown to host ballistic transport channels, even under ambient conditions [1]. Thereby, the transport of these 40nm wide ribbons, which are grown via self-assembly on sidewalls of SiC(0001) mesa structures, depends crucially on atomistic details of the structure [2]. Here we present high resolution STM and TEM investigations done on such ribbons.

For ribbons along the $[1\bar{1}00]$-direction STM reveals a continuous graphene layer with a zig-zag edge structure. Thereby, the lower edge merges into the SiC(0001) terrace giving rise to hybridization and formation of an edge state. This growth mode is confirmed by S/TEM investigations. Cross sectional STEM reveals freestanding graphene separated from the facette by more than three times the distance of graphene on SiC(0001). Moreover, the EDX and EELS capabilities of the HRTEM were used to characterize the surface near areas in detail. Upon growth of graphene by desorption of silicon by high temperature annealing, the first 6H-SiC unit cell reveals sp^2-hybridization coming along with Si deficiency. Compared to the facettes, it turns out that these residual imperfections in SiC are more frequent at terraces, which supports higher Si-evaporation rate at the mesas in order to grow selectively graphene nanoribbons. References: [1] J. Aprojanz et al., Nat. Comm. **9**, 4426, (2018). [2] A.A Zakharov et al., arXiv:1809.10001

DS 14.11 Tue 17:00 Poster E

Tunable 2D electron gas at the $LaAlO_3/SrTiO_3$(001) interface — Igor Maznichenko[1], •Sergey Ostanin[1], Arthur Ernst[2,3], and Ingrid Mertig[1,2] — [1]Institute for Physics, Martin Luther University Halle-Wittenberg, D-06099 Halle, Germany — [2]Max Planck Institute of Microstructure Physics, Weinberg 2, D-06120 Halle, Germany — [3]Institute for Theoretical Physics, Johannes Kepler University, Altenberger Straße 69, 4040 Linz, Austria

Currently, the formation of a two-dimensional electron gas (2DEG) at the TiO_2/LaO-terminated interface of $LaAlO_3/SrTiO_3$ (LAO/STO) is well understood. The LAO critical thickness of four unit cells needed to measure the 2DEG was established. Here, we show how 2DEG can be tuned externally by changing electronic balance at the LAO(001) surface or, alternatively, at the intrinsically hole-doped AlO_2/SrO interface of LAO/STO heterostructures. The effects of liquid gating at LAO(001) and imperfect AlO_2/SrO were simulated in the framework of the first-principles Green function method within a coherent potential approximation. We evaluated the Fermi surface cross sections and effective masses of the 2DEG carriers, which were computed upon the degree of external chemical disorder. These findings may be extremely important for applications of 2DEG.

DS 14.12 Tue 17:00 Poster E

Impact of long-range disorder on the 2D electron gas formation at a $LaAlO_3/SrTiO_3$ interface — •Igor Maznichenko[1], Sergey Ostanin[1], Arthur Ernst[2,3], and Ingrid Mertig[1,2] — [1]Institute for Physics, Martin Luther University Halle-Wittenberg, D-06099 Halle, Germany — [2]Max Planck Institute of Microstructure Physics, Weinberg 2, D-06120 Halle, Germany — [3]Institute for Theoretical Physics, Johannes Kepler University, Altenberger Straße 69, 4040 Linz, Austria

A two-dimensional electron gas (2DEG) can be formed at an interface between two insulators such as $LaAlO_3$ and $SrTiO_3$ without any additional doping. Nevertheless, structural imperfections or defects at the interface, which may arise during the growth process or be of another origin, can definitely affect 2DEG properties either increasing or reducing the 2DEG density. In this work, we study 2DEG formation at both perfect and imperfect interfaces of $LaAlO_3/SrTiO_3$ heterostructures in the framework of the density functional theory. Using a first-principles Green function method within a coherent-potential approximation, we investigate consistently the development of the 2DEG density starting from a defectless interface and introducing sequentially various kinds of long-range disorder such as cation intermixing and oxygen vacancies. Finally, we evaluate the 2DEG carrier density from the Fermi surface cross sections and effective masses of the carriers, which may be directly related to the multiple transport phenomena in the system [1].

[1] I. V. Maznichenko et al, Phys. Rev. Materials 2, 074003 (2018).

DS 14.13 Tue 17:00 Poster E

Characterization of electron emission from diamond-coated tungsten tips — •Alexander Tafel[1], Mingjian Wu[2], Erd-

mann Spiecker[2], Peter Hommelhoff[1], and Jürgen Ristein[1] — [1]Department Physik, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), 91058 Erlangen — [2]Institute of Micro- and Nanostructure Research & Center for Nanoanalysis and Electron Microscopy (CENEM), Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), 91058 Erlangen

Coating metal needle tips with diamond promises a robust high brightness photocathode useful for dielectric laser acceleration and time resolved electron microscopy and diffraction. The chemical and structural properties of tungsten tips coated with nanocrystalline diamond are thoroughly characterized. Electron diffraction and electron energy loss spectroscopy (EELS) confirm the presence of diamond with 20 nm sized columnar grains. Transmission electron microscopy and STEM-EELS reveal graphitic paths between diamond grains. The graphitic grain boundaries provide sufficient conductivity for the feedback of emitted electrons from the surface and - in case of surface hydrogen termination - the negative electron affinity of diamond substantially increases the electron yield. We present first experimental results of electron emission from diamond coated tips both in continuous field emission and femtosecond laser-triggered mode.

DS 14.14 Tue 17:00 Poster E

Temperaturabhängige Untersuchung des spezifischen elektrischen Widerstandes von Schichten aus MoN_x — •Sabine Stück[1], Martin Kommer[2], Martin Balzer[2], Martin Fenker[2] und Frank Schmidl[1] — [1]Friedrich-Schiller Universität Jena, Physikalisch-Astronomische Fakultät, Institut für Festkörperphysik, Helmholtzweg 5, 07743 Jena — [2]Forschungsinstitut Edelmetalle+Metallchemie, Katharinenstraße 17, 73525 Schwäbisch Gmünd

Wir untersuchen Schichten aus Molybdännitrid (MoN_x), die mittels HiPIMS und PLD hergestellt wurden, auf ihre strukturellen und elektrischen Eigenschaften. Besonderes Augenmerk liegt auf der Temperaturabhängigkeit des spezifischen elektrischen Widerstandes.

Neben der stöchiometrischen Zusammensetzung der Schichten, werden die aufgefundenen Phasen und die Kristallinität gezeigt und diskutiert. Für die strukturellen Untersuchungen kommen hier unter anderem AES und Röntgenbeugungsmethoden zum Einsatz. Schwerpunkt der Untersuchung stellt die temperaturabhängige Messung des spezifischen elektrischen Widerstandes dar. Dessen ungewöhnliche Temperaturabhängigkeit wird hier erörtert. Die Schichten werden bis in den einstelligen Kelvinbereich vermessen, sodass sich ein Übergang in die supraleitende Phase einstellt. Die kritische Temperaturen (T_C) sowie die kritischen Stromdichten (j_C) der Schichten werden bestimmt.

DS 14.15 Tue 17:00 Poster E

Ultrafast energy transport in nanoscopic metal-insulator multilayers - Electrons vs. phonons — •Marc Herzog[1], Jan-Etienne Pudell[1], Alexander von Reppert[1], Alexei Maznev[2], Matthias Kronseder[3], Christian Back[3,4], Gregory Malinowski[5], and Matias bargheer[6] — [1]Institut für Physik und Astronomie, Universität Potsdam — [2]Dept. of Chemistry, MIT — [3]Institut für Experimentelle und Angewandte Physik, Universität Regensburg — [4]Fakultät für Physik, TU München — [5]Institut Jean Lamour, Université Lorraine — [6]Helmholtz-Zentrum Berlin

The transport of heat (or energy in general) in nanoscopic heterostructures is of great interest on a fundamental as well as a technological level, e.g. in the context of thermal management in devices or heat-assisted magnetic recording. In metal-insulator metaerostructures heat can be conducted by diffusion of electrons and/or lattice vibrations. Using time-resolved x-ray diffraction, we recently observed a surprisingly large thermal equilibration time between two ultrathin films of Au and Ni of more than 80 ps [1]. A detailed analysis revealed a significant contribution of lattice heat transport although electrons typically dictate the thermophysical properties in these metals. Here, we extend such experiments to metallic multilayers with an incorporated few-nm insulating MgO layer to suppress electron transport and calibrate the heat transport by phonon diffusion. At length scales smaller than the phonon mean free path ballistic transport is expected to efficiently contribute. We thus discuss the possibility of ballistic phonon transport in such systems. [1] Pudell et al. Nat. Commun. 9, 3335 (2018).

DS 14.16 Tue 17:00 Poster E

Spatiotemporal control of surface acoustic waves (SAW), surface skimming longitudinal wave (SSLW) and static surface deformation — •Jan-Etienne Pudell[1], Marc Herzog[1], Mathias Sander[2], Daniel Schmidt[3], Matias Bargheer[1,4] und Peter Gaal[3] — [1]Institut für Physik und Astronomie, Universität Potsdam, Karl-Liebknecht- Str. 24-25, 14476 Potsdam, Germany — [2]ESRF - The European Synchrotron CS40220 38043 Grenoble Cedex 9 France — [3]Institut für Nanostruktur und Festkörperphysik, Universität Hamburg, 20355 Hamburg, Germany — [4]Helmholtz Zentrum Berlin, Albert-Einstein-Str. 15, 12489 Berlin, Germany

We present control of coherent and incoherent deformations in solids on sub-nanosecond timescales using a temporal and spatial sequence of optical excitation pulses. For this purpose, we introduce an experimental setup that exerts control of the spatial overlap of subsequent excitations via the polarization of the optical excitation pulse. Specific exemplary coherent control cases are discussed theoretically and compared to experimental data. As application we show the characterization of SAW and SSLW modes by suppressing the other mode respectively. Therefore, we use a thin film yttrium trioxomanganate on Yttria-stabilized zirconia substrate.

DS 14.17 Tue 17:00 Poster E

Effects of screening on the optoelectronic properties of 2D materials — Abderrezak Torche, •Jens Hühnert, and Gabriel Bester — University of Hamburg, Hamburg, Germany

2D materials represent nowadays a promising route for new technologies due to their exceptional optical and electronic properties. These properties are highly dependent on the surrounding environment, consequently, one can modify a desired property such as the band gap or the doping simply by changing the environment. Despite the fact that 2D materials have been studied since the discovery of graphene in 2004, both at the experimental and the theoretical levels, the understanding of the effects of screening (e.g. substrate effects) is still not complete although some general rules are well established.

From a theoretical point of view, the study of screening in 2D materials is computationally heavy. Standard approaches to study the optical properties of materials, such as the BSE formalism, have several limitations because the inclusion of the environment hinders the calculation of quasi-particle energies in 2D.

The goal of our research is to go beyond these limitations and treat larger systems (i.e. thousands of atoms) which are more relevant from an experimental (and/or industrial) point of view. For that goal, we propose a hybrid approach combining density functional theory and configuration interaction methods to predict the binding energies of excitations in 2D materials (excitons, trions, ...) taking the effect of the environment into account via screening.

DS 14.18 Tue 17:00 Poster E

Origin of Ferrimagnetic Properties in Disordered Spinel Ferrite Thin Films — •Vitaly Zviagin[1], Paula Huth[2], Chris Sturm[1], Jörg Lenzner[1], Annette Setzer[1], Reinhard Denecke[2], Pablo Esquinazi[1], Marius Grundmann[1], and Rüdiger Schmidt-Grund[1] — [1]Universität Leipzig, Felix-Bloch-Institut für Festkörperphysik, Linnéstr. 5, Germany — [2]Universität Leipzig, Wilhelm-Ostwald-Institut für Physikalische und Theoretische Chemie, Linnéstr. 2, Leipzig

Spinel ferrite thin films, $Zn_xFe_{3-x}O_4$ ($0 \leq x \leq 1.26$) and $ZnFe_2O_4$ (ZFO), were deposited on TiN/(100)MgO and (100) $SrTiO_3$ substrates by pulsed laser deposition. The bulk as well as surface cation distribution was estimated from the relative strength of O 2p to Fe 3d and 4s electronic transitions in the dielectric function (DF) as well as analysis of Fe 3p and 2p XPS core level spectra, respectively. As the predominant cation configuration becomes less inverse with Zn increase from x = 0 to 1.26, the surface becomes less deficient (abundant) in tetrahedral (octahedral) Fe^{3+} occupation, as compared to the bulk. The net magnetic response was related to the antiphase boundary and inhomogeneous composition defect formation. Bulk tetrahedral Fe^{3+} occupation in ZFO films was found to increase with the decrease in deposition temperature and was directly correlated to the increase in net magnetic response. The change in the ferrimagnetic order in the ZFO films was related to the bulk Fe distribution and is examined as a function of deposition as well as annealing temperature and atmosphere.

DS 14.19 Tue 17:00 Poster E

Single-source, metalorganic, low-temperature growth of carbon nanowalls: the role of precursor dissociation — •Sebastian Tigges, Axel Lorke, and Nicolas Wöhrl — University of Duisburg-Essen and CENIDE, Faculty of Physics, 47057 Duisburg, Germany

Carbon nanowalls (CNWs) exhibit exceptional thermal as well as elec-

trical conductivity and adjustable surface area. This makes them especially attractive for energy technologies (such as fuel cells) and application in sensors. Here, we investigate different CNW structures deposited at remarkably low temperatures (ca. 350°C). In an inductively coupled plasma-enhanced chemical vapour deposition system, specific morphologies are obtained by tuning essential process parameters such as flow rate of precursor gas and process pressure. Scanning electron microscopy reveals three distinct CNW structures of varying morphology and inter-wall distance. Raman spectroscopy shows significant variation in both defect density and defect type, depending on morphology. Additionally, X-ray photoelectron spectroscopy and Auger microscopy is used to determine the overall and spatially resolved chemical composition of different morphologies. Plasma characterization, specifically determination of the number density of light-emitting species in the plasma, is done by optical emission actinometry. It is illustrated, how the formation of individual morphologies is depending on the residence time of the complex precursor molecule, which is used as the carbon source in the process. From these observations a simple growth model is derived.

DS 14.20 Tue 17:00 Poster E

Sputter Deposition of Chalcogenide Superlattices with Varying Interfacial Diffusion — •Peter Kerres, Henning Hollermann, Kai Scheuvens, Matthias Dück, and Matthias Wuttig — I. Institue of Physics (IA), RWTH Aachen University

Superlattices consisting of thin layers of germanium telluride (GeTe) and antimony telluride (Sb_2Te_3) are currently considered as energy efficient phase-change memory devices. In order to unravel the detailed switching mechanism, the determination of the superlattice structure is crucial. Sputter deposition of the constituents offers a broad parameter window, thereby enabling a systematic investigation of samples with varying structure and morphology. This study focusses on the interdiffusion at adjacent GeTe/Sb_2Te_3 heterointerfaces employing X-Ray Diffraction (XRD). A series of superlattice samples has been deposited on a mica substrate, while the amount of interdiffusion is varied with the applied deposition temperature. Structural changes in the samples are monitored with $\theta - 2\theta$ XRD scans. The significant changes in the measurements are then compared with simulations, which take the disorder into account.

DS 14.21 Tue 17:00 Poster E

Ion-beam sputtering of tungsten oxide — •Mario Gies, Martin Becker, Fabian Michel, and Angelika Polity — Institute for Exp. Physics I and Center for Materials Research (LaMa), Justus Liebig University Giessen, Germany

Tungsten oxide films were prepared on glass substrates coated with fluorine-doped tin oxide (FTO) by ion-beam sputtering from a metallic tungsten target using different gas mixtures of argon and oxygen. The films were deposited at various growth temperatures between 100 and 400°C. The different growth temperatures allow the systematic adjustment of crystallinity between amorphous and polycrystalline tungsten oxide. At those temperatures a series of samples were created in which the oxygen flow rate was varied between 5 and 10 sccm. The results show that the choice of different oxygen flows during the deposition permits the creation of thin films with varying optical properties. Out of this, the various compositions of the films could be estimated. Besides those main series, hydrogen-doped films were deposited under the use of hydrogen as additional reactive gas during the sputtering process. All samples were investigated regarding different aspects like crystallinity, composition, morphology, optical properties and electrochromic behavior.

DS 14.22 Tue 17:00 Poster E

Hydrophobic and hydrophilic silica shells on metal nanoparticles via plasma-enhanced in-flight coating process — Lisa Wurlitzer[1,2], Patrick Post[3], •Simon Homann[1,2], Wolfgang Maus-Friedrichs[1,2], and Alfred Weber[3] — [1]Institute of Energy Research and Physical Technology, Leibnizstraße 4, 38678 Clausthal-Zellerfeld, Germany — [2]Clausthal Centre of Material Science, Agricolastraße 2, 38678 Clausthal-Zellerfeld, Germany — [3]Institute of Particle Technology, Leibnizstraße 19, 38678 Clausthal-Zellerfeld, Germany

Coated nanoparticles have a wide variety of applications in modern material science because of their interesting properties. TiO_2-nanoparticles for example are used in sunscreen, because of their photocatalytic activity. The goal of this work is to produce silica shells with metal and TiO_2 as core-materials for a targeted creation of hydrophilic and hydrophobic layers. SiO_2 is the here desired shell material because of its chemical inertness and optical transparency. This is archived with a modified method of an in-flight plasma-enhanced-chemical-vapor-deposition (PECVD) using a non-thermal dielectric barrier discharge. Tetryethyl orthosilicate (TEOS) and hexamethyldisiloxane (HMDSO) were used as precursors. The coated particles are studied via x-ray photoelectron spectroscopy (XPS). Results show a hydrophilic coating of silica-organic material on platinum using HMDSO, while the deposition of TEOS on TiO_2 results in a hydrophobic, inorganic silica shell.

DS 14.23 Tue 17:00 Poster E

Unraveling the interplay of structure and electronic properties in the phase-change material compound family of GST — •Carl-Friedrich Schön, Matthias Dück, and Matthias Wuttig — I. Physikalisches Institut (IA), RWTH Aachen University, D-52056 Aachen, Germany

Phase-change materials (PCM) are a promising candidate for universal memory, as their optical reflectivity and electrical resistivity change considerably between the amorphous and the crystalline state. Devices utilizing that transition have recently been realized in the form of the Micron/Intel Optane Memory. It is even more intriguing that some PCMs of the GeTe-SbTe compound family (GST) show the transition from insulating to metallic behavior (MIT) within the crystalline phase. Interlinked with disorder effects, this MIT's nature is unprecedentedly Anderson-like. While the understanding of the electronic properties is paramount, assumptions regarding band shape, effective mass and degeneracy at the L-point have yet to be proven. In this work, film thickness and the degree of disorder in terms of vacancy type, quantity and arrangement of GST thin films are varied. Growth control and structural characterization are employed to map the properties across the MIT, which is induced by the redistribution of randomly distributed vacancies to vacancy layers. The goal is to unravel the interplay of structure, morphology, band structure and electronic properties to gain insights into the mechanisms driving the MIT. The findings of this work are aimed to support the development of analogue neural computing units and multi-state memory devices.

DS 14.24 Tue 17:00 Poster E

External C-ERDA and RBS analysis setup — •Felix Junge[1], Masahiro Saito[1,3], Kim Holm[1,2], Felipe Lipp Bregolin[1], and Hans Hofsäss[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen, Göttingen Germany — [2]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, Halle, Germany — [3]Toray Research Center Inc., 3-3-7, Sonoyama, Otsu, Shiga 520-0842, Japan

In this work we describe the new construction of the external analysis setup at the University of Göttingen, which is used to perform Rutherford backscattering (RBS) simultaneously to coincidence elastic recoil detection analysis (C-ERDA) under atmospheric pressure. In addition, thin layers of titanium were deposited to a Si_3N_4 membrane and the RBS and C-ERDA spectra were recorded. Furthermore, polyamide and Mylar foils were measured as reference samples. The aim is to measure a depth profile of the hydrogen concentration in thin films and self supporting foils and thus to enable a quantitative elemental analysis of the light elements. Moreover, it is planned to load the titanium films with hydrogen and produce hydrogen containing amorphous carbon layers on Si_3N_4 membranes.

DS 14.25 Tue 17:00 Poster E

Depth profiling of PEALD-AlN films based on Al2p XPS peak decomposition — •Ali Mahmoodinezhad[1,2], Emilia Pozarowska[1], Karsten Henkel[1,2], Dieter Schmeisser[1], and Jan Ingo Flege[2] — [1]Applied Physics and Sensor Technology, BTU Cottbus-Senftenberg — [2]Applied Physics and Semiconductor Spectroscopy, BTU Cottbus-Senftenberg

AlN has remarkable properties (wide band gap, low electrical and thermal conductivity, high dielectric constant, piezoelectricity) and is attractive for (opto)electronic and sensor applications. However, high oxygen content within nitride films is always a critical issue due to the thermodynamically favorable oxidation against nitridation resulting in deteriorated materials properties. In order to clarify whether the oxidation is a surface-limited or a bulk process elemental depth profiling is essential. In this work XPS in combination with Ar+ sputtering is applied to carry out depth profiling of AlN films prepared by plasma-enhanced atomic layer deposition using different parameters (plasma source, power and pulse duration). Particularly, the Al2p core levels are analyzed where the signals are decomposed into four

components, representing weaker contributions of pure AlN and aluminum oxide phases as well as stronger signals of mixed oxygen-rich and nitrogen-rich phases. After sputtering (providing access to the deeper part of the film) the pure AlN phase content increases while the pure aluminum oxide content stays relatively constant. These issues are discussed with regard to the preparation parameters employed and accompanying XRD and electrical measurements.

DS 14.26 Tue 17:00 Poster E

Formation and characterization of Si-QDs in annealed Si/SiNx and Si/SiO2 multilayers — •Rostislav Medlín, Pavel Calta, Pavol Šutta, and Marie Netrvalová — New Technologies Research Centre, UWB Pilsen, Univerzitní 8, 306 14, Czech Republic

Si quantum dots (Si-QDs) embedded in dielectric matrix have attracted much attention for the applications in fields such as data storages or optoelectronics. In this work we performed a detailed comparative study of the structural, optical and photoluminescent properties of Si-QDs formed in annealed Si/SiNx and Si/SiO2 multilayers. Samples have been grown by means of PECVD with a substrate temperature of 250°C using silane, nitrogen and nitrous oxide as precursor gases and post-annealed between 600-1100°C. TEM, XRD, Raman, FT-IR, UV-Vis and PL techniques were used to characterize the prepared superlattices. The dependences of the photoluminescence, structural and chemical bonding characteristics of Si-QDs on the dielectric barrier material and thickness were investigated. The cross-section TEM, XRD and Raman measurements confirms the formation of Si-QD in the range 3-20 nm. It was found that the size of the formed Si-QDs was dependent on the annealing temperature as well as the sublayer thickness. Columnar growth and evolution of wavy interface morphology was discussed.

DS 14.27 Tue 17:00 Poster E

B20-type FeGe on Ge (100) grown by pulse laser melting — •Zichao Li[1,2], Yufang Xie[1,2], Mao Wang[1,2], Chi Xu[1,2], Ye Yuan[1,2], Slawomir Prucnal[1], and Shengqiang Zhou[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

B20-type FeGe is one of the noncentrosymmetric materials hosting skymions. Due to its nanoscale helical spin textures that only need extremely low spin-polarized currents to be moved, this material is one promising candidate for ultra-dense information storage and spintronics. In this work, we propose a simple method to prepare B20-type FeGe, which only includes a room temperature deposition of 10 nm Fe layer on Ge (100) substrates and a following process by pulse laser melting. The formation of B20 phase is confirmed by X-ray Diffraction With a preferential orientation of FeGe(111)//Ge(001). The FeGe samples show superparamagnetic properties and their blocking temperatures increase with increasing laser power. We conclude that this phenomenon is due to the increased grain size of B20 FeGe phase with increasing laser energy . This work provides a path of obtaining different B20-type transition metal germinides which can be magnetic-Skyrmion hosting materials for spintronics.

DS 14.28 Tue 17:00 Poster E

Investigation of ultra-low energy ion implanted graphene by RBS and NRA — •Manuel Auge and Hans Hofsäss — II. Physikalisches Institut, Universität Göttingen, 37077 Göttingen, Germany

Dopant introduction into both graphene and transition metal dichalcogenides (TMDs) in a controllable manner is highly desirable. Hence, electronic doping other than electric gauging or chemical functionalization would be a major breakthrough. In our study, a unique mass selected ion beam deposition system is used to incorporate low energy ions into 2D-lattices. Therefor, a 30 keV ion beam is decelerated in a UHV-chamber down to energies as low as 10 eV. A beam sweep ensures a uniform profile over an area of 1 cm^2 up to 2.5 cm^2. At the present time, sources are available for B, C, N ,F, P, S, Mn, Fe, Se, W and Au ions. In this work, we show the successful incorporation of B, Mn and Au into graphene. In order to proof the implanted areal concentration as well as the elemental composition, Rutherford backscattering measurements were performed on tetrahedral amorphous carbon films doped with Mn and Au, respectively. For this purpose, we use a 860 keV He^{2+}-beam and detect the backscattering events caused by the interaction between the high energetic projectile and the coulomb potential of atomic nuclei of the sample. Light elements in low concentrations are only hard to detect analytically. Nevertheless, implanted B can be investigated by a nuclear reaction analysis. We irradiate implanted test samples with a 430 keV proton beam generating the $^{11}B(p, 2\alpha)\alpha$ nuclear reaction with a detection limit of about $5 \cdot 10^{13}$ B/cm^2.

DS 14.29 Tue 17:00 Poster E

Towards multimodal measurements on printed thin films — •Michael Buchhorn[1], Christopher Greve[1], Fabian Panzer[2], and Eva Herzig[1] — [1]Dynamik und Strukturbildung - Herzig Group, Universität Bayreuth, Universitätsstraße 30, 95447 Bayreuth, Germany — [2]Lehrstuhl für Optoelektronik weicher Materie - Herzig Group, Universität Bayreuth, Universitätsstraße 30, 95447 Bayreuth, Germany

The performance of many novel material systems heavily depends on their nanoscale structure. The structure on the other hand can be to some extent controlled by the way the material is processed, which allows a certain tunability of the functionality of the materials.

For this reason, it is of interest to understand structure formation processes in detail. Using a slot die printing system with various environmental control parameters [1] we therefore wish to examine as many structural parameters during processing as possible to obtain a detailed picture of the formation process. To achieve this, we have extended our printing chamber with various simultaneous measurement capabilities [2] and demonstrate here the capabilities for sample quality and structural analysis of organic solar cell materials.

[1] Pröller, Stephan; Moseguí González, Daniel; Zhu, Chenhui; Schaible, Erik; Wang, Cheng; Müller-Buschbaum, Peter; Hexemer, Alexander; Herzig, Eva M. Rev. Sci. Inst., 88 (6), 066101, 2017

[2] Buchhorn, Michael; Wedler, Stefan; Panzer, Fabian, J. Phys. Chem. A, 122 (46), 9115, 2018

DS 14.30 Tue 17:00 Poster E

Investigations of $LaVO_3$ and $PrVO_3$ thin films by Raman spectroscopy and ellipsometry — Simon Brehm[1], •Cameliu Himcinschi[1], Ionela Lindfors-Vrejoiu[2], Kumar Deepak[3], Wilfrid Prellier[3], and Jens Kortus[1] — [1]Institute of Theoretical Physics, TU Bergakademie Freiberg, 09596 Freiberg, Germany — [2]II. Physikalisches Institut, Universität zu Köln, D-50937, Germany — [3]Laboratoire CRISMAT, CNRS-ENSICAEN, F-14050 Caen, France

In this work, 3d transition metal vanadates ($LaVO_3$ and $PrVO_3$) thin films grown by pulsed-laser deposition on different crystalline substrates ($DyScO_3$, LSAT, $LaGaO_3$, $SrTiO_3$) were investigated. The phase transition to orbital ordering of the films was evaluated by Raman spectroscopy. For this purpose, temperature-dependent measurements were carried out in a range of 90 K to 300 K using 633 nm laser line as excitation. The dependence of the orbital ordering on the film orientation on the different substrates was addressed. Additionally, spectroscopic ellipsometry was used to determine the optical constants of the $LaVO_3$ and $PrVO_3$ thin films at room temperature.

DS 14.31 Tue 17:00 Poster E

Superradiant and transport lifetimes of the cyclotron resonance in the topological insulator HgTe — •Jan Gospodaric[1], Vlad Dziom[1], Alexey Shuvaev[1], Andrei Pimenov[1], Alena Dobretsova[2], Nikolay Nikolaevich Mikhailov[2], and Ze Don Kvon[2] — [1]Institute of Solid State Physics, Vienna University of Technology, 1040 Vienna, Austria — [2]Rzhanov Institute of Semiconductor Physics and Novosibirsk State University, Novosibirsk 630090, Russia

In this work, we investigated the phenomenon of collective radiative decay, or superradiance, in three-dimensional topological insulator HgTe with conducting surface states. Specifically, by utilizing an approach of a continuous-wave spectroscopy we examined the cyclotron resonance of the surface electrons in the terahertz frequency range. Due to the quasi-classical regime of the cyclotron resonance at terahertz frequencies, the results can be well explained via classical electrodynamic approach. This allowed us to separate the energy losses in the system into intrinsic and radiation losses, respectively. We showed experimentally that a semi-transparent gate on the top of HgTe quantum well allows us to switch the sample to a regime where the superradiance, i.e. coherent emission, dominates the losses.

DS 14.32 Tue 17:00 Poster E

In-situ investigation of electrochromic coloration prozesses in tungsten trioxide thin films by optical spectroscopy — •Alexander G. Strack[1,2], Jan L. Dornseifer[1,2], Simon Burkhardt[1,2], Limei Chen[1,2], Matthias T. Elm[1,2,3], and Pe-

ter J. Klar[1,2] — [1]Institut of Experimental Physics I, Heinrich-Buff-Ring 16, 35392 Giessen, Germany — [2]Center for Materials Research (LaMa), Heinrich-Buff-Ring 16, 35392 Giessen, Germany — [3]Institute of Physical Chemistry, Heinrich-Buff-Ring 17, 35392 Giessen, Germany

Smart-windows with thin films of tungsten trioxide are helpful for an efficient heat management, since heat transfer though windows may be very high. A well insulated building may save costs. For decreasing heat transfer, it is desirable to understand the microscopic switching properties of the tungstenoxide film and to be able to control the process. With various experimental techniques it is possible to investigate the electrochromic coloring process in thin tungstenoxide films. Raman spectroscopy reveals the different vibrationaly modes of WO^{6+}, WO^{5+} and WO^{4+} in poly-crystalline tungsten films. We emply a principal component analysis to correlate the evolution of Raman modes with the coloration process. Corresponding results will be shown and discussed.

DS 14.33 Tue 17:00 Poster E

Surface dead layer in thin manganite films studied by Surface-Enhanced Raman Spectroscopy — Sebastian Merten, •Jonas Wawra, and Vasily Moshnyaga — I. Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Half-metallic mixed-valence manganites are promising materials for spintronic applications. However, extrinsic effects, like surface dead layer or chemical segregation, prevent that they unfold their true potential. Here, we present a Surface-Enhanced Raman (SER) spectroscopy study of the surface dead layer in doped $La_{0.7}$(Ca or Sr)$_{0.3}MnO_3$ thin films, grown by MAD technique. The required Au nanoparticles have been grown with the same technique. The SER spectra of the free manganite surface reveal an electron-enrichment, manifested by the appearance of strong Jahn-Teller stretching modes. To manipulate this electron-rich surface layer, we have modified the manganite surface by deposition of 1-2 monolayers of SrO, MgO and TiO_2, and compared the obtained SER spectra with those from the free surface. Financial support of the Deutsche Forschungsgesellschaft via SFB TP A02 is acknowledged.

DS 14.34 Tue 17:00 Poster E

Sum-frequency generation vibrational spectroscopy of 4-Nitrothiophenole and 4-Aminothiophenole adsorbed on gold surfaces — •Matthias Linke, Damian Firla, and Eckart Hasselbrink — Universität Duisburg-Essen, Universitätsstr. 5, 45141 Essen, Germany

Self-assembled molecular films and their characterization has attracted much interest over the last decades, especially in the field of nanotechnology. The application of such films relies on controlling of their topological as well as their chemical properties. An extensively studied system consists of gold as a substrate and thiol molecules as the molecular layer which is formed easily by self-assembly. Sum-frequency generation vibrational spectroscopy (SFGVS) is a useful tool for characterization of surfaces. Different vibrational modes could be observed although the ones of aromatic compounds in the range of 1200 to 1650 cm^{-1} typically show only moderate IR- and/or Raman-activity which both are a necessity for SFGVS. 4-Nitrothiophenole (NTP) and 4-Aminothiophenole (ATP), which differ in the substituent and the electronic effects caused by these, have been adsorbed on gold surfaces and studied by SFGVS. The ring mode 8a and the symmetrical stretching mode for the NO_2-group for NTP and the mode 19a for ATP have been observed and were used to characterize the layers.

DS 14.35 Tue 17:00 Poster E

The dependence of piezoelectric performance of AlN thin films on Si(111) on post-growth annealing treatment — •Dmytro Solonenko[1], Constance Schmidt[1], Chris Stoeckel[2], Karla Hiller[2], and Dietrich R.T. Zahn[1] — [1]Semiconductor Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany — [2]Zentrum für Mikrotechnologie, Chemnitz University of Technology, 09107 Chemnitz, Germany

Aluminum nitride (AlN) is a material well-suited for microelectromechanical systems (MEMS) due its relatively high piezoelectric coefficients as well as high physical and chemical stability. Thin AlN films, used in the production of MEMS, are often fabricated by reactive magnetron sputtering, which, despite its efficiency and low cost, is known to produce films of mediocre quality and thus tolerable piezoelectric performance. The effect of post-growth annealing, which is usually performed to improve the crystallinity of semiconductors, was investigated for sputtered AlN films by X-ray diffraction, Raman and IR spectroscopies, spectroscopic ellipsometry, and atomic force microscopy. The results show that the strain built in the films during the growth starts to effectively relax at around 1000 °C, which is related to a dewetting of the AlN crystallites from the silicon substrate surface under formation of O-containing species such as SiO_2 and AlON. Up to 800 °C, the average grain size enlarges and the film porosity is reduced, which positively affects the piezoelectric coefficient, d_{33}, determined using piezoresponse force microscopy.

DS 14.36 Tue 17:00 Poster E

Functionalization of Silicon Nanoribbons on Ag(110) — •Alexander Ehm, Dmytro Solonenko, Dietrich R.T. Zahn, and Patrick Vogt — Semiconductor Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany

Silicon nanoribbons (SiNRs) are quasi one-dimensional one-atom thin Si structures, forming under ultra-high vacuum conditions on well-ordered Ag(110) surfaces. These SiNRs have a width of 1.6 nm, a length of several 100 nm and are well aligned parallel to each other, along the Ag[-110] direction [1]. The atomic structure of the SiNRs is explained by inter-connected Si pentagons [2], a structure unique among all Si-related materials, leading to distinct properties when e.g. to diamond like Si. Oxidation of the SiNRs by exposure to molecular oxygen, for example, proceeds along the ribbons, starting from their extremities, while their edges and top are stable [3].

We used in situ Raman spectroscopy to get further insight into the vibrational properties of SiNRs and investigate their modification through oxygen and hydrogen adsorption. Our results confirmed the "burning match" effect [3], suggesting a higher stability of SiNRs when compared to other 2D Si materials. Oppositely, the hydrogenation of SiNRs fails, the reasons of which will be discussed.

[1] C. Leandri et al., Surface Science 574, L9-L15 (2005)
[2] J. I. Cerda et al., Nat. Comm. 13076 (2016)
[3] P. De Padova et al., Nano Lett., Vol. 8, No. 8, 2299-2304 (2008)

DS 14.37 Tue 17:00 Poster E

Understanding the Limits of Plasmonic Sensitivity and Tip-Enhanced Raman Spectroscopy — •Lu He, Mafuhjur Rahaman, Teresa Isabel Picoto Pena Madeira, and Dietrich R.T. Zahn — Reichenhainerstraße 70 P181 Chemnitz Germany

Tip-Enhanced Raman Spectroscopy has attracted growing interest over the last decades. Due to the confined electric field at the metallic tip apex, one can both enhance the Raman sensitivity, and reduce the probing area significantly. The enhancement factor can be large enough to enable this technique to be sensitive to detailed structures[1] and orientation of surface species[2] well beyond the diffraction limit of light reaching a spatial resolution of about 2 nm[1,2]. For a metal-metallic tip-sample system, the full width at half maximum (FWHM) of the local electric field is estimated by 2*sqrt(Rd), with R is the radius of the tip and d is the tip-sample distance[3]. However, the situation can be different if the substrate structure is smaller than the tip radius R. In this contribution we will address this issue by calculating the local electric field using finite element method simulations and varying the substrate dimensions. Our simulations will not only provide a deeper understanding of the TERS mechanism of such structures, but also help in realizing highly efficient TERS experiments using similar systems.

DS 14.38 Tue 17:00 Poster E

Active optical metasurfaces based on defect engineered phase-change and phase-transition materials — Jura Rensberg, Martin Hafermann, •Kevin Wolf, and Carsten Ronning — Institute of Solid State Physics, Friedrich Schiller University Jena, Germany

Energetic ion beams are widely used to modify the electronic and structural properties of solids by introducing impurity atoms into the crystal lattice. Commonly, the inevitable formation of irradiation damage during ion bombardment is described as disadvantageously for ion beam doping and subsequent post-implantation annealing procedures are required. Since the electronic structure of both, phase-change materials, such as chalcogenide glasses, and phase-transition materials, such as vanadium dioxide, are very sensitive to small amounts of lattice defects, area selective ion irradiation can be used to locally adjust either the phase and/or the phase transition temperature of these materials. Using this robust technique, optical metasurfaces including tunable absorbers based on thermally triggered dichroism and reconfigurable

polarizers based on artificially induced phase coexistence are demonstrated.

DS 14.39 Tue 17:00 Poster E

A sqeezable tunneling junction setup for the measurement of thermoelectricity in nanojunctions — •Matthias Popp and Heiko B. Weber — Friedrich-Alexander-Universität Erlangen-Nürnberg

Motivated by experiments on epitaxial graphene-graphene nanojunctions [Kis17] we built a setup which is capable of adjusting the distance between two silicon carbide (SiC) plates on the picometer scale. Thereby we can bring electrodes which are patterned on top of the SiC plates into close vicinity. By adjusting the distance between the plates we can adjust the (tunneling) resistance of the so formed nanocontact within a wide range. The observed stability is such that single-molecule junctions can be established. As a remarkable feature, we can induce temperature gradients across the junction, allowing for thermoelectrical measurements. On our poster we present first resoults of thermoelectricity measurements on gold-gold and gold-molecule-gold nanojunctions.

[Kis17] F. Kisslinger, *et al., Charge-carrier transport in large-area epitaxial graphene.* Annalen der Physik 1700048 (2017)

DS 14.40 Tue 17:00 Poster E

Using Tunnelling Spectroscopy to Monitor Changes in the Electronic Structure of Chalcogenide Thin Films Occurring by Tuning their Electronic Properties — •Lisa Metzner[1], Johannes Reindl[1], and Matthias Wuttig[1,2] — [1]I. Physikalisches Institut (IA), RWTH Aachen University, 52056 Aachen, Germany — [2]JARA - FIT, RWTH Aachen University, Germany

Phase change materials (PCM) possess some unique physical properties, which make them well suited candidates for the integration in novel data storage technology, like the recently presented 3D XPoint memory. In such devices, the large contrast in electrical resistivity between stable amorphous and crystalline phases, switched by electrical pulses on a nanosecond timescale, is exploited.

In addition to this extraordinary mechanism, in the material class of chalcogenides, to which the PCM belong, many compounds with other interesting physical properties such as good thermoelectrics, topological insulators or superconductors can be found. In these materials, methods like alloying or thermal annealing provide means for tuning their electronic structure and properties, such as n-p transitions or band gap engineering.

In order to quantify these changes in the electronic structure of the materials, the electronic density of states (DOS) around the Fermi level is a crucial physical property. This quantity can be determined by tunnelling spectroscopy. Therefore, here we present measurements performed on tunnel junctions of PbXTe components, which were produced by in-situ sputter deposition.

DS 14.41 Tue 17:00 Poster E

Investigation of bipolar resistive switching mechanisms in amorphous and crystalline $Ge_2Sb_2Te_5$ using different electrode materials — •Hagen Bryja, Mario Behrens, Andriy Lotnyk, and Bernd Rauschenbach — Leibniz Institute of Surface Engineering (IOM), Permoserstraße 15, 04318 Leipzig, Germany

Electric-field-induced resistive random-access memory has received much attention as candidate for next-generation non-volatile memory applications due to its fast switching, simple structure and low power consumption. Chalcogenide-based phase change alloy $Ge_2Sb_2Te_5$ (GST) has shown promising properties for such memory devices, since its switching mechanism relies on either ionic migration or pure electronic effects.

Here, the influence of the electrode material and solid phase of GST on bipolar resistive switching was investigated. For this, Pt/GST/Cr and Ag/GST/Cr memory cells were both prepared using pulsed laser deposited amorphous or crystalline GST. Transmission electron microscopy investigations and detailed analysis of the current-voltage characteristics are presented. In the case of Pt/GST/Cr the resistive switching arises from a pure space-charge limited conduction (SCLC) mechanism, whereas Ag/GST/Cr shows a combination of SCLC with electrochemical metallization effects. For both cells it was found that the magnitude of the resistance and the high/low resistance ratio are significantly affected by the solid phase of GST. Furthermore, application-related properties such as multi-state capability, endurance and retention time were compared.

DS 14.42 Tue 17:00 Poster E

Microstructuring of rf-sputtered VO2 thin films for improved transmittance properties — •Hannes Giese, Florian Kuhl, and Angelika Polity — Institute of Experimental Physics I and Center for Materials Research (ZfM/LaMa), Justus Liebig University Giessen, Heinrich-Buff-Ring 16, 35392 Giessen

Vanadiumdioxide (VO2) is a material which changes its transmittance properties due to a temperature induced metal-to-insulator phase transition (MIT). The transmittance for infrared light in the monoclinic low temperature phase is much higher than in the tetragonal high temperature phase, thus VO2 is predestined for use as a smart window coating for an improved climate control in buildings. To gain a better optical impression and a higher transmittance in the visible range, one attempts to reduce the VO2 covered area by microstructuring but on the other hand to maintain the switching effect.

The VO2 thin films were deposited by radio-frequency sputtering (rf sputtering). Microstructuring was carried out by photolithography with different patterns and both, positive and negative photoresists. As last step ion beam etching (IBE) was used for structuring the samples to obtain different patterns in the VO2 thin film. The samples were characterized by UV/Vis spectroscopy for optical properties and light microscopy for determining the pattern sizes. The influence of different patterns, variation of covered area, etching parameters and size of the structures on the optical parameters was investigated to gain the best compromise between enhancing the transmittance in visible light and still a good switching efficiency for the MIT in the infrared range.

DS 14.43 Tue 17:00 Poster E

Structural and electrical properties of layered $FeGe_2$ thin films — •Samuel Gaucher, Bernd Jenichen, and Jens Herfort — Paul-Drude-Institut für Festkörperelektronik, Berlin, Germany

The solid-phase epitaxy (SPE) of Ge thin films over Fe_3Si surfaces was investigated recently as a solution to create lattice-matched heterojunctions. A persistent challenge in this field had been to grow epitaxial semiconductors over metals by MBE, a limiting factor for a number of envisaged applications in the field of spintronics. In order to solve this issue, amorphous Ge was deposited on ferromagnetic quasi-Heusler compound Fe_3Si and crystallized slowly by annealing. Instead of pure Ge, the resulting single-crystalline films were shown to be a new 2D polymorph of $FeGe_2$ with space group P4mm. TEM studies reveal a layered structure with monolayer Fe planes sitting between tetragonal Ge bilayers.[1] The material does not exist in a bulk form, its creation being interpreted as an ordering phenomenon induced by minimization of the elastic energy of the epitaxial film.[1] It is possible to isolate the material on an insulating GaAs substrate by first growing a few monolayers of crystalline Fe_3Si, and then thicker amorphous Ge in a ratio such as to obtain the right stoichiometry for $FeGe_2$ (with some Si atoms sitting on Ge sites). Electrical measurements conducted on $FeGe_2$ films of 8 to 12 nm indicate a thickness dependence of their resistivity. Magnetotransport at low temperature reveal a strong anomalous Hall effect.

[1]Jenichen et al., Phys. Rev. Mater. **2**, 051402 (2018).

DS 14.44 Tue 17:00 Poster E

Electronic Noise in Hafnium and Yttrium Oxide-Based RRAM Devices — •Martin Lonsky[1], Eszter Piros[2], Stefan Petzold[2], Eric Jalaguier[3], Emmanuel Nolot[3], Christelle Charpin[3], Christian Wenger[4], Lambert Alff[2], and Jens Müller[1] — [1]Institute of Physics, Goethe-University Frankfurt, Frankfurt am Main, Germany — [2]Institute of Materials Science, Technical University Darmstadt, Darmstadt, Germany — [3]CEA, LETI, Minnatec Campus, Grenoble, France — [4]IHP GmbH, Leibniz-Institut für innovative Mikroelektronik, Frankfurt (Oder), Germany

Resistive random access memory (RRAM) devices have attracted great attention due to their potential to be applied as a reliable, fast and high-density non-volatile data storage solution. Here, we present a study on transition metal oxide-based devices, in which the mechanism of resistive switching is related to the formation and rupture of oxygen-deficient conducting filaments in the oxide layer. Up until today, the exact mechanisms of charge transport and their dependence on various parameters are not yet fully understood. In this context, a better and more detailed physical picture would yield strong benefits with regard to the fabrication of more reliable and efficient devices. Therefore, we compared HfO_2- and Y_2O_3-based memory cells by employing fluctuation spectroscopy, which is a powerful method to study

the charge carrier dynamics in RRAMs. For hafnium oxide-based devices, the electronic noise exhibits clear signatures of trap-assisted tunneling processes, whereas for yttrium oxide-based samples our results suggest a different charge transport mechanism to be predominant.

DS 14.45 Tue 17:00 Poster E

Highly conducting thin films of PdCoO2 prepared by MAD technique — Oleg Shapoval[1], Vladimir Roddatis[2], Sven Esser[3], Thomas Zimmermann[3], Philipp Gegenwart[3], and •Vasily Moshnyaga[1] — [1]Erstes Physikalisches Institut, Georg-August-Universität Göttingen, Germany — [2]Institut für Materialphysik, Georg-August-Universität Göttingen, Germany — [3]Experimentalphysik VI, Center for Electronic Correlations and Magnetism, Augsburg University, Germany

Pd-based delafossite PdCoO2 (PCO) with 2D conducting layers and extremely large mean free path of electrons is of great interest for applications in thermal transport or as conducting electrodes. However, the information on the growth of PCO films is scarce. We report the structure and electric properties of PCO thin films grown by metalorganic aerosol deposition (MAD) technique on hexagonal substrates, i.e. Al2O3(0001), YSZ(111), as well as on Ca3Co4O9 buffered SrTiO3(100). Under optimized processing conditions, i.e. growth rate, deposition temperature, post-annealing, a 20 nm thick PCO(001)/YSZ(111) film shows room temperature resistivity 5*10(-6)Ohmcm and residual resistance ratio, RRR(5K)=3. Low temperature magnetotransport (Hall effect and Shubnikov-de Haas oscillations) will allow us to disentangle between intrinsic and extrinsic parameters and further improve the quality of PCO films. Financial support from DFG through SFB 1073 (TPA02), MO2255-4 and TRR 80 (TP G3) is acknowledged.

DS 14.46 Tue 17:00 Poster E

Pathways of polymer degradation of PCPDTBT and PDTSTzTz — •Andreas Frueh[1], Ulf Dettinger[1], Heiko Peisert[1], Hans-Joachim Egelhaaf[2], and Thomas Chassé[1] — [1]Universität Tübingen, IPTC, Auf der Morgenstelle 18 D-72076 Tübingen, Germany — [2]ZAE Bayern, Auf AEG, Bau 16, 1. OG, Fürther Str. 250, D-90429 Nürnberg

The photodegradation kinetics of two prototypical low-bandgap polymers (PCPDTBT and PDTSTzTz) in thin films upon illumination with light with wavelenths between 365 and 700 nm have been studied using UV/vis and fluorescence spectroscopy. For both polymers, two different degradation behaviors were found: There is a non-linear initial reaction kinetic and a more linear behavior in later stages of the photo oxidation. In dependence on the illumination wavelength, thereaction rate may depend on the energy of incident photons or on the number of absorbed photons giving valuable information on the most probable degradation pathway. In particular for PCPDTBT, the initial reaction rate depends on absorbance pointing to the involvement of singlet oxygen in the polymer degradation. Photoluminescence spectroscopy supports this hypothesis. In contrast, in later stages a radical mechanism is proposed, , which was concluded from a clear increase of the reaction rate at higher photon energies in UV region.

DS 14.47 Tue 17:00 Poster E

Study of Resistive Switching on La0.3Ca0.7MnO3/YBa2Cu3O7-δ Bilayers Deposited by Sputtering DC — John Betancourt[1,2], Jhon E. Ordoñez[1], Carlos W. Sanchez[1], Wilson Lopera[1], •Katherine Gross[1], and Maria E. Gómez[1,2] — [1]Thin films group, Universidad del Valle, Cali, Colombia — [2]Centro de Excelencia en Nuevos Materiales, CENM

Devices based on phenomenon of resistive random access memory (RRAM) have been studied on different transition metal oxides. In this materials the favorable properties as low power consumption, simplicity, long retention time and even multilevel switching are very important. We have deposited La0.3Ca0.7MnO3 (LCMO) films on YBa2Cu3O7-δ (YBCO)/ SrTiO3 (STO) to study the resistive switching on complex oxide. In this case, LCMO (t= 60, 30 and 15 nm) was used like insulator material in contact with a fixed YBCO layer (t= 60 nm) as a bottom electrode. From XRD we found that the LCMO and YBCO layers growth textured aligned with substrate. The electrical properties with temperature using Ag like top electrode indicated the insulator and metal behavior of LCMO and YBCO respectively. The I-V curves allow us investigate the hysteretic response and the presence of two resistive states at room temperature and associated with electrical transport mechanisms like space charge limited conduction (SCLC). Finally, the resistance switching with applied voltage tests were performed indicating a relation between the thicknesses of the LCMO layer with the HRS/LRS ratio.

DS 14.48 Tue 17:00 Poster E

Investigation of Hydrogen Gas Sorption in Thin Metal Films Using a Quartz Crystal Micro Balance — •Sonja Schneidewind[1], Julian Blaschtschak[1], Max Aker[1], Andreas Fleischmann[2], Loredana Gastaldo[2], Andreas Reifenberger[2], and Magnus Schlösser[1] — [1]ITEP, KIT, Karlsruhe, Germany — [2]Kirchhoff-Institut für Physik, Heidelberg, Germany

Certain metals have the ability to solve hydrogen in their lattice structure and to subsequently form metal hydrides. Out of these materials, titanium has one of the lowest dissociation pressure which allows a quasi-irreversible hydrogen capture. However, the titanium surface tends to form an oxide layer at contact with air which acts as effective permeation barrier. The oxidation can be prevented by sputtering a thin palladium film on top allowing the hydrogen permeation through the Pd layer into the Ti getter. This technique can be used to build effective passive hydrogen pumps or by employing the radioactive isotopologue, tritium, one can build dedicated radioisotope heat sources, e.g. for calibration purposes.

In order to study kinetics, materials and loading parameters, we perform sorption experiments by using a high-resolution quartz crystal micro balance with deuterium at the ng scale. As an additional testing method, AFM and XRD are used to get information about the film structure and to verify the absorbed gas amount. Finally, the findings will be applied to a dedicated loading of identical metal films with tritium gas which will then be validated by Beta-Induced X-Ray Spectroscopy.

DS 14.49 Tue 17:00 Poster E

Indium tin oxide (ITO) direct wafer bonding — •Michael Hönle[1], Kurt Hingerl[2], and Thorsten Wagner[2] — [1]OSRAM Opto Semiconductors GmbH, Leibnizstraße 4, Regensburg, 93055, Germany — [2]Johannes Kepler University Linz, Altenberger Straße 69, 4040 Linz, Austria

Direct wafer bonding allows combination of separately grown and prepared Si and III-V devices and, moreover, high bonding toughness can be achieved at temperatures as low as room temperature. In order to facilitate good electrical interconnection and little absorption, the intermediate bonding layer ideally should offer high electrical conductivity and high transparency. Indium tin oxide (ITO) is a material which offers both of these properties. In this work we demonstrate the feasibility of a defect free ITO-ITO direct wafer bond of non-patterned Si wafers and characterize the bond interface qualitatively and quantitatively. Moreover, to create insight into the bonding mechanism of an ITO-ITO direct wafer bond, high resolution transmission electron microscopy (HR-TEM) was employed. To show the possible application of ITO-ITO direct wafer bonding with III-V materials, we transferred epitaxially grown GaN layers to Si wafers and display that the obtained bonded wafers are robust enough for further front of line processing. In order to optimize the bonding process a good understanding of the material properties is needed, therefore ITO layers were analyzed using surface analytical methods before and after direct wafer bonding.

DS 14.50 Tue 17:00 Poster E

Spin-orbit torques in epitaxially grown two-dimensional transition metal dichalcogenides — •Amilcar Bedoya-Pinto, Avanindra Pandeya, Kai Chang, Ilya Kostanovskiy, Peter Werner, and Stuart Parkin — NISE department, Max Planck Institute of Microstructure Physics, Weinberg 2, 06120 Halle (Saale), Germany

Transition metal dichalcogenides (TMDCs), layered materials which have captured great attention due to their tunable electronic properties, are commonly fabricated via exfoliation of bulk crystals. Although there has been progress in fabricating devices out of exfoliated heterostructures, there are applications -such as spin transfer torques- that rely on atomically clean interfaces for an optimal performance. Our approach is to grow high-quality NbSe2 layers on Al2O3 (0001) by molecular beam epitaxy (MBE), gaining thereby a precise control of the layer thickness, electronic properties (doping) and improving the quality of the interfaces involved in spin transfer and spin-to-charge conversion. We use spin-torque ferromagnetic resonance (ST-FMR) of a NbSe2/NiFe/MgO device structure to quantify the spin-orbit torques (SOTs) produced by the TMDC thin films. First results show a strong symmetric component of the ferromagnetic resonance lineshape, as well as a scaling of the resonance linewidth with external DC bias, both

signatures of sizable spin-orbit torques induced by the NbSe2 layer. This underlines the relevance of in-situ grown TMDC/ferromagnet heterostructures towards highly efficient spin-orbitronic devices.

DS 14.51 Tue 17:00 Poster E

Metal ions at metal/polymer interfaces — •Maria Sonnenberg, René Gustus, and Wolfgang Maus-Friedrichs — Technische Universität Clausthal, Clausthaler Zentrum für Materialtechnik, Leibnizstraße 9, 38678 Clausthal-Zellerfeld, Germany

Understanding the interaction between thin polymer films and metal surfaces is necessary for the plastics processing industry. During the processing of plastic, polymer is melted in the extruder unit. Often thin polymer layers are formed on the surface of the extruder, which leads to peeling off of partly solidified polymer into the melt. These polymer particles will not melt again and generate weak points within the product. Basic understanding of the underlying mechanisms is important in order to avoid steel/polymer interaction. For this purpose thin layers of polycarbonate were prepared on a silicon wafer. Iron was evaporated onto the polymer surfaces under ultra-high vacuum conditions. Afterwards the samples were heated up to 200°C. The interfaces after metal evaporation and after heating were examined by electron spectroscopy (XPS). Experiments show that the diffusion of iron atoms in the polymer melt occurs. The interaction of polycarbonate with iron atoms was investigated. XPS results indicate the formation of a carbonyl-iron bond and an interaction of iron atoms with the aromatic rings.

DS 14.52 Tue 17:00 Poster E

Reactive Metal-Organic Interfaces Studied with HAXPES: Modify Reaction Depth and Interphase Formation — •Stefan Renato Kachel, Martin Schmid, Benedikt P. Klein, Nicolas Bock, and J. Michael Gottfried — Fachbereich Chemie, Philipps-Universität Marburg, Germany

Interfaces between organic semiconductors and metallic layers are ubiquitous in organic electronic devices and can significantly influence device functionality. The vapor deposition of a metal onto an organic layer is often followed by a diffusion of the metal atoms into the organic layers. These metal atoms can react with the organic molecules forming a reacted interphase instead of an abrupt interface. A versatile technique for the quantitative characterization of these interphase layers is the hard X-ray photoelectron spectroscopy (HAXPES), which allows for non-destructive chemical depth profiling and chemical analysis across the interphase region. Here we studied two different systems, the reactive calcium on α-sexithiophene (6T) and less reactive cobalt on 2H-tetraphenylporphyrin (2HTPP) system. In order to gain control over the thickness of the interphase layer, we varied process parameters such as sample temperature and metal atom flux during interphase preparation. We found that the temperature of the organic film during metal deposition was the only parameter that significantly influenced the formation of the interphase layer by nearly a factor of 2 independent of the system. Furthermore we observed a higher reaction depth and a complex diffusion mechanism for the Ca/6T system.

DS 14.53 Tue 17:00 Poster E

Finding and understanding surface structures with SAMPLE — •Lukas Hörmann, Andreas Jeindl, Alexander T. Egger, and Oliver T. Hofmann — Institute of Solid State Physics, NAWI Graz, Graz University of Technology, Austria

Even if the physical properties of an organic semiconductor are ever so promising in the bulk phase, they may drastically change upon adsorption on the surface. Specifically, surfaces can induce the formation of polymorphs with worse, or under the right conditions, also greatly improved properties. Normally, the exponential growth of possible polymorphs with system size prohibits rigorous computational studies, that could explore the full configurational and thermodynamic search space. Thus, we use SAMPLE [1,2], which employs machine learning to suitably fit a physical energy model and therewith efficiently calculate the adsorption energies of an exhaustive set of coarse grained polymorphs.

We showcase the capabilities of this approach for monolayers of molecules with very different interactions on coinage metals. With SAMPLE we not only find the best polymorphs, but also defects and other local minima. Ab-initio thermodynamics allows us to also consider temperature effects and create phase diagrams. Our unique combination of a physically inspired energy model and statistical learning enables us to gain insight into the molecular interactions on the surface. This allows us to not only tell which polymorph forms, but also which interactions are the reasons for the formation of specific structures.

[1] Hörmann et al., arXiv:1811.11702
[2] Scherbela et al., Phys. Rev. Materials 2, 043803

DS 14.54 Tue 17:00 Poster E

Simulating Charge Transport Through Metal-Organic Semiconductor Interfaces: Bulk or Contact Limited? — •Markus Krammer[1], Philipp Breitegger[2], Chris Groves[3], and Karin Zojer[1] — [1]Institute of Solid State Physics, NAWI Graz, Graz University of Technology, Austria — [2]Institute of Electronic Sensor System, Graz University of Technology, Austria — [3]Department of Engineering, Durham University, United Kingdom

The performance of organic electronic devices crucially relies on an efficient charge injection. This efficiency is governed by a complex interplay of experimentally tunable properties like level alignment and disorder. The impact of this interplay on the bulk current is only poorly understood from a theoretical point of view. To overcome this lack of knowledge, we utilize mesoscopic simulations to predict the current density across the contact interface. In these simulations, charges are viewed to migrate through disordered organic semiconductors due to hopping between localised states. Parameters like injection barrier, energetic disorder, electric field, Coulomb interactions and temperature can be directly considered. This intuitive method holds the promise to understand the effects and interactions that govern the interplay between interfacial and bulk properties. We analyse the current density for instructive combinations of interface and bulk properties. This analysis yields two distinct regimes, a bulk limited regime and a contact limited regime. The evolution of the current density with respect to injection barrier, energetic disorder and electric field strength is investigated and the origin of bulk vs. contact limitation is analysed.

DS 14.55 Tue 17:00 Poster E

Bisquinolylamide Metal Complexes for OFET — •Pascal Schweitzer[1], Georg Albrecht[1], Clemens Geis[1], Harald Locke[2], Peter R. Schreiner[2], and Derck Schlettwein[1] — [1]Justus-Liebig-Universität Gießen, Institut für Angewandte Physik — [2]Justus-Liebig-Universität Gießen, Institut für Organische Chemie

Metal-organic complexes with two pincer-type bisquinolylamide ligands give the possibility to introduce a doubly charged metal ion M(II) center in an octahedral coordination sphere. Such coordination geometry is not commonly found in organic semiconducting complexes. Metals like Zn, Cr, Mn, Fe, Co were used in this present approach. The resulting cross-shaped complexes lead to stacking of the ligands' electronic systems in two directions of the solid, indicated by XRD measurements on single crystals. Organic field-effect transistors (OFET) prepared on microstructured interdigitated gold electrode arrays on SiO_2 were used to investigate the charge-carrier mobility and electrical conductivity of these new molecular complexes. Potentiometry by atomic force microscopy in high vacuum was used to yield contact resistances between gold and the semiconductor materials in steady-state. In-situ measurements during film growth gave insight into layer and contact formation. Injection barriers between gold and the semiconductors were calculated from Kelvin probe force microscopy and data from cyclic voltammetry.

DS 14.56 Tue 17:00 Poster E

Laterally structured dielectrics by area-selective atomic-layer-deposition — •Daniel Anders, Philip Klement, Fabian Michel, Jörg Schörmann, and Sangam Chatterjee — Institute of Experimental Physics I and Center for Materials Research (ZfM), Justus-Liebig-University Giessen, D-35392 Giessen, Germany

Industrial semiconductor manufacturing combines lithography, etching, and deposition processes to create (opto-) electronic devices. The quest for miniaturization of those devices has led to complex fabrication processes with multiple patterning and etching steps to achieve area-select deposition. However, for more advanced technology a tool must deposit different combinations of materials area-selectively. Atomic-layer-deposition (ALD) is a technique for depositing high-quality, ultrathin films of dielectrics with the potential of area-selective deposition that could reduce the number of manufacturing steps and allow for advanced structures. Here, we demonstrate the successful direct patterned deposition of TiO_2 on SiO_2 creating smooth surfaces of alternating dielectrics. A combination of electron beam lithography using a PMMA mask, ion beam etching, plasma treatment and ALD enables a patterned deposition. Several process parameters were varied, and their effect on the resulting structure was investigated by atomic force microscopy, scanning electron microscopy, and X-ray pho-

toelectron spectroscopy. We find that a number of factors must be considered in design, patterning, and deposition to achieve reproducible results. Our work enables the realization of lateral heterostructures as central building blocks for advanced technology applications.

DS 14.57 Tue 17:00 Poster E

Study of the in-plane lattice constant of phase change materials during deposition — •Hetal Vaishnav[1], Marvin Kaminski[1], Marc Pohlmann[1], and Matthias Wuttig[1,2] — [1]I. Institute of Physics, Physics of New Materials, RWTH Aachen University, 52056 Aachen, Germany — [2]JARA-Insitut Energy-efficient information technology (PGI-10), FZ Jülich, 52428 Jülich, Germany

Phase change materials (PCMs) are higher order chalcogenides which can be rapidly switched between the amorphous and crystalline state upon heating. The unique properties of the crystalline phase of these chalcogenides have recently been attributed to a novel bonding mechanism which we have coined metavalent bonding (MVB). In this bonding mechanism the electrons are on the verge of delocalization. This immediately raises the question how these materials behave in reduced dimensions such as thin films, where electron delocalization is impeded. To answer this question, thin films of different chalcogenides have been grown by molecular beam epitaxy (MBE). In the literature, two unexpected observations have been reported for GeTe thin films. For certain substrates, an increased in-plane lattice constant was observed for thin films, which reached the bulk value for thicker films. For other substrates, a transition from an amorphous to a crystalline state has been observed at a thickness of a few bilayers. These findings cannot be directly explained by strain effects or pseudomorphic growth. Hence, in this work, further investigations for different materials like SnTe and Sb2Te3 will be presented and compared to GeTe thin films.

DS 14.58 Tue 17:00 Poster E

Herstellung von Schichten aus MoN_x mittels hochionisierender PVD-Verfahren — Martin Balzer[1], Martin Kommer[1], •Sabine Stück[2], Martin Fenker[1] und Frank Schmidl[2] — [1]Forschungsinstitut Edelmetalle+Metallchemie, Katharinenstraße 17, 73525 Schwäbisch Gmünd — [2]Friedrich-Schiller Universität Jena, Physikalisch-Astronomische Fakultät, Institut für Festkörperphysik, Helmholtzweg 5, 07743 Jena

Schichten aus Übergangsmetallnitriden finden aufgrund ihrer extremen Härte, hohen Schmelzpunkte und chemischer Stabilität vorallem Anwendung als Verschleißschutzschichten. Hier gewinnen Molybdännitride (MoN_x) aufgrund ihrer überlegenen mechanischen Eigenschaften zunehmend an Interesse. Unter den Übergangsmetallnitriden weisen die Molybdännitride deutlich erhöhte Härtewerte und eine sich selbst ausbildende schmierende Phase (Magnéli-Phase) bei erhöhten Temperaruren auf. Diese Eigenschaften machen das Material interessant für tribologische Anwendungen.

Wir haben Schichten aus Molybdännitrid mit unterschiedlicher Kristallstruktur und Zusammensetzung hergestellt. Besonders von Interesse ist die Herstellung des hexagonalen δ-MoN, da diese Phase nicht mit allen PVD-Verfahren hergestellt werden kann. Wir verwenden die hoch-ionisierenden PVD-Verfahren HiPIMS (High Power Impulse Magnetron Sputtering) und PLD (Pulsed Laser Deposition). Die beiden Verfahren werden hier dargestellt, sowie der beobachtete Einfluss der Prozessparameter auf die Schichtbildung erörtert. Die Möglichkeiten und Grenzen der beiden Verfahren sollen hier aufgezeigt werden.

DS 14.59 Tue 17:00 Poster E

Controlling the B-site Ordering by a Layer-by-Layer MAD growth — •Philipp Ksoll[1], Christoph Meyer[1], Vladimier Roddatis[2], and Vasily Moshneaga[1] — [1]Erstes Physikalisches Institut, Georg-August-Universität Göttingen — [2]Institut für Materialphysik, Georg-August-Universität Göttingen

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 chemical composition by in situ optical ellipsometry and oxygen atmosphere during the deposition process. Epitaxial superlattices (ABO3)n/(AB'O3)n (A = La, Sr; B = Ni, Mn, Co, Fe, Mo) with n decreasing down to 1 unit cell to obtain A2BB'O6 have been grown on SrTiO3 and Al2O3 substrates. The films were characterized by global (X-ray diffraction, SQUID, Raman spectroscopy) and local (AFM, TEM) techniques to maintain a full control of the individual layer thickness and to elucidate its influence on the physical properties. Further on, a half-metallic ferromagnetic Sr2FeMoO6 films with transition temperatures well above room temperature, Tc~450 K, have been prepared. Financial support by the DFG via project Mo2255-4 is acknowledged.

DS 14.60 Tue 17:00 Poster E

Evaluation of sputter-damage of zinc-doped indium oxide deposition on Perovskite layers by different deposition techniques — •Marlene Härtel[1,2], Eike Köhnen[2], Ruslan Muydinov[1], Steve Albrecht[2], and Bernd Szyszka[1] — [1]Technische Universität Technologie für Dünnschicht-Bauelemente, Berlin, Deutschland — [2]Helmholtz-Zentrum Institut für Silizium Photovoltaik, Berlin, Deutschland

To deposit high quality transparent conductive oxides (TCOs), a lot of energy as well as high temperatures are commonly used. To be able to employ so called TCOs in monolithic Silicon / Perovskite tandem solar cell application, where the Perovskite is targeted to function as a top cell absorber, quite some challenges need to be overcome. The illumination of the bottom silicon cell happens through the top cell, therefore the front contact must be highly transparent and sufficiently conductive to prevent parasitic absorption and to transport charge carriers. However, deposition conditions of high-quality TCOs are damaging for Perovskite top-cells. Therefore, methods to quantify sputter-damage are investigated. This work aims to compare different deposition techniques in terms of applicability, and different methods to detect sputter-damage and it's causes, when depositing amorphous zinc-doped indium oxide.