O 48: Poster: 2D Materials beyond Graphene: TMDCs, Silicene and Relatives

Time: Tuesday 18:15–20:30 Location: Poster A

O 48.1 Tue 18:15 Poster A

Chemical and electronic decoupling of organic molecules by a monolayer of hexagonal boron nitride — •Christine Brülke[1], Timo Heepenstrick[1], Ina Krieger[1], Xiaosheng Yang[2], Simon Weiss[2], Frank Stefan Tautz[2], Serguei Soubatch[2] und Moritz Sokolowski[1] — [1]Institut für Physikalische und Theoretische Chemie der Universität Bonn — [2]Peter Grünberg Institut, Forschungszentrum Jülich

Hexagonal boron nitride (hBN) is a widely studied material due to its similarity to graphene and its properties as a wide band-gap insulator. We report on the ability of one monolayer hBN to electronically and chemically decouple one monolayer of PTCDA from the Cu(111) surface. Using spot profile analysis low energy electron diffraction (SPA-LEED) and scanning tunneling microscopy (STM) we find a big similarity of the PTCDA monolayer to the (102) plane of the bulk crystal. Investigations via photoelectron spectroscopy (XPS and UPS) show electronic decoupling of the molecules from Cu(111) by the hBN monolayer. The HOMO of the monolayer is located at -2.5 eV below E_F, in accordance with previous findings for multilayers of PTCDA. Normal incidence standing wave experiments (NIXSW) reveal that the vertical binding distance of PTCDA to the hBN layer is very large (3.38 Å) and that the out-of-plane distortion of the molecule is very minute (< 0.1 Å). This points to a weak physisorptive bonding in contrast to the chemisorptive bonding found for PTCDA on Cu(111).

O 48.2 Tue 18:15 Poster A

Epitaxial Growth and Air-stability of Monolayer Antimonene — •xu wu[1,2], yan shao[1], hang liu[1], yeliang wang[1], jiatao sun[1], zhongliu liu[1], shixuan du[1], and hongjun gao[1] — [1]Institute of Physics, Chinese Academy of Sciences, 100190 Beijing, China — [2]Max Planck Institute for Solid State Research, 70569 Stuttgart, Germany

The investigation of two-dimensional (2D) materials has developed rapidly in recent years, inspired by their unique properties and the promise of applications. Recently, many theoretical papers have reported a honeycomb lattice of antimony atoms with expected applications in electric and photoelectric devices [2], called antimonene[1].Here we report the growth of a monolayer of antimonene on layered PdTe2 substrates by epitaxy[3]. Combining our experimental and theoretical results, we verifed that the antimonene is a 2D continuous monolayer with weak coupling to the substrate. Moreover, our fndings reveal that the antimonene is quite inert with respect to air. The monolayer antimonene with its large bandgap and chemical stability is promising for applications in nanoelectronic devices.

[1] S. Zhang et al., Angew. Chem. Int. Ed. 54, 3112 (2015).
[2] G. Pizzi et al., Nat. Commun. 7, 12585 (2016).
[3] X. Wu et al., Adv. Mater. 29, 1605407 (2017).

O 48.3 Tue 18:15 Poster A

Coupling of plasmonic metasurfaces to WS_2 monolayers — •Florian Spreyer[1], Feng Shun[2], Yu Ting[2], and Thomas Zentgraf[1] — [1]Universität Paderborn, Paderborn, Germany — [2]Nanyang Technological University, Division of Physics and Applied Physics, Singapore

Recent studies show great potential for transition metal dichalcogenides (TMD) and their optical application. By downscaling TMD's to a single layer flake of atomical thickness, like it is done with graphene, TMD's become semiconductors with a direct band gap. In the past years, new ways of fabrication provided greater flake sizes and higher quality of single layer flakes. Here we study hybrid metasurfaces by combining TMD monolayer flakes with plasmonic nanostructures. We present recent results of the characterization of tungsten disulfide (WS_2) flakes transferred to different substrates. By using photoluminescence and AFM measurements we locate monolayers of WS_2 and determine their thickness. In addition, metasurfaces made of plasmonic gold nanoantennas with a rotational C3 symmetry are designed and characterized. The plasmonic nanoantennas are fabricated on top of the WS_2 monolayers and the optical properties are studied in the experiment.

O 48.4 Tue 18:15 Poster A

Structure and mechanical properties of carbon nanomembranes — •Florian Gayk, Julian Ehrens, Tjark Heitmann, Andreas Mrugalla, Patrick Vorndamme, and Jürgen Schnack — Universität Bielefeld, PF 100131, D-33615 Bielefeld

Carbon nanomembranes (CNMs) are successfully synthesised by irradiating monolayers of polyaromatic molecules with electrons which induces crosslinking [1]. But the internal structure of the resulting CNMs remains vague. To make a proposal we investigate them in terms of classical molecular dynamics calculations using LAMMPS. Since several classical carbon potentials are available we first study the accuracy of the potentials concerning Young's moduli by testing them on well known structures such as diamond or graphene. The second generation REBO and EDIP potentials turn out to provide reasonable results. We propose a method how to simulate the effect of the irradiation process in our molecular dynamics framework. The obtained CNM structures are discussed.

[1] P. Angelova et al., ACS Nano 7 (2013) 6489

O 48.5 Tue 18:15 Poster A

Electron Lattice Discretization in Two-Dimensional Hexagonal Flat Band Systems — •Maximilian Uhl[1,2] and Wolfgang Häusler[1] — [1]Institut für Physik, Universität Augsburg — [2]Present Adress: Max-Planck-Institut für Festkörperforschung, Stuttgart

The $\mathcal{T}_3$-lattice is a two-dimensional hexagonal lattice where jumps between certain lattice sites are suppressed by destructive quantum interference [2]. It features interesting properties such as a flat band where the electron single particle energies are constantly zero. Owing to Coulomb interactions, the electrons form Wigner crystals in the ground state. However, due to localization to specific lattice sites, perfect Wigner crystals can only be formed at commensurability with the underlying $\mathcal{T}_3$-lattice, requiring specific discrete electron densities [1]. Then, the system is insulating. At other electron densities, the extra carriers may contribute to a nonzero conductance [1]. The commensurability condition is described by an equation of integers [1]. At first glance, its distribution as a function of normalized electron density ν seems completely irregular. In this work, a twelvefold symmetry has been found, allowing for the identification of strong degeneracies. Analytical and numerical analysis revealed various unexpected properties such as that distances of commensurate ν^{-1} tend to be divisible by three or that the minimal distance of commensurate ν^{-1} always keeps appearing even for ν^{-1} going towards infinity.

[1] W. Häusler: Phys. Rev. B **91**, 041102 (2015)
[2] B. Sutherland: Phys. Rev. B **34**, 5208 (1986)

O 48.6 Tue 18:15 Poster A

Controlling the Topological Properties of Stanene: Realistic Modeling and Experimental Approaches for Substrates — •Maximilian Bauernfeind[1], Philipp Eck[2], Marius Will[1], Domenico Di Sante[2], Lenart Dudy[1], Ronny Thomale[2], Jörg Schäfer[1], Ralph Claessen[1], and Giorgio Sangiovanni[2] — [1]Physikalisches Institut and Röntgen Research Center for Complex Material Systems, Universität Würzburg, D-97074 Würzburg — [2]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, D-97074 Würzburg

Stanene, the two-dimensional (2D) honeycomb lattice made of Sn atoms with its non-trivial topological electronic structure could play a revolutionary role in future electronic devices. A bottleneck to reach this ultimate goal is the fabrication of stanene on a substrate, without destroying its topological properties by strain or charge transfer, induced by the bonding situation. To overcome this problem, one approach is to decouple the stanene layer from the substrate. This may, e.g., be achieved by a buffer layer between the substrate and the stanene layer. We present a systematic study of buffer layers made of different group-III and group-V atoms on the wide-bandgap semiconductor SiC(0001). With band structure calculations based on density-functional theory (DFT), we observe a passivation of the SiC(0001) surface. Additionally, the buffer has an influence on the buckling and the vertical distance of the stanene layer. Some buffer layer materials render the stanene layer topological. First experimental data on the fabrication of an Al buffer layer will also be presented.

O 48.7 Tue 18:15 Poster A

Hexagonal Boron-Carbon-Nitrogen - a two-dimensional direct band gap semiconductor — •Axel Enders[1,3], Sumit

Beniwal[2,3], Suchetana Sarkar[1], Paulo Costa[3], Peter Dowben[3], James Hooper[4], Daniel Miller[5], Eva Zurek[5], and Shih-Yuan Liu[6] — [1]Physikalisches Institut, Universität Bayreuth, 95440 Bayreuth — [2]Universität Erlangen-Nürnberg, 91058 Erlangen — [3]Dept. of Physics and Astronomy, University of Nebraska, Lincoln, NE 68588, USA — [4]Dept. of Theoretical Chemistry, Jagellionian University, 30-060 Krakow, Poland — [5]Dept. of Chemistry, Buffalo, New York 14260, USA — [6]Dept. of Chemistry, Boston College, Chestnut Hill, MA 02467, USA

Two-dimensional h-BCN, synthesized from the precursor molecule bis-BN cyclohexane on the (111) surfaces of Ir and Rh under UHV, was investigated with a comprehensively suite of in-situ local probe microscopy and spectroscopy methods, combined with density functional theory. The lattice structure of h-BCN is identical to that of graphene, with the graphenic sites occupied by atoms of boron, nitrogen and carbon. On the basis of measured band gaps and the computationally predicted electronic band structure, especially a direct electronic band gap that is intermediate to those of the zero-band gap semiconductor graphene and the insulating h-BN, and the theoretical prediction that the band gap is dependent on the molecular tiling, it can be expected that the h-BCN layers are potentially exciting candidates for 2D electronic materials

O 48.8 Tue 18:15 Poster A

Effects of substrate on defects production in 2D inorganic materials under ion irradiation in Helium Ion Microscope — •Sadegh Ghaderzadeh[1], Silvan Kretschmer[1], Mikhail Maslov[1,2], Mahdi Ghorbani-Asl[1], and Arkady Krasheninnikov[1,3] — [1]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Moscow Institute of Physics and Technology, Dolgoprudny, Russia — [3]Department of Applied Physics, Aalto University School of Science, Finland

Helium Ion Microscope (HIM) does not only provide high-resolution images of the samples, but also creates the possibility of changing their morphologies in a controllable manner by introducing defects. Recently, two-dimensional (2D) materials including transition-metal dichalcogenides (TMDCs) have drawn attention as the promising building blocks for the future electronic devices. Exposure to energetic He ions has been shown to give rise to defect formation, but the mechanism of defect production in the TMDC samples on substrates is not fully understood. In this work, we study the effects of substrates on the creation of defects in 2D materials under He ion irradiation. Using a binary collision approach and analytical potential molecular dynamics, we show that while at low (less than 500 eV) He ion energies defects appear mostly due to direct ion impacts, at high energies defect creation is dominated by backscattered ions and atoms sputtered from the substrate. Our results provide microscopic insights into defect formation mechanisms in supported 2D materials.

O 48.9 Tue 18:15 Poster A

Time-resolved photoemission electron microscopy on monolayered WSe_2 — •Bernhard Huber[1], Sebastian Pres[1], Bernhard Mahlmeister[1], Daniel Fersch[1], Victor Lisinetskii[1], Steffen Michaelis de Vasconcellos[2], Robert Schneider[2], Johannes Kern[2], Matthias Hensen[1], Rudolf Bratschitsch[2], and Tobias Brixner[1] — [1]Institut für Physikalische und Theoretische Chemie, Universität Würzburg, Am Hubland, 97074 Würzburg — [2]Physikalisches Institut, Wilhelm-Klemm-Str. 10, 48149 Münster

Atomically thin transition metal dichalcogenides (TMDCs) have emerged as a promising material system for optoelectronic applications, e.g., as a single-photon source, which was recently demonstrated with a single layer of WSe_2 [1]. Here we present time-resolved photoemission electron microscopy (TR-PEEM) results on WSe_2 in a pump–probe spectroscopy scheme revealing spatio–temporal features at the 100 nm length scale. As illumination source a widely tunable high-repetition-rate (1 MHz) laser system pumping a non-collinear optical parametric amplifier is used, providing pulses from 900 nm down to 230 nm. In the presented experiment, a pump pulse centered at 700 nm excites slightly above the A exciton resonance (1.63 eV) which occurs at the K and K' points of the Brillouin zone. A probe pulse (350 nm) consequently transfers the excited-state manifold into photoemitted electrons which are detected with PEEM.

[1] J. Kern et al., Adv. Mater. **2016**, 28, 7101–7105

O 48.10 Tue 18:15 Poster A

Real time investigation of the growth of hexagonal boron nitride on metal surfaces using LEEM — •Miriam Raths[1,2], Janina Felter[1,2], and Christian Kumpf[1,2] — [1]Peter Grünberg Institut (PGI-3), Forschungszentrum Jülich, 52425 Jülich, Germany — [2]Jülich Aachen Research Alliance (JARA)

The 2D material hexagonal boron nitride (hBN) has attracted strongest interest recently, due to its specific structural and electronic properties. As an insulator (band gap of >5eV) it is a very promising material for hetero-epitaxial systems in conjunction with other 2D materials. In this study, we aim for a deeper understanding of its nucleation and growth, as it is necessary to produce high quality monolayers of hBN. In-situ Low-Energy Electron Microscopy (LEEM) studies enable us to follow the formation of hBN monolayers on metal surfaces by chemical vapour deposition of borazine in real time. We report on the growth of hBN on the Ni(111) surface, and compare with earlier studies performed in our group on Cu(111) and Ag(111).

O 48.11 Tue 18:15 Poster A

Investigation of hybridized hexagonal boron nitride and graphene (hBNC) on SiC(0001) — •Shayan Parhizkar[1,2], Markus Franke[1,2], Serguei Soubatch[1,2], You-Ron Lin[1,2], Nafiseh Samiseresht[1,2], Miriam Raths[1,2], François C. Bocquet[1,2], and Christian Kumpf[1,2] — [1]Peter Grünberg Institut (PGI-3), Forschungszentrum Jülich, 52425 Jülich, Germany — [2]Jülich Aachen Research Alliance (JARA-FIT)

Hybridized 2D heterostructures are of great interest due to their high variety of electronic properties and their great potential for future electronic and optoelectronic applications. Hexagonal boron nitride (hBN) and graphene, two well known 2D materials that are dielectric and conductive, respectively, have identical crystal structures and very similar lattice parameters. This makes them compatible in hybrid systems and motivates the investigation of their interaction.

Here we report on structural and electronic properties of hybridized hexagonal boron nitride and graphene (Gr-R0°), so-called hBNC, epitaxially grown on the wide bandgap semiconductor SiC as a function of the domain ratio. Starting from pure hBN to almost pure graphene, we investigated single 2D layers using X-ray standing waves (XSW) and (angular resolved) X-ray photoemission spectroscopy (ARPES and XPS).

O 48.12 Tue 18:15 Poster A

Growth and structure of mono- to few-layer vanadium disulphide on graphene on Ir(111) — •Joshua Hall[1], Tobias Wekking[1], Felix Huttmann[1], Stefan Kraus[1], Nico Rothenbach[2], Katharina Ollefs[2], Lucas M. Arruda[3], Nick Brookes[4], Gunnar Schönhoff[5], Jan Berges[5], Tim Wehling[5], Wolfgang Kuch[3], Heiko Wende[2], and Thomas Michely[1] — [1]II. Physikalisches Institut, Universität zu Köln, Germany — [2]Faculty of Physics and CENIDE, University of Duisburg-Essen, Duisburg, Germany — [3]Institut für Experimentalphysik, Freie Universität Berlin, Germany — [4]European Synchrotron Radiation Facility, ESRF, France — [5]Institut für Theoretische Physik, Bremen Center for Computational Materials Science, Universität Bremen, Germany

Using scanning tunnelling microscopy and low-energy electron diffraction we study the growth and structure of vanadium disulphide VS_2. The mono- to few-layer samples of VS_2 on graphene on Ir(111) are grown by in situ molecular beam epitaxy. Depending on the specific growth parameters, a variety of growth scenarios evolves. Monolayer VS_2 displays smoothly joined domains of a (3×1) superstructure that appears to result from an uniaxial distortion and buckling of the hexagonal VS_2 lattice. In X-ray circular magnetic dichroism experiments, the ferromagnetism proposed in monolayer VS_2 [1] is not found. In few-layer VS_2, the hexagonal lattice is restored, still exhibiting multiple superstructures.

[1] Isaacs and Marianetti, PRB 94, 035120 (2016)

O 48.13 Tue 18:15 Poster A

Vibronic spectroscopy of single phthalocyanine molecule on MoS_2/Au(111) — •Gaël Reecht, Nils Krane, Christian Lotze, and Katharina J Franke — Freie Universität Berlin , Berlin ,Germany

Transition metal dichalcogenides (TMDC) as MoS_2 are two-dimensional semiconducting materials. Single layer TMDC are particularly promising as they present a direct band-gap at the K point, a giant excitonic renormalization and a spin splitting of the valence band. Due to the presence of a band gap, MoS2 can also be used to decouple nanostructures from a metallic substrate. With a LT-STM, we studied

phthalocyanine molecules (Zn-Pc and H_2-Pc) on MoS_2 grown previously on Au(111). As reported for other decoupling systems (graphene, NaCl, H-BN), we observe a high spatial resolution of the molecular orbitals on MoS_2. Moreover, for the molecular states with an energy in the gap of MoS_2, the lifetime of the state is strongly enhanced and a series of vibronic modes can be resolved. In the extreme case of the H_2-Pc, vibronic states with energies from few meV to hundreds of meV are observed. Finally, we compare the measured vibrational energies with results of DFT, Raman spectroscopy and LE-STM.

O 48.14 Tue 18:15 Poster A

Li Adatoms on Single Layer Molybdenum Disulfide on Au(111) — •Asieh Yousofnejad, Timo Kubsch, Nils Krane, Gaël Reecht, Christian Lotze, and Katharina J. Franke — Fachbereich Physik, Freie Universität Berlin

Two-dimensional transition metal dichalcogenides (2D TMDCs) have attracted attention recently because of their interesting electronic and optical properties. Molybdenum disulfide (MoS_2) shows a transition from an indirect band gap in bulk structure to a direct band gap in the monolayer structure. In order to obtain functional devices, tuning of the band structure is desirable. One approach to achieve this is for instance doping by alkali atoms.

Here, we grow MoS_2 on Au(111) by depositing Mo and annealing in an H_2S atmosphere. We then deposit Li on a sample at a temperature below 110K. We observe single Li atoms on the MoS_2 islands. However, at measuring temperatures of 4K these atoms are mobile and can be easily dragged by the STM tip. Using Scanning Tunneling Spectroscopy we do not find evidence for a change of the band gap of MoS_2, suggesting a negligible charge transfer.

O 48.15 Tue 18:15 Poster A

Intra- and inter-layer magnetic interactions in a van der Waals crystal — •Moemi Kawashima[1,2], Akira Akaishi[2], and Jun Nakamura[2] — [1]Department of Engineering Science, The University of Electro-Communications, Chofu, Tokyo 182-8585, Japan — [2]Institute of Condensed Matter Theory and Optics, Jena, Germany

Chromium triiodide (CrI_3) with a layered structure is known to be a soft ferromagnet in its bulk form. Huang *et al.* recently reported that the magnetic properties of CrI_3 differ when the layers approach the 2D limit, and become sensitive to the number of layers: monolayered and trilayered CrI_3 are ferromagnetic, whereas bilayered CrI_3 happens to be antiferromagnetic. In order to explore the mechanism of such a layer-number dependent magnetism of CrI_3, we have investigated the magnetic properties of CrI_3 thin films using the van der Waals density functional theory. We have found out that the ground states for all of monolayered, bilayered and trilayered CrI_3 are ferromagnetic, in both the low-temperature ($R_{\bar{3}}$ with an ABC-stacking) and high-temperature ($C_{2/m}$ with another ABC-stacking) structure. However, it has been revealed that trilayered CrI_3 is most stable with an AA-stacked structure, and the magnetic ground state of bilayered CrI_3 becomes antiferromagnetic with an AA-stacked structure. These results suggest that the bilayered CrI_3 observed in the experiments of Huang *et al.* had an AA-stacked structure, and that the crystallographic properties of 2D CrI_3 have a strong connection to its magnetism. We will also discuss impacts of the choice of the van der Waals functional on the magnetic interaction through van der Waals interactions.

O 48.16 Tue 18:15 Poster A

Photoemission electron microscopy study of MXene microflakes — •Bharti Parashar[1], Pika Gospodaric[1], Kanit Hantanasirisakul[2], Slavo Nemsak[1], Tomas Duchon[3], Johanna Hackl[1], Lukasz Plucinski[1], Steven May[2], Yury Gogotsi[2], and Claus M. Schneider[1] — [1]Peter Grünberg Institut PGI-6, Forschungszentrum Jülich, 52425 Jülich, Germany — [2]Drexel University Materials Science & Engineering, 3141 Chestnut Street (LeBow 344), Philadelphia, PA 19104 U.S.A. — [3]Department of Surface and Plasma Science, Charles University in Prague, Czech Republic

Recent advances in photoemission electron microscopy (PEEM) facilitate access to electronic structure with sub-100 nm lateral resolution, either through x-ray absorption (XAS) or photoemission (PES) spectroscopy. Utilizing these techniques, we have studied thin chemically exfoliated Ti_3C_2 MXene microflakes prepared on Si(001) and HOPG substrates. Well-separated single flakes of approx. 5 micrometers in size were characterized with respect to their functionalization with F^-, OH^-, and O^{2-} groups. The results revealed fluorine-rich clusters of up to 1 micrometer in diameter distributed non-uniformly on the surface of the flakes and we observed their influence on the electronic structure of Ti.

These results provide important complementary information to other, spatially non-resolved techniques, and they are the first steps towards understanding of the electronic band structure of these microscopic objects.

O 48.17 Tue 18:15 Poster A

Interaction of slow highly charged ions with 2D materials — •Sascha Creutzburg[1], Janine Schwestka[2], Tibor Lehnert[3], Robert Leiter[3], Arkady V. Krasheninnikov[1], Roland Kozubek[4], René Heller[1], Stefan Facsko[1], Ute Kaiser[3], Marika Schleberger[4], Friedrich Aumayr[2], and Richard A. Wilhelm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Ion Beam Physics and Materials Research — [2]TU Wien, Institute of Applied Physics — [3]Ulm University, Central Facility of Electron Microscopy — [4]University Duisburg-Essen, Faculty of Physics and CENIDE

The neutralisation of highly charged ions (HCIs) upon impact on a solid surface occurs within a timescale smaller than about 10 fs [1,2]. Recently, freestanding 2D layers became available and their utilization for transmission studies of HCIs makes a more detailed investigation of the neutralisation mechanisms possible. The charge exchange of HCIs transmitted through single layer graphene [1] and carbon nanomembranes [3] was investigated by means of an electrostatic analyser. Additionally, the ion stopping is measured and the kinetic energy loss depends strongly on charge exchange. In this contribution the transmission measurements are extended to 2D materials beyond graphene, i.e. MoS_2 and hBN.

[1] E. Gruber et al., Nat. Commun. 7, 13948 (2016).
[2] R. A. Wilhelm et al., Phys. Rev. Lett. 119, 103401 (2017).
[3] R. A. Wilhelm et al., Phys. Rev. Lett. 112, 153201 (2014).

O 48.18 Tue 18:15 Poster A

Ellipsometric determination of the anisotropic refractive index of WSe_2 via angle resolved measurements for E = 1.89 eV — •Walter Enns[1], Sergej Neb[1], Sebastian Fiechter[2], and Walter Pfeiffer[1] — [1]Universität Bielefeld, Fakultät für Physik, Universitätsstr. 25, 33615 Bielefeld, Germany — [2]Helmholtz Zentrum Berlin, Institut für Solare Brennstoffe, Hahn-Meitner-Platz 1, 14109 Berlin, Germany

Although the transition metal dichalcogenide (TMDC) van der Waals crystals are obviously optically anisotropic, little information is found in literature. Experimental determination of the optical anisotropic response is complicated by the preferential cleaving of crystals along the van der Waals gaps. In addition the formation of a contamination layer in air and the macroscopicly uneven surface are further experimental hurdles. Here it is shown that precise angle resolved ellipsometric single-wavelength measurements combined with statistical and error analysis enables extracting the complex anisotropic refractive index from the coupled ellipsometric values Δ and Ψ. The experimentally obtained values show reasonable agreement with theoretical calculations of the dielectric function [1, 2].

[1] S. Sharma, et al., Phys. Rev. B **60**, 8610 (1999)
[2] A. Kumar, et al., Physica B: Condensed Matter **407**, 24 (2012)

O 48.19 Tue 18:15 Poster A

Hot carrier dynamics in semiconducting transition-metal dichalcogenides – valley-polarized excitation in bulk $2H$-MoS_2 and monolayer WS_2/Au(111) — •Hauke Beyer[1], Gerald Rohde[1], Antonija Grubisic Cabo[2], Ankatrin Stange[1], Luca Bignardi[3], Daniel Lizzit[3], Paolo Lacovig[3], Silvano Lizzit[3], Kai Rossnagel[1], Philip Hofmann[2], and Michael Bauer[1] — [1]Institute of Experimental and Applied Physics, Kiel University, 24098 Kiel, Germany — [2]Department of Physics and Astronomy, Aarhus University, 8000 Aarhus C, Denmark — [3]Elettra Sincrotrone Trieste, S.S. 14 Km 163.5, 34149 Trieste, Italy

Time- and angle-resolved photoelectron spectroscopy (trARPES) is employed to study the valley-selective excitation and near-surface dynamics of carriers at K and K′ in semiconducting transition-metal dichalcogenides (TMDC). Upon photoexcitation with circularly polarized laser pulses ($\lambda \approx 600$ nm), circular dichroism can be observed in excited-state intensity as well as dynamics. The poster will present and compare experimental results of bulk $2H$-MoS_2 and monolayer WS_2/Au(111). In the latter case, we observe a significantly enhanced dichroism of the excitation intensity in comparison to the bulk sample, which we attribute to the lack of mirror domains of the WS_2 sample. Furthermore, a dependence of the population dynamics on the polar-

ization state of the excitation laser pulse is observed only for $2H$-MoS_2. This difference is associated with K to K′ intervalley scattering processes affecting the carrier dynamics in bulk TMDC samples but being absent in the case of monolayer WS_2/Au(111).

O 48.20 Tue 18:15 Poster A

Tuning optoelectronic properties on 2D material devices — •Nieves Morquillas[1], Saül Veléz[1,3], Felix Casanova[1,2], Luis Hueso[1,2], Reyes Calvo[1,2], and Jose Ignacio Pascual[1,2] — [1]CIC nanoGUNE, 20018 San Sebastian (Spain) — [2]Ikerbasque, 48011 Bilbao (Spain) — [3]Department of Materials, ETH Zürich, 8093 Zürich (Switzerland)

Transition metal dichalcogenides are promising materials for optoelectronis due to their tunability. We characterize the optoelectronic properties of semiconducting 2D devices by combined photoluminescence and electric transport measurements in a scanning photocurrent microscope (SPCM). We study the photocurrent created at Schottky barriers of MoS2 devices, including systems with an interface between 1L and 2L showing a potential barrier at the boundary. We also investigated a heterostructure of MoS2 on top of NbSe2, a strong electron acceptor, where we find areas at the heterostructure with a high on/off current ratio.

Another tunable property is the pseudo-spin. For an odd number of layers, inversion symmetry is broken and thus it is possible to tune a new degree of freedom, the valley. Here we investigate the effect of a ferrimagnetic substrate (Yttrium Iron Garnet, YIG) on the pseudo-spin of a WSe2 single layer by circularly polarized light in a scanning confocal microscope (SCFM). The ferrimagnetic substrate has a characteristic magnetic domain arrangement with an effective out-of-plane magnetic field. Contrary to expected, we observed a stronger effect from the substrate roughness than from the effective magnetic field.

O 48.21 Tue 18:15 Poster A

Magnetic Field Dependence of Energy Dissipation on a Topological Insulator Surface Studied by Pendulum AFM — •Dilek Yildiz[1,2], Marcin Kisiel[1,2], Urs Gysin[1], and Ernst Meyer[1] — [1]Universität Basel, Department of Physics, Basel, Switzerland — [2]Swiss Nanoscience Institute, Basel, Switzerland

Bodies in relative motion separated by few nanometers gap experience a tiny friction force. Although nature of non-contact friction is not fully understood yet, it can be measured by highly sensitive cantilever oscillating like a tiny pendulum over the surface. Such frictional nature on layered systems is yet another exotic playground. Topological insulators, such as Bi2Te3 present an opportunity to investigate multiple facets of non-contact friction. Although electronic properties of topological insulators have been studied extensively, frictional response of those surfaces are yet to be reported. We studied energy dissipation on Bi2Te3 surface by means of pendulum geometry AFM/STM. Energy dissipation peaks were measured few nanometers above the surface at relatively large voltages. Such dissipation peaks are observed to shift as a function of external magnetic field. Our results indicate that energy dissipation is mainly due to electrostatic friction.