DS 27: 2D Materials beyond Graphene (jointly with O)

Time: Tuesday 18:30–20:30 Location: P2-EG

DS 27.1 Tue 18:30 P2-EG

Effect of different sulfur environment on sulfurization of MoO3 into MoS2 nanoflakes — •Prabhat Kumar, Megha Singh, and Gade B Reddy — Thin Film Laboratory, Department of Physics, Indian Institute of Technology Delhi, Hauz Khas, New Delhi-110016

In present work, Molybdenum disulfide (MoS2) nanostructured thin films (NTFs) were synthesized by sulfurizing MoO3 NTFs in three different non-conventional methods (named methods 1-3). Method 1 uses sulfur vapors, second utilizes H2S/Ar gas and third adopts plasma of H2S/Ar gas. The effect of sulfurizing ambient on its efficiency to convert MoO3 into MoS2 has been studied. And parameters such as crystallinity, purity, uniformity and stoichiometry control have been basis of this study. The samples showed uniform nanoflakes (NFs) structures throughout sample, revealed by SEM, same as their precursor MoO3. XRD and Raman disclosed crystalline MoS2 in all three methods, however the degree of crystallinity was greater in case of sulfurization in H2S/Ar plasma ambient. HR-TEM revealed formation of core-shell nanostructures comprising of MoO2 in core and MoS2 making shell. Quantitative analysis of sulfurized films carried out by XPS, shows the presence of MoS2 in methods 1,2 and 3 with percentage found to be 18%, 87% and ~100% respectively. Plasma ambient has resulted in high quality of MoS2 NTFs based on parameters such as crystallinity and stoichiometry control. Hydrogen sulfide plasma provides reducing environment as well as source of reactive sulfur species for sulfurization. The advantage of using plasma is reduced temperature and time.

DS 27.2 Tue 18:30 P2-EG

X-ray absorption spectroscopy studies on transition metal dichalcogenide heterointerfaces — •Florian Rasch[1], Sage Bauers[2], Danielle Hamann[2], Gavin Mitchson[2], Kyle Hite[2], Javier Herrero-Martín[3], Manuel Valvidares[3], David Johnson[2], Bernd Büchner[1], and Jorge Hamann-Borrero[1] — [1]Leibniz Institute for Solid State and Materials Research Dresden, Dresden, Germany — [2]Department of Chemistry and Materials Science, University of Oregon, Eugene, Oregon, United States — [3]ALBA Synchrotron Light Source, Cerdanyola del Vallès, Barcelona, Spain

Transition metal dichalcogenides (TMD) are layered quasi 2D materials that exhibit exciting physical phenomena such as superconductivity (SC) and charge density waves (CDW), which strongly depend on the TMD dimensionality. In order to study the effect of dimensionality on the electronic properties of TMD a series of ferecrystal heterostructures with chemical formula $[(MSe)_m/(TSe_2)_n]_k$ (M = Sn, Pb, Bi and T = V, Nb, Ti) were synthesized with precise control of the dimensionality, i.e. m and n. Additionally, study of the charge transfer (CT) into the dichalcogenide layer is possible by changing the M cation. Here we present a X-ray absorption spectroscopy (XAS) study at the transition metal $L_{2,3}$ edges for $(PbSe)_1/(VSe_2)_n$ (with n = 1, 3), as well as $(MSe)_1/(NbSe_2)_1$ and $(MSe)_1/(TiSe_2)_1$ (with M = Sn, Pb, Bi) heterostructures at temperatures below and above T_{CDW}. Our experiments clearly show strong changes of the transition metal XAS spectra by changing the M ion. Moreover, X-ray magnetic circular dichroism reveals weak magnetism for samples containing Ti and V.

DS 27.3 Tue 18:30 P2-EG

Synthesis and Spectroscopy of Bismuthene — •Felix Reis[1], Gang Li[2,3], Lenart Dudy[1], Maximilian Bauernfeind[1], Stefan Glass[1], Werner Hanke[3], Ronny Thomale[3], Jörg Schäfer[1], and Ralph Claessen[1] — [1]Physikalisches Institut and RCCM, Universität Würzburg, Würzburg, Germany — [2]Institute for Solid State Physics, Vienna University of Technology, Vienna, Austra — [3]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Würzburg, Germany

The search for quantum spin Hall materials with large band gap has become one of the major research thrusts of solid state physics. Despite other approaches, graphene with its honeycomb lattice geometry always fascinated the community. Here, we report the realization of so-called "bismuthene", which is synthesized on the wide-bandgap substrate SiC(0001). Scanning tunneling microscopy imaging clearly displays the honeycomb structure. Using tunneling spectroscopy, we find a huge bulk gap of $\sim 800\,\mathrm{meV}$, with the Fermi level positioned well inside this gap. Interestingly, metallic edge states are observed when the bismuthene film edge is approached. A comparison of angle-resolved photoemission measurements and density functional theory band structure calculations is a further manifestation of the formation of bismuthene. To understand the empirical electronic properties, a detailed theoretical analysis is performed. A low-energy effective model demonstrates that the substrate not only stabilizes bismuthene, but plays a crucial role in the formation of the observed huge band gap, which is driven by the large on-site spin-orbit coupling.

DS 27.4 Tue 18:30 P2-EG

Thermodynamic stability, electronic and optical properties of graphene oxide dependence on oxidation level. — •Ivan Guilhon[1], Lara K Teles[1], Marcelo Marques[1], Friedhelm Bechstedt[2], Jürgen Fürthmuller[2], and Silvana Botti[2] — [1]Grupo de Materiais Semicondutores e Nanotecnologia, Instituto Tecnológico de Aeronáutica, DCTA, 12228-900 São José dos Campos, Brazil — [2]Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Universität, Max-Wien-Platz 1, D-07743 Jena, Germany

Graphene oxide is a two-dimensional material with potential applications in ultra-thin electronic, optoelectronic and sensor devices. It is an intermediate compound in the graphene synthesis through chemical route. Despite the fact that the chemical composition of such system have strong influence on its electronic and optical process, these interesting features have not been investigated until now.

We propose a statistical model for graphene oxide based on the cluster expansion of the disordered system based on the generalized quasi-chemical approximation (GQCA). Epoxide and hydroxyl groups are considered. Thermodynamic stability of the system is investigated and the known tendency of the system to decompose into highly oxidized domains and pristine graphene is explained and discussed in the light of binodal and spinodal decomposition. We calculate the energy gap as a function of the degree of oxidation considering composition fluctuation effects in the whole composition range, showing tunable electronic properties in a wide range interval. Optical absorbance spectra are predicted for different chemical compositions.

DS 27.5 Tue 18:30 P2-EG

Low Temperature Scanning Tunneling Spectroscopy on MoS_2 nanoflakes on Au(111) — •Daniela Dombrowski[1,2] and Carsten Busse[1,2] — [1]II. Physikalisches Institut, Universität zu Köln — [2]Institut für Materialphysik, Westfälische Wilhelms-Universität Münster

We perform low temperature scanning tunneling spectroscopy at 5 K of MoS_2 nanoflakes grown on Au(111) by a combination of physical and chemical vapour deposition. We find a band gap of approx. 1.9 eV and pronounced peaks, originating from the MoS_2 bands. The Shockley-surface state at 0.5 eV is present on the bare gold surface, but absent below the MoS_2 islands.

Furthermore, we take advantage of the spatial resolution of scanning tunneling spectroscopy to measure the influence of the moiré superstructure arising from the lattice mismatch between the MoS_2 layer and the underlying gold substrate. We observe a significant shift of the valence band edge, whereas the conduction band remains almost unchanged, hence leading to a variation of the gap energy induced by the moiré pattern.

Finally, we find a new state right above the valence band, which is associated with the edge of the MoS_2 flakes.

DS 27.6 Tue 18:30 P2-EG

Structural dynamics of TMDC heterostructures studied by femtosecond electron diffraction — •Daniela Zahn, Thomas Vasileiadis, Lutz Waldecker, and Ralph Ernstorfer — Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany

Vertical heterostructures of two-dimensional (2D) crystals offer intriguing new perspectives for the fabrication of novel nanodevices [1]. Especially for optoelectronic devices, it is important to understand their relaxation dynamics after optical excitation, which are governed by the interplay of electronic and phononic coupling across the interface and electron-phonon coupling in the individual materials. One experimental technique that can directly observe the structural response to photoexcitation is femtosecond electron diffraction [2]. The evolution of

the atomic mean-square-displacement can be experimentally accessed by means of the Debye-Waller effect. Our focus lies on heterostructures with staggered (type II) band alignment, which exhibit photo-induced charge separation across the interface. We present results on bulk WSe_2/WS_2 heterostructures revealing sub-picosecond transfer of hot charge carriers across the interface and intralayer energy transfer from the charge carriers to the lattice on a timescale of few picoseconds in both materials. The results suggest that the equilibration between the two materials is carried out primarily by hot charge carrier transfer while vibrational coupling plays a minor role.

[1] A. Geim, I.V. Grigorieva, Nature 499, 419-425 (2013).
[2] L. Waldecker, R. Bertoni, R. Ernstorfer, JAP 117, 044903 (2015).

DS 27.7 Tue 18:30 P2-EG

Growth of ultrathin MoS_2 films - Temperature dependency — •Vanessa Zeuner, Lukas Madauss, and Marika Schleberger — Universität Duisburg-Essen, Deutschland

Molybdenum disulfide (MoS_2) is an important representative of transition metal-dichalcogenides (TMDCs).With a direct bandgap it is an interesting candidate for a variety of electronic and optoelectronic applications. Therefore, the growth of large area, two dimensional films is investigated. We synthesized the MoS_2 films by chemical vapour deposition on SiO_2/Si substrates and used MoO_3 and S powders as the reactants. The influence of the temperature during the process on the morphology of the two dimensional MoS_2 flakes is studied.

DS 27.8 Tue 18:30 P2-EG

Electronic Structure of surface-doped FeTe bulk crystals and epitaxial FeTe thin films on Bi_2Te_3 — •Fabian Arnold[1], Jonas Warmuth[2], Jan Fikáček[3], Matteo Michiardi[1], Marco Bianchi[1], Jan Honolka[3], Tim Wehling[4], Philip Hofmann[1], and Jens Wiebe[2] — [1]Department of Physics and Astronomy, Aarhus University, Aarhus, Denmark — [2]Department of Physics, Hamburg University, Hamburg, Germany — [3]Institute of Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic — [4]Institut für Theoretische Physik, Universität Bremen, Bremen, Germany

The realization of unconventional superconductivity in iron-based superconductors (SCs) has attracted growing attention in the physics community in the recent years, especially after the discovery of high temperature superconductivity in systems involving thin layers. Iron-chalcogenides have the simplest crystal structure in this materials class which turns them into good candidates for fundamental studies of the electronic structure and its relation to the superconductivity. It is especially interesting that for strongly correlated high-Tc SC materials like Fe-based SCs, a transition to the SC phase upon chemical doping is observable. Here we present an angle-resolved photoemission spectroscopy study of bulk FeTe and thin films of FeTe grown on the topological insulator Bi_2Te_3 [1,2], surface-doped with alkali atoms, and compare to ab-initio calculations. Interestingly, there is almost no change in the electronic structure upon surface doping. [1] S. Manna et al., arXiv:1606.03249 (2016), Nat. Commun. (in press). [2] T. Hänke et al., arXiv:1606.09192 (2016), Nat. Commun. (in press).

DS 27.9 Tue 18:30 P2-EG

Near-surface dynamics of hot carriers in $2H$-MoS_2: momentum-dependent relaxation and spin- and valley-polarized excitation — •Hauke Beyer, Petra Hein, Gerald Rohde, Ankatrin Stange, Marcel Behrendt, Kerstin Hanff, Lexian Yang, Kai Rossnagel, and Michael Bauer — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Germany

Time- and angle-resolved photoelectron spectroscopy (trARPES) is employed to study different aspects of ultrafast near-surface carrier dynamics in $2H$-MoS_2. Momentum-dependent population and relaxation processes within the conduction-band energy landscape are monitored following photoexcitation with 395 nm laser pulses. Our results indicate that surface-localized defect states play a key role in the final depopulation of the conduction band [1]. Furthermore, we are able to selectively address K and K' valleys in the trARPES experiment using circularly polarized 590 nm laser pulses owing to the lack of inversion symmetry in the top layer of $2H$-MoS_2. Similar to recent trARPES results reported for $2H$-WSe_2 [2], dichroism is observed in excited state intensity as well as dynamics.

[1] P. Hein et al., Phys. Rev. B **94**, 205406 (2016).
[2] R. Bertoni et al., arXiv:1606.03218.

DS 27.10 Tue 18:30 P2-EG

Ultra-thin Bi2Te3 films on semiconductor substrates — •Mert Taşkin and Oğuzhan Gürlü — Istanbul Technical University, Department of Physics, Maslak, 34469, Istanbul, Turkey

Bi2Te3 has a rhombohedral crystal structure and it consists of quintuple layers (QLs) along c-axis. QLs bind with van der Waals interaction. Consequently, the crystal can be cleaved from this interface and the resulting Te1 terminated (0001) surface can be investigated with scanning probe techniques. Bi2Te3 was shown to be a topological insulator (TI) besides being a thermoelectric material; yet, the knowledge on the electronic structure of this material at ultra-thin limit is still incomplete. Before making any attempt at an application with Bi2Te3 in the 2D limit, it is quite important to understand its general physical properties. We modified chemical vapor deposition (CVD) technique to grow ultra-thin Bi2Te3 films on semiconductor/metal-oxide surfaces. In this process we obtained ultra-thin films and micro-particles of Bi2Te3. The heights of obtained Bi2Te3 films are measured to be a few QLs. The radius of Bi2Te3 micro-particles are 1-5 micrometers. Here the structural and spectroscopic characteristics of these ultra-thin films will be discussed.

DS 27.11 Tue 18:30 P2-EG

The interaction of the calcium-intercalated silicene (CaSi2 - R15) surface with a H2 molecule, a DFT study — •Pingo Mutombo, Petr Brázda, Martin Ondráček, and Lukáš Palatinus — Institute of Physics, Academy of Sciences of the Czech Republic, Cukrovarnická 10, CZ-16200, Prague, Czech Republic

First-principles calculations have been used to investigate the silicene intercalated CaSi2-R15 compound and discuss the adsorption of H2 at its silicon-rich surface. We assess the stability of the surface by calculating the surface energy. We further determine the band structure of the compound, the surface work function, and charge redistribution both inside the compound and near the surface. It was found that there is a charge transfer from Ca to Si atoms. Moreover, the silicene-related Dirac cone shifts from high symmetric point of the hexagonal Brillouin zone and moves below the Fermi level,due the presence of the Ca atoms. DFT calculations suggest that a hydrogen molecule undergoes a dissociative adsorption on the topmost Si atoms, indicating a high reactivity of the silicene surface layer.

DS 27.12 Tue 18:30 P2-EG

Structural modifications of 2D hexagonal boron nitride caused by ion irradiation — Lara Bröckers, •Henry Bohnen, and Marika Schleberger — Fakultät für Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

Single layers of hexagonal boron nitride (hBN) – often called *white graphene* – are a two-dimensional insulating material, which is interesting as a building block for heterostructures with graphene or other 2D semiconducting materials. Its atomic structure is similar to the structure of graphene. That makes it interesting to test if one can cause the same structural modifications of hBN by ion irradiation, as shown for graphene.[1,2] Therefore we irradiated ultrathin hBN layers with swift heavy ions under grazing incidence. We investigated the efficiency (i.e. number of ions needed to create one folding on average) for different number of layers and different substrates. As a result we found a higher efficiency for the folding of thicker layers hBN in comparison to graphene.

[1] Akcöltekin S. et al. *Applied Physics Letters* 98 (2011) 101063
[2] Ochedowski O. et al. *NimB*, 340 (2014) 39-43.

DS 27.13 Tue 18:30 P2-EG

Nanostructuring 2D Materials by Ion Irradiation — •Andre Maas[1], Roland Kozubek[1], Lukas Madauss[1], Ursula Ludacka[2], Mukesh Kumar Tripathi[2], Henning Lebius[3], Marko Karlusic[4], Jani Kotakoski[2], and Marika Schleberger[1] — [1]Universität Duisburg and Cenide, Fakultät für Physik, 47048 Duisburg, Germany — [2]Universität Wien, Boltzmanngasse 5, 1090 Vienna, Austria — [3]CIMAP, (CEA-CNRS-ENSICAEN-UCN), blvd Henri Becquerel, F-14070 Caen, France — [4]Ruder Bošković Institute, Bijenička cesta 54, 10000 Zagreb, Croatia

To fully exploit the colossal technological potential of 2D materials, methods to introduce defects in a controlled way are a key factor. We have investigated energetic ion irradiation induced defects and nanostructures in 2D materials like graphene and single layer MoS2. We show that apart from the well-known binary collisions caused by singly charged keV projectiles, the dense electronic excitation triggered by highly charged ions as well as swift heavy ions may be used to create

various characteristic nanostructures each of which may be fabricated by choosing the proper irradiation conditions.

Our experiments, including optical spectroscopy techniques and atomic resolution STEM, reveal unique morphologies such as closed bilayer edges with a given chirality, nanopores of round shape as well as chemical modifications like hydrogenation of the 2D material. By controlled variation of ion parameters like kinetic energy, charge state, angle of incidence, etc., this wide spectrum of modifications in 2D materials can be accessed.

DS 27.14 Tue 18:30 P2-EG

Investigation of sputter processes on metalic surfaces and 2D-Materials using Time-of-Flight mass spectroscopy — •Stephan Sleziona[1], Philipp Ernst[1], Matthias Herder[2], Andreas Wucher[2], and Marika Schleberger[1] — [1]Universität Duisburg-Essen, AG Schleberger, Germany — [2]Universität Duisburg-Essen, AG Wucher, Germany

We have investigated the sputtering processes and ionization probability of metallic surfaces (Indium and Molybdenum) irradiated by two different kinds of ions. We used highly charged ions (HCI), i.e. Xe^{30+} Ions (E_{pot}= 15 keV and E_{kin}= 180 keV) , and singly charged Ar-Ions with kinetic energy of E_{kin}= 4 keV. While the interaction of the latter with the solid is dominated by nuclear stopping the interaction of HCIs consist partly of electronic stopping, too. To study the differences, the Indium surface was irradiated by both types of ions and Time-of-Flight (ToF) mass spectra were recorded. In order to do so we optimized the spatial positions of the Argon-Gun, the HCI source,the spectrometer, and the laser, which was used to post-ionize secondary neutral particles . In addition, the operating voltages and timings of the different components were optimized. With this new set-up we obtained ToF spectra which show a significant difference between the two types of ions. Most recently we used this technique to investigate sputter processes of 2D-Materials.

DS 27.15 Tue 18:30 P2-EG

Influence of the Charge Density Wave Order on Quasiparticle Excitations in $2H$-$NbSe_2$ — •Eva-Maria Liebhaber[1], Olof Peters[1], Michael Ruby[1], Kai Rossnagel[2], Benjamin W. Heinrich[1], and Katharina J. Franke[1] — [1]Fachbereich Physik, Freie Universität Berlin, 14195 Berlin, Germany. — [2]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, 24098 Kiel, Germany.

The transition metal dichalcogenide (TMDC) $2H$-$NbSe_2$ is a layered material with interesting properties of strongly correlated electrons at low temperatures. A superconducting phase with a critical temperature of $T_{c,SC} \approx 7.2\,K$ coexists with a threefold symmetric charge density wave (CDW) with $T_{c,CDW} \approx 33\,K$. Although the material has been studied intensively for a long time, the exact interplay between superconductivity and CDW order is still under debate. Recently, Soumyanarayanan *et al.* observed a quantum phase transition from the familiar triangular CDW to a stripe charge order which they assigned to local strain caused by subsurface defects [1].
Here, we investigate the influence of the different CDW phases on the quasiparticle excitation spectra using low temperature scanning tunneling spectroscopy with superconducting tips. The quasiparticle spectra show variations with the periodicity of the CDW as well as on the atomic scale.

[1] A. Soumyanarayanan *et al.*, *Proceedings of the National Academy of Sciences* **110**, 1623-1627 (2013).

DS 27.16 Tue 18:30 P2-EG

Structural analysis of PTCDA domains on an epitaxial hexagonal boron nitride (hBN) monolayer via SPA-LEED and STM — •Christine Brülke[1], Timo Heepenstrick[1], Moritz Sokolowski[1], and Sergey Subach[2] — [1]Institut für Physikalische und Theoretische Chemie der Universität Bonn, Wegelerstraße 12, 53115 Bonn, Germany — [2]Peter Grünberg Institut, Forschungszentrum Jülich, 52452 Jülich, Germany

Epitaxial monolayers of hBN on metal surfaces are of interest as two-dimensional insulating substrates as well as templates for the formation of epitaxial layers of organic molecules. Here, we report a structural analysis of one monolayer of PTCDA on hBN/Cu(111) by spot profile analysis low energy electron diffraction (SPA-LEED) and scanning tunneling microscopy (STM). hBN grows on the Cu(111) surface in an incommensurate structure with a lattice mismatch of 2.0 % (at 100 K) corresponding to an unstrained hBN layer. The films show rotational mosaicity, however, the majority of the hBN domains are in or close to alignment with the unit cell vectors of the Cu(111) surface (± 2°).

On this hBN layer PTCDA molecules form ordered domains with a herringbone structure with lattice constants a = (19.8 ± 0.3) Å and b = (12.4 ± 0.2) Å. This yields a size of the unit cell that deviates by 3.1 % and 2.2 % from that in the (102) plane of the α and β bulk crystals, respectively. The majority of PTCDA domains are statistically distributed in their azimuthal orientation. There is only a small preference for domains that are oriented along the unit cell vectors of the hBN layer.

DS 27.17 Tue 18:30 P2-EG

Deposition of biphenylthiols on Au(111) by Electrospray Ionization — •Patrick Stohmann[1], Sascha Koch[1], Antoine Hinaut[2], Thilo Glatzel[2], Ernst Meyer[2], and Armin Gölzhäuser[1] — [1]Department of Physics, Universität Bielefeld, Universitätsstrasse 25, 33615 Bielefeld, Germany — [2]Department of Physics, University of Basel, Klingelbergstrasse 82, CH-4056 Basel, Switzerland

When aromatic self-assembled monolayers (SAMs) are electron-irradiated, intermolecular cross-linking leads to the formation of Carbon Nano Membranes (CNM) with molecular thickness [1]. The preparation of SAMs requires clean surface conditions for the formation of well-defined molecular structures as well as for the analysis via scanning probe techniques. However, thermal evaporation under UHV conditions may lead to the fragmentation of molecules during the sublimation while the formation of wet-prepared SAMs may suffer from polluting adsorbates on the bare surface. Here we present the study of biphenylthiols on Au(111), prepared by Electrospray Ionization (ESI). ESI allows for the introduction of organic molecules in vacuum under controlled conditions on atomically clean surfaces and was successfully applied in previous experiments [2]. The molecular deposition on the surface is investigated by means of scanning tunneling microscopy (STM) and nc-atomic force microscopy (NC-AFM) combined with Kelvin probe force microscopy (KPFM). [1] A. Turchanin et al., A. Gölzhäuser, Adv. Mater., 2009, 21, 1233-1237 [2] A. Hinaut et al., E. Meyer, Beilstein J. Nanotechnol., 2015, 6, 1927-1934

DS 27.18 Tue 18:30 P2-EG

Spectroscopic Mapping and Imaging Ellipsometry applied to Conducting, Semi-Conducting and Insulating 2D-Materials — Sebastian Funke[1], Ursula Wurstbauer[2,3], Aleksandar Matkovic[4], Avery Green[5], and •Peter H. Thiesen[1] — [1]Accurion GmbH, Stresemanstraße 30, 37079 Göttingen, Germany — [2]Walter Schottky Institute and Physics-Department, TU München, Garching 85748, Germany — [3]Nanosystems Initiative Munic 80799, Germany — [4]Centre for Solid State Physics and New Materials, Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia — [5]College of Nanoscale Science and Engineering, State University of New York, 253 Fuller Road, Albany, New York 12203

The poster will present the localization and characterization of Graphene Monolayer flakes and similar thicknesses regions of insulating hexagonal boron nitride (hBN) and on semiconducting transition metal dichalcogenide Molybdenum disulphide (MoS2).

Matkovic et al. characterized monolayers of graphene by spectroscopic imaging ellipsometry (SIE). The resulting Fano resonance modelling for the dispersion of Graphene can be used to search for flakes of graphene on different substrates, based on the spectroscopic mapping of the ellipsometric angles Δ and Ψ. This ellipsometric flakesearch is less dependent from the substrate compared to e.g. conventional light microscopy.

DS 27.19 Tue 18:30 P2-EG

Imaging Mueller Matrix Ellipsometry for the Characterization of Microstructured Anisotropic Thin-Film Samples — Matthias Duwe[1], Sebastian Funke[1], Christian Röling[1], •Peter H. Thiesen[1], Aday J. Molina-Mendoza[2], and Andres Castellanos-Gomez[3] — [1]Accurion GmbH, Stresemannstr. 30, 37079 Göttingen, Germany — [2]Universidad Autonoma de Madrid. Departamento de Fisica de la Materia Condensada. Campus Universitario de Cantoblanco, 28049 Madrid, Spain — [3]IMDEA Nanoscience, C/ Faraday 9, Campus Universitario de Cantoblanco, 28049 Madrid, Spain

Imaging ellipsometry (IE) is an established technique for the characterization of structured thin-film samples with lateral resolutions down to the micron scale. In most cases, however, imaging ellipsometers featuring microscopic resolution only yield the ellipsometric angles Δ and

Ψ. Thus, these ellipsometers mainly have been applied to isotropic samples so far. Here, we present imaging Mueller matrix ellipsometry (IMME) with high microscopic lateral resolution capable of measurements at a variable angle of incidence. By operating Accurion*s imaging ellipsometer EP4 (PCSA configuration) in a rotating-compensator mode, the ellipsometer yields Mueller matrix micrographs for the upper 3x4 matrix elements of the sample. We applied this imaging Mueller matrix ellipsometer to the characterization of microscopic flakes of anisotropic 2D-materials, such as black phosphorus.

DS 27.20 Tue 18:30 P2-EG

Lateral heterostructures of MoS2 and carbon nanomembranes — •Antony George[1], Christof Neumann[1], Zian Tang[1], Andreas Winter[1], Uwe Hübner[2], Michael Mohn[3], Ute Kaiser[3], and Andrey Turchanin[1] — [1]Friedrich Schiller University Jena, Institute of Physical Chemistry, D-07743 Jena, Germany — [2]Leibniz-Institut für Photonische Technologien e.V., 07745 Jena, Germany — [3]Electron Microscopy Group of Material Science, Ulm University, 89081 Ulm, Germany

Atomically thin two dimensional (2D) materials are promising for future ultrathin electronic and optoelectronic devices. In order to realize such devices, it is highly desired to connect/stitch different 2D materials laterally. Here, we present our recent results of the fabrication of lateral heterostructures of molecular thin carbon nanomembranes (CNMs) with MoS2 by electron beam assisted crosslinking. To this end, MoS2 single layer crystals grown by chemical vapour deposition (CVD) were transferred onto gold films on mica substrates. Then, self-assembled monolayers of 4*-nitro-1, 1*-biphenyl-4-thiol (NBPT) were grown on the areas between the MoS2 crystals. Electron beam irradiation was employed to crosslink the SAM molecules with each and with the edges of the MoS2 crystals. The formed CNM-MoS2 lateral heterostructures were transferred onto new solid and holey substrates and characterized by complementary methods including Raman spectroscopy, atomic force microscopy (AFM), helium ion microscopy (HIM) and high resolution transmission electron microscopy (HRTEM).