DS 4: Poster

Time: Tuesday 10:00–13:00 Location: P

DS 4.1 Tue 10:00 P

Two-color time-resolved Kerr rotation measurements of twisted MoS_2/WS_2 heterostructures — •Michael Kempf[1], Alina Schubert[1], Annika Bergmann[1], Mustafa Hemeid[1], Antony George[2], Andrey Turchanin[2], Rico Schwartz[1], and Tobias Korn[1] — [1]University of Rostock, Rostock, Germany — [2]University of Jena, Jena, Germany

Transition metal dichalcogenides (TMDC) have revealed many intriguing properties in recent years. For valleytronics especially, the coupling of spin and valley degrees of freedom shows great promise. Using valley-selective optical selection rules, a coupled spin-valley polarization can easily be introduced in these systems. Keeping possible future applications in mind, the dynamics of this polarization, especially its lifetime, is of great importance. Yet in pristine monolayer TMDCs this is strongly limited due to ultrafast optical exciton recombination and electron-hole exchange interaction. By contrast, in TMDC heterostructures, ultrafast interlayer charge transfer may circumvent these limits on valley polarization lifetimes.
We use two-color time-resolved Kerr rotation measurements to study the spin-valley dynamics in disulfide-based TMDCs and their heterostructures. The independent tunability of our coupled laser systems allows to selectively pump and probe their excitonic transitions resonantly. We present low-temperature valley dynamics studies on TMDC monolayers and twisted MoS2-WS2 heterostructures fabricated by combining CVD-grown and exfoliated monolayers.

DS 4.2 Tue 10:00 P

Revealing in plane g factors in multilayer WSe2 via time-resolved Faraday experiments — •Simon Raiber, Dennis Falter, and Christian Schüller — Universtiät Regensburg

With the increasing investigation of two-dimensional heterostructures, the question arises how far the layer-intrinsic properties are imparted to multilayer van der Waals structures. While the effects of external magnetic fields on transition metal dicalcogenides monolayers have been studied intensively during the last years, the interaction of multiple layers remained largely disregarded.

We demonstrate a non-zero effective g factor for in plane magnetic fields in few-layer WSe2 making use of time-resolved Faraday rotation experiments. The found values commensurate to the established out of plane effective g factors. This indicates an isotropic effective in plane g factor for multilayer WSe2, which stands in contrast to monolayer samples. Up to now no standard theoretical approach can model an non-zero in plane g factor.

DS 4.3 Tue 10:00 P

Controlled moirè potentials of MoSe2/WSe2 heterostructures for time resolved kerr measurments — •Andreas Beer, Philipp Parzefall, Laura Zinkl, Anna Weindl, and Christian Schüller — Universität Regensburg

In heterostructures the twist angle serves as an degree of freedom to severly manipulate exciton dynamics.

We fabricate heterostructures with advanced twist angle control by staking CVD-grown triangulars of TMDCs.

To track the excitons dynamics on the femtosecond timescale we use two color pump probe measurements.

DS 4.4 Tue 10:00 P

Strong coupling of Bloch Surface Waves and excitons in ZnO up to 430 K — •Sebastian Henn, Marius Grundmann, and Chris Sturm — 1Universität Leipzig, Faculty of Physics and Earth Sciences, Felix-Bloch institute for solid state physics, Linnéstr. 5, 04103 Leipzig, Germany

Exciton-polaritons are bosonic quasi-particles consisting of a cavity photon and an electron-hole pair, exhibiting interesting physical phenomena like Bose-Einstein condensation [1]. Of special interest are exciton-polaritons in semiconductors with large exciton binding energies, where the strong coupling is observable above room temperature [2]. We report here on the experimental observation of the strong coupling between ZnO excitons and Bloch Surface Waves (BSW) up to 430 K. The sample consists of a Bragg reflector and a thin ZnO top layer. This system holds several advantages compared to exciton-polaritons in conventional microcavities: high propagation lengths due to the low loss BSW with large in-plane wave vector, a reduced complexity of production and direct access to the mode-supporting surface layer. In combination with a stable operation at high temperatures, this is of interest for the development of integrated optics devices. By means of a prism coupler in reflection geometry the polariton dispersion was observed and analyzed. We determined the temperature dependent coupling strength, exciton energy and dielectric background.

[1] J. Klaers *et al.*, Nature **468**, 545-548 (2010)
[2] C. Sturm *et al.*, New J. Phys. **11**, 073044 (2009)

DS 4.5 Tue 10:00 P

Novel 2D surface alloys on Pt(111): electronic and structural properties — •Marta Przychodnia[1], Tomasz Grzela[1], Roland Wiesendanger[2], and Maciej Bazarnik[1,2] — [1]Institute of Physics, Poznan University of Technology, Poznan, Poland — [2]Department of Physics, Hamburg University, Hamburg, Germany

Lately, a new class of 2D magnetic films has been discovered, namely rare earth (RE) metals - transition metals (TM) surface alloys. Limiting the dimensionality of RE-TM alloys to 2D (so-called surface alloys) influences their properties in surprising ways. For example, a $GdAu_2$ and $GdAg_2$ surface alloys are ferromagnetic while in bulk they are antiferromagnetic. Small change of Au to Ag in this system raise the Curie temperature from 19°C to 85°C showing potential for tuneability.

Here, I will present the comparison study of Dy-Pt and Gd-Pt mono- and double-layers of surface alloys grown on Pt(111). Structural and electronic properties in atomic scale of both systems were investigated using scanning tunneling microscopy (STM) and spectroscopy (STS).

DS 4.6 Tue 10:00 P

Measuring Material-Specific Properties with Ultra-High Vacuum Atomic Force Microscopy — •Frederic Luis Condin, Jesús Sánchez Lacasa, and Baran Eren — Department of Chemical and Biological Physics, Weizmann Institute of Science, Rehovot, Israel

The real-space imaging capabilities provided by scanning probe microscopy techniques have undoubtedly revolutionized the scientific study of surfaces and processes happening thereon. Whereas scanning tunneling microscopy is limited to conductive samples, atomic force microscopy can be used for any surface. A general problem of scanning probe microscopy is its lack of element specificity, i.e., it cannot be used for the identification of materials or adsorbed surface species without additional information or prior knowledge about the sample. We address this problem and present contributions towards the chemical identification of surface materials. To this end, we calculate Hamaker constants on different points of a sample from bias voltage and tip-sample distance dependent measurements of the frequency shift in amplitude and frequency modulation atomic force microscopy.

DS 4.7 Tue 10:00 P

Coordinated Development of Tubes and Optics: New possibilities for X-ray Analytics — •Jörg Wiesmann, Moritz Schlie, Jürgen Graf, Frank Hertlein, and Paul Radcliffe — Incoatec GmbH, Max-Planck-Strasse 2, 21502 Geesthacht

At Incoatec, we have a long history of offering solutions driven by the needs of the customers. As a specialist for multilayer optics we penetrated the crystallography market with our complete IμS Microfocus Solutions in 2006. Optics can only evolve their whole strength when the source is also matched to it. Due to this fact, we started in 2011 with the in-house development of X-ray sources. The aim was to offer the best combination of optics and sources for certain applications in small and macromolecular structure analysis. We were able to launch new solutions like the IμS3.0 and the IμS DIAMOND that offers a flux density of more than $5*10^{10}$ ph/s/mm^2 within a spot of less than 100μm. This high flux density is achieved with a low power air-cooled source that doesn't need maintenance during the typical life time of more than 6 years. We will summarize the key parameters for combining multilayer optics and microfocus tubes to achieve collimated or focused X-ray sources with high brilliance. The main part of the talk will explain the application-dependent design of our metal-ceramic tubes and how to match them with our multilayer optics. Applications include crystallography, nanotechnology and thin film research.

DS 4.8 Tue 10:00 P

Persistent response in ultra-strongly driven mechanical membrane resonators — •Fan Yang[1], Felicitas Hellbach[1], Felix Rochau[1], Wolfgang Belzig[1], Eva Weig[1,2], Gianluca Rastelli[3], and Elke Scheer[1] — [1]Fachbereich Physik, Universität Konstanz, 78457 Konstanz, Germany — [2]Fakultät für Elektrotechnik und Informationstechnik, Technische Universität München, 80333 München, Germany — [3]INO-CNR BEC Center and Dipartimento di Fisica, Università di Trento, 38123 Povo, Italy

We study experimentally and theoretically the phenomenon of *persistent response* in ultrastrongly driven membrane resonators. The term persistent response denotes the development of a vibrating state with nearly constant amplitude over an extreme wide frequency range of more than 50% of the eigenfrequency. This phenomenon is unusual and is key to avoid breakdown, since it imposes a self-limitation of the maximum amplitude. We reveal the underlying mechanism by directly imaging the vibrational state using advanced optical interferometry. We argue that this state is related to the nonlinear interaction between higher-order flexural modes and higher-order overtones of the driven mode. Finally, we propose a stability diagram for the different vibrational states that the membrane can adopt.

DS 4.9 Tue 10:00 P

Tunable frequency comb in flexural-mode-coupling regime in nonlinear mechanical membrane resonators — •Mengqi Fu, Fan Yang, and Elke Scheer — Fachbereich Physik, Universität Konstanz, 78457 Konstanz, Germany

Multimode coupling in mechanical systems has attracted broad interest in many realms of physics[1,2]. Recently, the research on the multimode coupling has been extended to strong nonlinear systems and novel phenomena have been observed caused by the strong nonlinearity of the coupled flexural modes[2]. Here, we demonstrate a novel tunable frequency comb generated by driving the mechanical system into the strongly nonlinear regime, i.e. the flexural-mode-coupling regime, by one-tone excitation. The studied system is based on a suspended SiN membrane ($\sim$ 500 nm thickness) with a quality factor of $\sim$ 19000. The frequency separation between neighboring sidebands of the frequency comb strongly depends on the damping factor, nonlinearity, vibration amplitude and the detuning frequency of the two coupled flexural modes. The frequency separation is tunable by varying the detuning frequency and the strength of the drive power. By systematically investigating the frequency response of the fluctuations close to the coupled flexural modes, we show that the observed frequency comb is generated when the "very states"[3] produced by the nonlinearity of the coupled flexural modes are crossed experimentally.

1. A. Ganesan et al., Phys. Rev. Lett. 118, 033903 (2017).
2. F. Yang et al., Phys. Rev. Lett. 127, 014304 (2021).
3. J.S. Huber et al., Phys. Rev. X, 10, 021066 (2020).

DS 4.10 Tue 10:00 P

Forming-free resistive switching in amorphous gallium oxide device — •Aman Baunthiyal[1], Jon-Olaf Krisponeit[1], Christian Habben[1], Alexander Karg[1], Martin Eickhoff[1], Sandra Pérez Domínguez[2], Manfred Radmacher[2], and Jens Falta[1] — [1]Institute of Solid State Physics, University of Bremen, Germany — [2]Institute of Biophysics, University of Bremen, Germany

Currently, semiconductor based devices are reaching their limitations in terms of scalability and long time storage capability. To overcome this problem, inorganic and organic materials which show resistive switching (utilized in ReRAMs), magnetic switching (MRAMs), and phase change switching (PCRAMs) have been studied over the past 40 years. In ReRAMs, a repeatable switching between high resistive state (HRS) and low resistive state (LRS) can be observed when a voltage sweep is applied across an active layer sandwiched between two metal electrodes.

In this study, the forming-free bipolar resistive switching was observed in a Al/GaO_x(76 nm)/Ru devices. The observed switching was proposed to be connected to the formation and rupture of conductive filaments constituted by oxygen vacancies in the GaO_x film. X-ray photoelelectron spectroscopy (XPS) analysis confirmed the high amount of oxygen vacancies in the GaO_x film. The LRS was found to be of ohmic nature, while the HRS followed Poole-Frenkel emission model. Due to their stable endurance cycle and long retention time with more than 10^3 order resistance ratio ,the devices can be regarded as promising prototypes for future non-volatile ReRAMs.

DS 4.11 Tue 10:00 P

Adsorption of fluids on hydrophobic surfaces under sub- and supercritical conditions — •Mike Moron, Göran Surmeier, Marc Moron, Jennifer Bolle, Susanne Dogan, Julia Nase, Michael Paulus, and Metin Tolan — Fakultät Physik/DELTA, TU Dortmund, 44221 Dortmund, Germany

Adsorption at interfaces is crucial for many industrial applications, e. g. adsorption-based separation, regeneration of adsorbents in purification processes as well as for natural gas storage. In subcritical systems the adsorption layers of different fluids had been successfully described as molecular thin layers. The layer thickness diverges when the pressure reaches the condensation pressure of the corresponding fluid, meaning that the adsorption layer transforms into a macroscopic condensate. Supercritical adsorption, however, is far less understood on a molecular scale because of the complex requirements to the experimental environment, although the phenomenon is of outstanding importance for many applications. For example, the use of supercritical CO_2 is a gentle method to dry porous materials without damaging the frameworks. We investigated the pressure dependent adsorption of the fluids argon, carbon dioxide, hexafluoroethane, octafluoropropane, and decafluoropropane on a hydrophobic silicon wafer coated with octadecyltrichlorsilane by means of X-ray reflectivity (XRR), where we could access the supercritical regime for hexafluoroethane and argon. The XRR studies were carried out at PETRA III Beamline P08 (DESY, Hamburg) at a photon energy of 25 keV and Beamline BL9 (DELTA, Dortmund) at 27 keV, repsectively.

DS 4.12 Tue 10:00 P

Simulation Based Conductivity Tensor Determination of Sintered Nanosilver — •Lennart Schwan[1,2], Michael Feige[1], Andreas Hütten[2], and Sonja Schöning[1] — [1]Bielefeld Institute for Applied Materials Research (BIfAM), Bielefeld University of Applied Sciences, Department of Engineering Sciences and Mathematics, Interaktion 1, 33619 Bielefeld — [2]Thin Films & Physics of Nanostructures, Bielefeld University, Department of Physics, Universitätsstrasse 25, 33615 Bielefeld, Germany

3D-printing of conductive and dielectric materials in one process is an emerging technology. In addition to the printing of planar structures like circuit boards, the modern Multi Material Jetting process allows to realize three dimensional structures such as antennas, coils or cooling elements.

In the present case the conductive material consists of small silver particles which are sintered with infrared light. The conductivity reaches up to 70 % of the conductivity of copper but is highly anisotropic due to the print and sinter process.

In order to optimize the printed structures with regard to the anisotropic conductivity, it is necessary to determine reliable value of the conductivity tensor. Here we propose an approach based on a coupling of FEM simulation with mathematical optimization to determine the conductivity tensor. The simulation with the conductivity tensor as free parameter is fitted to experimental data of meander shaped test structures which are orientated in different directions to consider all components of the conductivity tensor.

DS 4.13 Tue 10:00 P

Molecular dynamics simulations of carbon nanomembranes (CNMs) — •Julian Ehrens, Levin Mihlan, and Jürgen Schnack — Universität Bielefeld, Universitätsstrasse 25, D-33615 Bielefeld

CNMs are made by electron-induced crosslinking of aromatic self-assembled monolayers (SAMs) [1,2]. Their supposedly irregular internal structure can not be adequately investigated by standard techniques, e.g. X-ray diffraction, which requires a characterization through physical quantities like solvent permeability and the Young's modulus. In order to propose possible internal molecular structures obtained from various initial configurations of the SAM and irradiation processes, we investigate the monolayers with respect to the Young's modulus in terms of classical molecular dynamics calculations using LAMMPS and use the experimental value of around 10 GPa for comparison. We present three distinct methods to calculate the Young's modulus: Global scaling of all coordinates (curvature of energy), stress-strain response from clamped straining and barostatted dynamics. Discrepancies among the methods with regard to vastly different outcomes of the Young's modulus will be discussed considering finite size effects and suitability of each method for this particular system.

[1] Dementyev, Petr, et al. "Carbon Nanomembranes from Aromatic Carboxylate Precursors" ChemPhysChem 21.10 (2020): 1006
[2] Ehrens, Julian, et al. "Theoretical formation of carbon nanomem-

branes under realistic conditions using classical molecular dynamics" Phys. Rev. B 103, 115416

DS 4.14 Tue 10:00 P

Influence of processing parameters on the electrical conductivity of 3D printed silver structures — •Michael Feige, Lennart Schwan, and Sonja Schöning — Bielefeld Institute for Applied Materials Research (BIfAM), Bielefeld University of Applied Sciences, Department of Engineering Sciences and Mathematics

3D-printing of conductive and dielectric materials in one process is an emerging technology. The Multi Material Jetting technique allows to realize three dimensional structures such as antennas, coils or cooling elements.

The deployed method is very similar to that used by a conventional inkjet printer. Small ink drops are deposited layer by layer through fine nozzles in the print heads. The stacking of those layers finally forms the 3D buildup. Multiple materials are introduced by two or more print heads.

In the considered case the dielectric material, a polymer, is cured with UV-light. The conductive material consists of small silver particles and is sintered with IR-light.

The electrical conductivity can reach up to 70 % of the conductivity of copper but it is anisotropic with regard to the print direction and it depends on several production parameters. We are identifying these contributing key factors, like layer thicknesses, drop placement patterns, environmental conditions during the print stage and temperature patterns used for heat treatment during postprocessing. In addition we investigate how the determined influence of the parameters can be used to optimize the conductivity.

DS 4.15 Tue 10:00 P

Selective Area Epitaxy of Bi-based 3D Topological Insulators on Sapphire — •Christoph Ringkamp, Michael Schleenvoigt, Peter Schüffelgen, Gregor Mussler, and Detlev Grützmacher — Peter-Grünberg-Institut 9, Forschungszentrum Jülich, 52428 Jülich, Germany

Topological insulators (TI) possess topologically protected, conducting surface states, which – in conjunction with superconductors (SC), are predicted to show Majorana signatures. A prerequisite for this is a high transparency between the TI and the SC, and that is why an in-situ fabrication of the TI/SC heterostructures is crucial. On Si(111) substrates, we have already established the selective area growth and a shadow mask technique to fabricate such heterostructures via molecular-beam epitaxy (MBE). However, one major problem in transport experiments still poses the impact of the Si substrate, as the Si/TI interface may serve as an additional conducting channel. Hence, we intend to grow the TI/SC heterostructures on sapphire, as it is a purely insulating substrate, which may allow to investigate the topological properties of the TI films in transport experiments in more detail.

We will report on the selective area epitaxy via MBE of Bi-based TI like Bi_2Te_3 and Bi_2Se_3 on sapphire substrates that are prepared with a combination of lithographically defined SiO_2 and Si_3N_4 structures as a growth mask and their application as a shadow mask for TI/SC heterostructures. Additionally, I will show a substantial improvement of the carrier mobility in the TI films on sapphire compared to Si(111).

DS 4.16 Tue 10:00 P

Area-selective deposition on 3D granular PtC scaffolds — •Fabrizio Porrati, Sven Barth, and Michael Huth — Goethe Uni Frankfurt

We present a novel fabrication method to prepare 3d metallic nanostructures by area-selective chemical vapor deposition (CVD). The method is based on the fabrication of 3d PtC granular scaffolds by focused electron beam induced deposition (FEBID). These nanostructures are written between two electrods and biased by an electrical current in order to increase their temperature to several hundreds degrees. This is possible since the 3d PtC scaffolds are high ohmic resistors with low thermal coupling to the substrate. Here we show that CoFe and NbNC metallic layers form on the 3d biased scaffolds by decomposition of the HFeCo3(CO)12 and Nb(NMe2)3(N-t-Bu) precursor gas when injected in the SEM preparation chamber.

DS 4.17 Tue 10:00 P

Characterizing ALD printed structures by imaging ellipsometry — •Peter H. Thiesen[1], Ivan Kundrata[2,3], Maksym Plakhotnyuk[3], and Julien Bachmann[2,3] — [1]Accurion GmbH, Göttingen, Germany — [2]FAU, Erlangen, Germany — [3]ATLANT 3D, Lyngby, Dänemark

ATLANT 3D Nanosystems develops a disruptive 3D printing technology for micro and nano device rapid prototyping. The initial 3D printer prototype will be able to process oxides such as SiO2, TiO2, Al2O3, ZnO, and platinum with line width of 400 um. Later on, we will add processing of other materials, such as metals, sulfides, nitrides etc., also with a better selection of resolution down to 10 um. Thin film metrology of printed structures requires a fast measurement technique that is sensitive to thinnest films and offers a high lateral resolution also suited for the next development steps. Imaging Ellipsometry is an all-optical, non-contact metrology technique. It combines microscopic imaging with the measurement principles of spectroscopic ellipsometry and reaches a spatial resolution of about 1 micro meter. Ellipsometry is based on the samples interaction with polarized light and enables the characterization of ultra-thin films. The thickness of ALD-structures, printed at variable process parameters or with different materials was characterized by imaging ellipsometry. The standard characterization was done with a fixed angle of incidence system, equipped with a high power LED-HUB (SIMoN, EP4, Accurion GmbH) at an AOI of 60° and selected wavelength. Additionally, microscopic maps at different AOIs and wavelength of selected samples were recorded.

DS 4.18 Tue 10:00 P

Electrical transport properties of Vanadium-doped $Bi_2Te_{2.4}Se_{0.6}$ — Ch. Riha[1], B. Düzel[1], K. Graser[1], •O. Chiatti[1], E. Golias[2], J. Sánchez-Barriga[2], O. Rader[2], O. Tereshchenko[3], and S. F. Fischer[1] — [1]Novel Materials Group, Humboldt-Universität zu Berlin, 10099 Berlin, Germany — [2]Helmholtz-Zentrum-Berlin für Materialien und Energie, 12489 Berlin, Germany — [3]Physics Department, Novosibirsk State University, 630090 Novosibirsk, Russia

Transport in the topological surface states (TSSs) of topological insulators, such as Bi_2Se_3, can be masked by unintentional bulk doping. The alloy $Bi_2Te_{2.4}Se_{0.6}$ is a promising candidate to investigate TSSs, because in $Bi_2Te_{3-y}Se_y$ materials bulk n-type doping tends to be suppressed. In this work [1], single crystals of $V_xBi_{2-x}Te_{2.4}Se_{0.6}$, with $x = 0.015$ and 0.03, are grown by the Bridgman method. Angle-resolved photoemission spectroscopy shows gapless TSSs for both Vanadium concentrations. The resistivity, the Hall charge carrier density, and the mobility for temperatures from 0.3 to 300 K are strongly dependent on the Vanadium concentration, with carrier densities as low as 1.5×10^{16} cm^{-3} and mobilities as high as 570 cm^2/Vs. Below 10 K, resistivity, carrier density, and mobility are constant, as expected for gapless TSSs. Also, the magnetoresistance shows for both Vanadium concentrations weak antilocalization, which is analyzed with the Hikami-Larkin-Nagaoka model and yields phase-coherence lengths of up to 250 nm for $x = 0.015$.

[1] C. Riha *et al.*, Phys. Status Solidi B, 2000088 (2020)

DS 4.19 Tue 10:00 P

Magnetotransport and thermoelectric properties of vanadium disulfide (VS_2) flakes — •Yejin Lee[1,2], Gyu-Hyeon Park[1,2], Grigory Shipunov[1], Geishendorf Kevin[1], Bernd Buechner[1], Kornelius Nielsch[1,2], Saicharan Aswatham[1], and Andy Thomas[1,2] — [1]IFW Dresden — [2]Technische Universität Dresden

Two-dimensional transition metal dichalcogenides (TMDCs) have drawn extensive interest due to their intriguing electrical transport properties. Vanadium disulfide (VS_2) is a member of metallic TMDCs and interestingly, theoretical calculations have predicted magnetic characteristics. Here, we investigate magnetotransport and thermoelectric properties of exfoliated VS_2 flakes from a single crystal grown by chemical vapor transport technique. The magnetotransport characterizations were performed in an external magnetic field of up to 9 T. We found that the VS_2 flake exhibits a specific temperature dependence at around 21 K, which is consistent with the presence of a weak magnetic anomaly seen in the single crystal. In addition, a negative magnetoresistance is observed with a steep decrease at 2.5 T and below 20 K, where the slope of the magnetic field dependent Hall resistance changes. Furthermore, Seebeck coefficients are evaluated and it indicates a p-n type transition in the low temperature regime if a single band model is assumed. This findings provide further insight into the magnetotransport and thermoelectric properties of van Der Waals TMDCs.

DS 4.20 Tue 10:00 P

Influence of the module number on the folding process in thin spider silk films — •Mirjam Hofmaier[1,3], Birgit Urban[1], Sarah Lentz[4], Thomas Scheibel[4], Andreas Fery[1,3], and Martin Müller[1,2] — [1]Leibniz Institute of Polymer Research Dresden, Institute of Physical Chemistry and Polymer Physics, Hohe Str. 6, 01069 Dresden — [2]Technical University Dresden, Chair of Macromolecular Chemistry, 01062 Dresden — [3]Technical University Dresden, Chair of Physical Chemistry of Polymeric Materials, 01062 Dresden — [4]University of Bayreuth, Chair of Biomaterials, Prof.-Rüdiger-Bormann Str. 1, 95447 Bayreuth

Aiming at a better understanding of the folding process in recombinantly produced[1], multiblockcopolymer-like spider silks, herein we report experimental work on thin films of eADF4(Cx) proteins with x = 1-16 modules. Thin eADF4(Cx) films were characterized as-cast and during methanol post-treatment (pt) using dichroic attenuated total reflection (ATR-) FTIR spectroscopy, circular dichroism (CD), and scanning force microscopy (SFM).[2]

During post-treatment, FTIR reveals an increasing β-sheet content from $< 10\%$ to > 28 % and a decreasing random coil content from $> 65\%$ to $< 50\%$, which could be confirmed by CD analysis.[2-3] An out-of-plane orientation of the antiparallel β-sheets of the crystalline blocks could be suggested by dichroic ATR-FTIR spectroscopy.[2]

[1] D. Huemmerich et al., Biochem., 2004, 43, 13604-13612. [2] M. Hofmaier et al., JPC B, 2021, 125, 1061-1071. [3] C. Borkner et al., ACS Appl. Polym. Mater., 2019, 1, 3366-3374.

DS 4.21 Tue 10:00 P

Enhancement of the Raman Emission in Hexagonal Boron Nitride — •Felix Schaumburg, Marcel Ney, Vasilis Dergianlis, Günther Prinz, Martin Paul Geller, and Axel Lorke — Faculty of Physics and CENIDE, University Duisburg-Essen, Germany

Optical spectroscopy, especially Raman- and photoluminescence (PL)-spectroscopy, is commonly used to study the optical properties of two-dimensional materials. In order to obtain the highest signal, it is important to reduce spurious effects, such as backscattered laser light.

We studied a number of exfoliated h-BN flakes with different thicknesses on a silicon (Si) substrate with a 300 nm silicon dioxide (SiO_2) top-layer. With changing the h-BN layer-thickness, we found a specific thickness, where all Raman signals showed maximum intensity, whereas the backscattered laser light was almost completely suppressed. To explain the increased signal, we calculated the reflectivity of the layer system (air, h-BN, SiO_2, Si) for different h-BN layer thickness, by using the transfer-matrix-algorithm. For our 532 nm excitation laser, the minimum surface reflectivity was found for a layer thickness of around 160 nm. With AFM measurements, we were able to confirm that the thickness of the samples, with the strongest Raman signal, corresponds almost exactly to the calculated thickness.

Our results suggest that the PL from defects will also be strongly enhanced for an h-BN thickness of 160 nm and an excitation laser wavelength of 532 nm. This optimal thickness for the defect state PL emission can easily be calculated for other excitation laser wavelengths, as well as for other materials.

DS 4.22 Tue 10:00 P

Vibrational spectroscopic characterization of local electrochemical modification of graphene — Tilmann Neubert[1,2,3,4], Jörg Rappich[1], Kannan Balasubramanian[3,4], and •Karsten Hinrichs[2,3] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Institut für Silizium Photovoltaik, Kekuléstr. 5, 12489, Berlin — [2]ISAS - e.V., In Situ Spectroscopy Group, Schwarzschildstr. 8, 12489 Berlin — [3]HU Berlin, School of Analytical Sciences Adlershof (SALSA), Unter den Linden 6, 10117 Berlin — [4]Department of Chemistry, HU Berlin, Unter den Linden 6, 10117 Berlin

Local properties of an electrochemical modification and the underlying graphene between the contacts of a field effect transistor (FET) were analyzed by Raman and infrared (IR) spectroscopies. IR spectroscopic ellipsometry (IRSE) enabled us to probe spots from about 0.1 to a few mm, IR microscopy of a few 10 μm, Raman of about 1 μm, photothermal AFM-IR at the nm-scale. For graphene surfaces modified electrochemically with maleimidophenyl (MP) or 4-Aminophenyl acetic acid (4-APhAA) the interpretation of Raman spectra allowed a detailed characterization of the graphene properties whereas IR is used for identification of characteristic molecular vibrations of the functional layers. The Raman spectra reveal if the electrochemically formed oligomers are covalently bound or physically adsorbed. AFM-profiles and IRSE interpretation reveal similar thicknesses of the deposited (a few nm thick) layers. Funding: EFRE 1.8/13 and SALSA.

DS 4.23 Tue 10:00 P

The Dielectric Tensor of Microtextured Squaraine Thin Films obtained by Imaging Mueller Matrix Ellipsometry — •Manuela Schiek[1], Sebastian Funke[2], Matthias Duwe[2], Peter H. Thiesen[2], Kurt Hingerl[1], and Frank Balzer[3] — [1]Johannes Kepler University of Linz, Austria. — [2]Accurion GmbH Göttingen, Germany. — [3]University of Southern Denmark, DK.

Imaging Mueller matrix ellipsometry combines the power of variable angle spectroscopic ellipsometry and optical microscopy mapping. Here we illustrate the determination of the full biaxial dielectric tensor of an organic material crystallizing in an orthorhombic phase. This is achieved by analyzing thin film samples with a single crystallographic orientation parallel to the substrate subdivided in micro-sized rotational domains. Oscillator dispersion relations reasonably model the diagonal tensor components and reproduce well the Davydov splitting of the material.

[1] Funke, Duwe, Balzer, Thiesen, Hingerl, Schiek. J. Phys. Chem. Lett. 19 (2021) 3053.

DS 4.24 Tue 10:00 P

Modelling of Two-Dimensional Electronic Spectroscopy Response of a Plasmon-Exciton System — •Marti Bosch[1], Antonietta De Sio[2], Christoph Lienau[2], and Erich Runge[1] — [1]TU Ilmenau — [2]Universität Oldenburg

Two-dimensional electronic spectroscopy (2DES) records the optical response of a system after the interaction with three timely delayed laser pulses. The dynamics and electronic couplings in complex optical systems can be analyzed with a high temporal resolution by correlating the excitation and emission intensities as a function of the time delay as well as the used frequencies. The interpretation of 2DES experimental results is challenging and it is often useful to support them with numerical calculations. In this work, we present the semi-classical calculations of the third order non-linear response signal of a plasmon-exciton system. We model the response signal of coupled two-level systems based on a perturbative density matrix approach [1] and implement the non-unitary time evolution of the system using the Lindblad formalism. We discuss the differences appearing for fermionic and bosonic systems and compare the results to preliminary experimental results. [1] Mukamel, S. (1995) Principles of nonlinear optical spectroscopy. O.U.P, New York

DS 4.25 Tue 10:00 P

Surface-localized phonon modes on the Si(553)-Au surface — •Julian Plaickner[1,2], Eugen Speiser[1], Sandhya Chandola[1,2], Christian Braun[3], Wolf Gero Schmidt[3], Norbert Esser[2,4], and Simone Sanna[5] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie, Hahn Meitner Platz 1, 14109 Berlin — [2]Leibniz-Institut für Analytische Wissenschaften, ISAS e.V., Schwarzschildstraße 8, 12489 Berlin — [3]Lehrstuhl für Theoretische Materialphysik, Universität Paderborn, 33095 Paderborn — [4]Technische Universität Berlin, Institut für Festkörperphysik, Hardenbergstraße 36, 10623 Berlin — [5]Institut für Theoretische Physik and Center for Materials Research (LaMa), Justus Liebig Universität Gießen, Heinrich Buff Ring 16, 35392 Gießen

The Si(553)-Au surface is investigated with Raman spectroscopy and ab-initio calculations. A characterization of the phonon modes is provided below and above the phase transition temperature (Phys. Rev. B 103, 115441 (2021)). Some phonon modes shows a significant temperature dependence. The analysis of the calculated displacement patterns indicates that these modes are localized at the Si step edge or involve a change of the Au-Au bond length. The large temperature-induced frequency shift observed for transversal Au-related modes demonstrates that the dimerization is significantly affected by the phase transition due to charge transfer between Au- and Si-related states. The charge transfer leads to Raman scattering by charge density fluctuations, which is responsible for the detected Raman activity even for such modes that should be silent due to symmetry.

DS 4.26 Tue 10:00 P

Femtosecond Spectrostroscopic Ellipsometry — •Shirly Espinoza — ELI Beamlines, Institute of Physics, Czech Academy of Science, Prague, Czech Republic

The current status of a versatile experimental platform dedicated to ultrafast pump-probe ellipsometry with time resolution about 100 fs will be presented. The setup measures the ellipsometric spectra in the range 350-750 nm. The monochromatic pump beam can be chosen

from 350 nm to 2 um. This setup give information of ultrafast changes on the optical properties of the materials forming a thin film. Recent results and ideas for expansion of the capabilities of the setup will be presented for discussion.

DS 4.27 Tue 10:00 P

Metal-insulator transition via ion irradiation in epitaxial La0.7Sr0.3MnO3-δ thin films — Lei Cao[1], Andreas Herklotz[2], Diana Rata[2], Chenyang Yin[3], Oleg Petracic[3], Ulrich Kentsch[1], Manfred Helm[1], and •Shengqiang Zhou[1] — [1]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, 01328, Germany — [2]Institute of Physics, Martin Luther University Halle-Wittenberg, Halle, 06120, Germany — [3]Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institut (PGI-4), JARA-FIT, Forschungszentrum Jülich GmbH Jülich, 52425, Germany

Complex oxides provide rich physics related to ionic defects. For the proper tuning of functionalities in oxide heterostructures, it is highly desired to develop fast, effective and low temperature routes for the dynamic modification of defect concentration and distribution. In this work, we report on the use of helium-irradiation to efficiently control the vacancy profiles in epitaxial La0.7Sr0.3MnO3-δ thin films. The viability of this approach is supported by the lattice expansion in the out-of-plane lattice direction and dramatic change in physical properties, i.e., a transition from ferromagnetic metallic to antiferromagnetic insulating. In particular, a significant increase of resistivity up to four orders of magnitude is evidenced at room temperature, upon irradiation by highly energetic He-ions. Our result offers an attractive means for tuning the emergent physical properties of oxide thin films, via strong coupling between strain, defects and valence.

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