O 23: Poster Ultrafast Electron Dynamics

Time: Monday 18:00–20:00 Location: P2

O 23.1 Mon 18:00 P2

Charge Density Waves and Doublon Lifetime in Doped 1*T*-TaS_2 — •J. Jayabalan[1], Gaël Reecht[1], Florian Diekmann[2], Ping Zhou[1], Walter Schnelle[3], Kai Rossnagel[2], Manuel Gruber[1], and Uwe Bovensiepen[1] — [1]Universität Duisburg-Essen, Germany. — [2]Christian-Albrechts-Universität zu Kiel, Germany. — [3]Max Planck Institute for Chemical Physics of Solids, Dresden, Germany.

Below a certain critical temperature, the periodic rearrangement of atoms into a long-range ordered star-like pattern transforms the metallic 1*T*-TaS_2 into an insulating state by opening a band gap [B. Sipos, *et al.*, Nature Materials **7**, 960 (2008)]. This metal-to-insulator transition progresses through distinct charge density wave (CDW) states, driven by the interplay between electron-electron and electron-lattice interactions. In the commensurate CDW state of 1*T*-TaS_2, the carriers excited into its upper Hubbard band (UHB), also known as a doublon state, decay in less than 20 fs due to the presence of unintentionally doped holes in the sample [M. Ligges, *et al.*, Phys. Rev. Lett., **120**, 166401 (2018)]. Through ultraviolet time-resolved photoemission spectroscopy at the Γ point, we identify a long-lived feature near the upper Hubbard band (UHB) energy in 1*T*-$Ta_{(1-x)}W_xS_2$. Through variations in temperature, doping concentration, and pump-induced effects, we identify this observed feature as long-lived doublons. With STM measurements, we show a long living hole dynamics through localized excitations at specific locations of the sample. Funding by the DFG through FOR 5249 QUAST is gratefully acknowledged.

O 23.2 Mon 18:00 P2

Ultrafast low-energy photoelectron diffraction for the study of surface-adsorbate interactions with 100 femtosecond temporal resolution — Hermann Erk[1], Carl Erik Jensen[1], •Stephan Jauernik[1], and Michael Bauer[1,2] — [1]Institute of Experimental and Applied Physics, Kiel University, 24098 Kiel, Germany — [2]Kiel Nano, Surface and Interface Science KiNSIS, Kiel University, 24118 Kiel, Germany

In this contribution a novel method of ultrafast electron diffraction for the study of structural dynamics at surfaces is presented. In our photoemission-based experiment we analyze the energy-momentum distribution of low-energy photoelectrons excited by a near ultraviolet (NUV) ultrafast laser pulse in graphite that are diffracted as they pass through an ordered tin-phthalocyanine adsorbate layer. The probing electron pulse is generated in the immediate vicinity of the surface. This limits the propagation distance of the electron pulse before diffraction to a few nanometers and thus minimizes pulse broadening effects due to space charge and dispersion. We experimentally demonstrate a time resolution of this ultrafast low-energy photoelectron diffraction (ULEPD) of about 100 fs [1], which is only limited by the pulse width of the NUV laser pulse and exceeds reported values of conventional ultrafast low-energy electron diffraction [2] by a factor of 10.

[1] H. Erk *et al.*, Phys. Rev. Lett. **133**, 226201 (2024)
[2] S. Vogelgesang *et al.*, Nat. Phys. **14**, 184 (2017)

O 23.3 Mon 18:00 P2

Studying electron-phonon interaction in $MoTe_2$ using time-resolved and frequency-domain ARPES — •Carl Eric Jensen[1], Stephan Jauernik[1], Petra Hein[1], and Michael Bauer[1,2] — [1]Institute of Experimental and Applied Physics, Kiel University, 24098 Kiel, Germany — [2]Kiel Nano, Surface and Interface Science KiNSIS, Kiel University, 24118 Kiel, Germany

The layered transition metal dichalcogenides $MoTe_2$ and WTe_2 attracted significant attention in the recent years due to the topological properties of their noncentrosymmetric T_d-phase and their manipulation by coherent phonon excitation [1,2]. In this contribution we present time-resolved and frequency-domain ARPES (FD-ARPES) data of 1T'-$MoTe_2$. Optical excitation of the electronic system by a near-infrared (1.5 eV) pump pulse results in the excitation of coherent phonons in this material. The frequencies of the observed coherent phonon modes agree with all-optical measurements of $MoTe_2$ [2,3]. A Fouriertransform of the time-resolved ARPES data into the frequency-domain proviedes further insights into the interaction between electrons and phonons: The FD-ARPES data reveal the electronic band-selectivity of the indivitual coherent phonon modes. The results are compared with published work on WTe_2 [4].

[1] Sie et al. Nature 565, 61-66 (2019)
[2] Zhang et al. Phys. Rev. X 9, 021036 (2019)
[3] Fukuda et al. Appl. Phys. Lett. 116, 093103 (2020)
[4] Hein et al. Nature Communications 11, 2613 (2020)

O 23.4 Mon 18:00 P2

Ultrafast Charge Transfer and Band Renormalization in Bilayer Graphene/single layer Ag/SiC — •Eduard Moos[1], Zhi-Yuan Deng[1], Hauke Beyer[1], Arpit Jain[4], Chengye Dong[4], Joshua A. Robinson[4], Kai Rossnagel[1,2,3], and Michael Bauer[1,2] — [1]Kiel University, Germany — [2]Kiel Nano, Surface and Interface Science KiNSIS, Germany — [3]Electron Synchrotron DESY, Germany — [4]Pennsylvania State University, United States

Intercalated monoelement metals between mono- to multi-layer graphene/SiC interfaces are a new type of van der Waals heterostructures with extraordinary properties. In the monolayer limit, silver (MLAg) exhibits a metal-semiconductor transition and enables ultrafast charge transfer between layers. Due to the twisted arrangement of the Brillouin zones, low binding energy of the valence band maximum of MLAg and the resulting band gap of bilayer graphene (BLGr), this is an interesting model system to investigate charge transfer and interlayer coupling mechanisms.

In this contribution, time- and angle-resolved photoemission spectroscopy (TRARPES) with a time resolution of 35 fs is used. The data show clear evidence for a net charge transfer between Ag and graphene on a time scale of 50 fs. On longer time scales, the electronic structure of BLGr undergoes significant changes, including an enhancement of the intrinsic splitting of the pi band as well as a reduction of the band gap. We associate these with changes in the electronic and/or structural symmetry of BLGr.

O 23.5 Mon 18:00 P2

Ultrafast dynamics of thin films of small PAHs — •Lorenzo Maddii Fabiani, Tobias Reiker, and Helmut Zacharias — Center for Soft Nanoscience, Busso-Peus-Str.10 48149 Münster Germany

Polycyclic aromatic hydrocarbons (PAHs), which are estimated to constitute approximately 10% of the total carbon content in space, are omnipresent in interstellar environments. Molecular reactions of molecules in space, such as ionization, fragmentation and dissociation are fundamental to the chemical evolution of the interstellar medium. To investigate the initial electronic dynamics in alternant and non-alternant PAHs in the condensed phase following optical excitation, we performed time-resolved two-photon photoemission (tr-2PPE) experiments. Thin films of PAHs were prepared on gold-coated quartz substrate. In the range from femtosecond to 200 ps up to three lifetimes after excitation of S1, S2 or S3 were observed. We provide experimental ultrafast lifetimes of nine different alternant and non-alternant small PAH molecules in thin films. For the alternant molecules an increase of the lifetimes with molecular size is found, and the lifetimes decrease generally with increasing of the probe photon energy. In contrast, non-alternant PAHs exhibited less predictable behavior. Overall, the dynamics of excited electronic states provide a fundamental basis for unraveling the reaction processes occurring within the interstellar medium.

O 23.6 Mon 18:00 P2

Transient IR pump-probe spectroscopy on AuNP-TiO_2 structures — •Lisa Mehner[1], Wouter Koopman[1], Felix Stete[1], Steven Berth[1], Alexander von Reppert[1], and Matias Bargheer[1,2] — [1]Insitute for Physics and Astronomy, University of Potsdam — [2]Helmholtz-Zentrum Berlin

Photocatalysts can enhance redox reactions by supplying energetic electrons and holes. Combining gold nanoparticles (AuNP) and TiO_2 nanoparticles (NP) presents a promising route for realizing broad band photocatalysts as AuNP allow broad band absorption and TiO_2NP provide a long excited carrier lifetime. Electrons excited in the AuNP can transfer into the semiconductor if the energy is sufficient to overcome the interfacial Schottky barrier. Transferred electrons are expected to have a prolonged lifetime in the TiO_2 conduction band, since no vacancies are available for recombination in the va-

lence band. Here, we present our initial findings on charge transfer of a TiO_2NP+AuNP sample measured by transient pump-probe spectroscopy with optical pump-pulses and IR probe-pulses. Our measurements confirm the transfer of charges to the conduction band . Comparing TiO_2NP+AuNP to pure TiO_2NP suggests that both electron transfer from Au to TiO_2 as well as direct excitation of TiO_2 trap states occurs. The decrease in carrier lifetime with increasing fluence moreover indicates back transfer of charges from TiO_2 to Au.

O 23.7 Mon 18:00 P2

Photo-induced electron pressure drives THz phonon in Platinum-Copper superlattice — •Jan-Etienne Pudell[1], Marc Herzog[2], Max Mattern[2], Alexander von Reppert[2], Daniel Schick[3], Ulrike Boesenberg[1], Angel Rodriguez-Fernandez[1], Wonhyuk Jo[1], Roman Shayduk[1], Wei Lu[1], Felix Brause[1], Michel Hehn[5], Matias Bargheer[2,4], and Anders Madsen[1] — [1]European XFEL, Germany — [2]Institut für Physik, Uni Potsdam, Germany — [3]MBI, Berlin — [4]HZB Berlin, Germany — [5]IJL, Université Lorraine, France

Using ultrafast X-ray diffraction (UXRD) at the MID end-station at the European XFEL, we investigate the ultrafast lattice dynamics of metal-metal superlattice (SL) with few atomic layers of Pt and Cu upon femtosecond photoexcitation. Our results reveal that the absorbed optical energy is rapidly localizes within the Pt layers, driving the excitation of a coherent artificial THz phonon mode defined by the superlattice period. The signal's amplitude and phase modulation of the SL Bragg peaks induced by the lattice excitation i.e. the artificial THz phonon, are predominantly driven by electron pressure within the first picoseconds. This response is faster than the Debye-Waller effect, which is limited by the electron-phonon coupling time.

O 23.8 Mon 18:00 P2

Ultrafast current response of solids - limits of quasi-classic current formula — •Jelena Schmitz, Adrian Seith, Jan Wilhelm, and Ferdinand Evers — Institute of Theoretical Physics and Regensburg Center for Ultrafast Nanoscopy (RUN), University of Regensburg, D-93053 Regensburg, Germany

In a quasi-classical picture, the velocity of an electron with crystal momentum $\mathbf{k}$ is given by [1] $\mathbf{v}_n(\mathbf{k}) = \partial\epsilon_n(\mathbf{k})/\partial\mathbf{k} + q\,\mathbf{E}(\mathbf{t}) \times \mathbf{\Omega}_n(\mathbf{k})$(1), where $\epsilon_n(\mathbf{k})$ denotes the band structure and $\mathbf{\Omega}_n(\mathbf{k})$ the Berry-curvature associated with the n-th band. Expression (1) is expected to describe the material's current response to a time-dependent external field, $E(t)$, in the limit of slow and weak driving. Motivated by recent progress in generating ultrashort laser pulses, we study the limits of applicability of Eq.(1) in the limit of fast and strong driving. To this end, we adopt the framework of the Semiconductor-Bloch Equations (SBE) [2,3]; we derive Eq.(1) using a perturbative expansion of the SBE leading to analytical expressions for the limits of applicability and compare Eq.(1) with numerical solutions of the full SBE [4].

For massive Dirac Fermions, we find the bandgap energy and the Fermi level as the parameters determining the frequency domain as well as the maximum E-field strength for which the SBEs lead to matching results with Eq.(1).We also calculate corrections to Eq.(1) that enable us to identify Berry-curvature terms at higher frequencies.[1] Xiao, Di et. al., Rev. Mod. Phys. 82, 1959 (2010) [2] Schmitt-Rink, Stefan et. al., Phys. Rev. B 37, 941 (1988) [3] Wilhelm, Jan et. al., Phys. Rev. B 103, 125419 (2021) [4] https://github.com/ccmt-regensburg/CUED/

O 23.9 Mon 18:00 P2

XUV pulses with variable photon energy, pulse duration and bandwidth for time-resolved ARPES — •Isabella Alexandra Hofmeister, Niklas Hofman, Michael Schildbach, and Isabella Gierz — University of Regensburg, Regensburg, Germany

Time- and angle-resolved photoemission spectroscopy (trARPES) provides an unprecedented view on non-equilibrium quasiparticle dynamics and band structures in momentum space. Extreme ultraviolet (XUV) pulses generated by high harmonics generation (HHG) in noble gases are usually required to gain access to the complete first Brillouin zone. HHG yields a broad spectrum containing all the odd harmonics of the driving frequency up to a cut-off energy determined by the intensity and frequency of the drive. Therefore, a single harmonic is typically selected for trARPES using grating monochromators, multilayer mirrors, or a combination of filters. We compare different approaches implemented in a single trARPES setup with respect to their bandwidth and pulse duration and present strategies to enable complementary trARPES measurements with either good energy or good temporal resolution.

O 23.10 Mon 18:00 P2

Terahertz Excitation Source for Next Generation Time-of-Flight Momentum Microscopy at FLASH — Michael Herb[1], •Stefan Miedaner[1], Thomas Seitz[1], Jure Demsar[2], Stephan Winnerl[3], and Isabella Gierz[1] — [1]University of Regensburg, Germany — [2]Johannes Gutenberg University of Mainz, Germany — [3]Helmholtz Center Dresden-Rossendorf, Germany

We will combine the broad spectral tunability of the free-electron laser FLASH with Terahertz excitation for next-generation time-of-flight momentum microscopy (ToF-MM). This unique combination will enable unprecedented access to the non-equilibrium electronic and structural properties of novel quantum materials using a variety of time-resolved spectroscopic, diffraction, and microscopic techniques. This requires the design and installation of a compact Terahertz pump source operating at Megahertz repetition rate. Here, we present the current status of the photoconductive-emitter-based source [1] and its characterization by electro-optic sampling.

[1] Optics Express 29, 427247 (2021)

O 23.11 Mon 18:00 P2

table-top source for x-ray absorption spectroscopy with photon energies upto 350 eV — •Rajdwip Bhar, Oscar A. Naranjo-Montoya, Lukas Kalkhoff, Marika Schleberger, Heiko Wende, Alexander Tarasevitch, and Uwe Bovensiepen — University of Duisburg-Essen, Duisburg, Germany

Material science research aims to understand electronic properties and dynamics of complex materials. Performing pump-probe experiments using optical pump and x-ray probe enables capturing element-specific snapshots of the pump induced changes in a material. This contribution describes the development of a tabletop soft x-ray spectroscopy setup based on high harmonic generation using noble gases in a hollow core waveguide (HCW) [1].

To generate high harmonics with higher photon energies, a near-infrared driving laser source based on optical parametric chirped-pulse amplification (OPCPA) was developed [2]. Starting with an 800 nm seed and a 1030 nm pump, the OPCPA generates 1.5 μm and 3 μm pump pulses with pulse energies of 1.8 mJ and 0.8 mJ, respectively. The 1.5 μm pulses, compressed to $\sim$ 40 fs using chirped mirrors, pump the HCW, generating harmonics that reach photon energies up to 350 eV. Near-edge x-ray absorption spectroscopy at the B K-edge in crystalline boron and hexagonal boron nitride (hBN) samples was performed, showing excellent agreement with literature data.

[1]O. A. Naranjo-Montoya et al., Review of Scientific Instruments **95**, 103001 (2024).

[2]M. Bridger et al., Opt. Express **27**, 31330-31337 (2019).

O 23.12 Mon 18:00 P2

New end-station for time- and angle-resolved photoelectron spectroscopy in Artemis facility — •Yu Zhang, Charlotte E. Sanders, Bruce Weaver, Tiffany Walmsley, James O. F. Thompson, Richard T. Chapman, and Emma Springate — Central Laser Facility, STFC Rutherford Appleton Laboratory, Research Complex at Harwell, Harwell, United Kingdom

Artemis, located at the Central Laser Facility in the UK, is a user facility offering time- and angle-resolved photoelectron spectroscopy (TrARPES) utilizing extreme ultraviolet (20-45 eV) photon sources based on high harmonic generation of ultrafast laser. After more than a decade of operation, Artemis has established itself as a leading facility in the research of ultrafast electron dynamics on surfaces. Recently, Artemis received an significant upgrade of its end-station, which will provide users with state-of-the-art techniques in ultrafast time-resolved measurements. These new capabilities include both momentum and real-space mapping, large-angle E-k mapping with a deflector, and a closed-loop cryostat for low-temperature measurements. Detailed information about these features can be found in the poster. Along with the recently upgraded 100kHz laser source, Artemis is committed to delivering high-performance TrARPES for its user communities.

O 23.13 Mon 18:00 P2

Temporal evolution of surface plasmon polariton skyrmions — •Philipp Gessler, Alexander Neuhaus, Maria Azhar, Pascal Dreher, Frank Meyer zu Heringdorf, and Karin Everschor-Sitte — University of Duisburg-Essen, Germany

In recent years, structures reminiscent of those found in magnets [1] have been predicted and observed in Surface Plasmon Polaritons (SPPs). Of particular interest are topological SPP structures such

as skyrmion lattices [2,3] or merons [4]. In particular, these structures have been identified in various quantities related to the electric field, many of which exhibit amplitudes that oscillate over time. Building on insights from micromagnetism, our objective is to explore the dynamic behavior of these novel SPP states beyond mere temporal oscillations.

[1] C. Back et al., J. Phys. D: Appl. Phys. **53**, 36 (2020)
[2] S. Tsesses et al., Science **361**, 6406 (2018)
[3] T. J. Davis et al., Science **368**, 6489 (2020)
[4] Y. Zheng et al., Nanophotonics **13**, 2 (2024)

O 23.14 Mon 18:00 P2

Femtosecond momentum microscopy of field-effect gated bilayer WSe_2 and monolayer graphene — •Bent van Wingerden, Jan Philipp Bange, Jonas Pöhls, Wiebke Bennecke, Paul Werner, Daniel Steil, Matthijs Jansen, R. Thomas Weitz, Marcel Reutzel, and Stefan Mathias — I. Physikalisches Institut, Georg-August Universität Göttingen, Germany

Atomically-thin transition metal dichalcogenides and their respective Moiré heterostructures can host a variety of strongly correlated electronic phases, such as Wigner crystals and Mott insulators. The formation of these phases critically depends on the precise occupation of the corresponding Moiré superlattice states [Regan *et al.* Nature 579, (2020)], and might therefore be controlled by field-effect doping of charge carriers [Nguyen *et al.* Nature 572 (2019)]. In our work, we realized this in combination with a table-top time-resolved ARPES setup, i.e. our Göttingen femtosecond momentum microscopy experiment [Schmitt *et al.*, Nature 608, (2022)]. Our extension of ARPES experiments on field-effect gated heterostructures into the time domain on a laboratory scale will facilitate the study of non-equilibrium dynamics of strongly correlated phases and charged quasiparticles, e.g. trions. We provide proof-of-principle data on field-effect gated monolayer graphene and present time-resolved photoemission data of a WSe_2 bilayer at different charge carrier densities.

O 23.15 Mon 18:00 P2

Towards ultrafast momentum microscopy of exciton dynamics at ZnO surfaces — •Hashima Marukara, Junde Liu, and Stefan Mathias — Georg-August-Universität Göttingen, I. Physikalisches Institut, Germany

The semiconductor ZnO, known for its wide band gap and high exciton binding energy, stands out as a promising material among transparent conductive oxides for applications in optoelectronics and catalysis[1,2]. Surface excitons, i.e. bound electron-hole pairs localized at the material's surface, play a crucial role in mediating its optical and electronic properties, significantly influencing energy conversion processes at the surfaces [3]. An ideal tool to study these ultrafast processes is time- and angle-resolved photoelectron spectroscopy, which gives access to the exciton landscape and the relevant excitation and relaxation pathways. In our new project within the CRC1633 "Proton-coupled electron transfer", we aim to study the ultrafast surface exciton dynamics at the ZnO(10-10) surface using our Göttingen time-resolved momentum microscopy setup. By using this technique, which gives us access to full energy and momentum space, we aim to gain detailed information on the ZnO's exciton momentum and real-space properties (localized/delocalized/defect/etc.) and the accompanying exciton dynamics [4].

[1] Gierster et al., Nat Commun 12, 978 (2021)
[2] Foglia et al., Struct. Dyn. 6, 034501 (2019)
[3] Deinert et al., Phys. Rev. Lett. 113 057602 (2014)
[4] Reutzel et al., Advances in Physics X 9, 2378722 (2024)

O 23.16 Mon 18:00 P2

Towards momentum microscopy of plasmon excited WSe_2 — •Mattis Langendorf[1], Paul Werner[1], Marco Merboldt[1], Jan Philipp Bange[1], Wiebke Bennecke[1], Jonas Pöhls[1], Tobias Meyer[2], Thomas R. Weitz[1], Marcel Reutzel[1], and Stefan Mathias[1] — [1]Georg-August-Universität Göttingen, I. Physikalisches Institut, Germany — [2]Georg-August-Universität Göttingen, Institut für Materialphysik, Germany

Femtosecond momentum microscopy represents a uni measurement technique that effectively integrates the advantages of angle-resolved photoemission spectroscopy (ARPES) and photoelectron emission microscopy (PEEM) within a single microscope. The capacity to transition between real- and momentum-space imaging in time-resolved photoelectron spectroscopy enables the investigation of quasiparticles in both regimes [Bange et al., Nature Photonics, in press (2024)]. In this contribution, we pursue the characterization of electron-hole pairs, i.e. excitons, which were excited by a collective excitation of charge carriers, i.e. a surface plasmon polariton (SPP). In this approach, the propagating SPPs are imaged with photoemission electron microscopy, and the formation of excitons in the TMD is then visualized with time-resolved dark-field imaging techniques.

O 23.17 Mon 18:00 P2

Control and manipulation of low-energy electrons — •Dennis Epp[1], Frank Long[1,2], Benjamin Schröder[1], and Claus Ropers[1,2] — [1]Max-Planck-Institute for Multidisciplinary Sciences, Göttingen, Germany — [2]4th Physical Institute, University of Göttingen, Germany

In surface science and materials physics, electron pulses are a powerful probe of structural dynamics in time-resolved diffraction and microscopy experiments. A fundamental challenge lies in the Coulomb interaction [1] and initial energy distribution, which negatively affects the electron beam size and pulse duration after propagation towards the sample. Active control of electron pulse properties by compression schemes has proven to enhance temporal resolution [2-4]. This is particularly important for low-energy electrons and their high dispersion due to low propagation velocity [4]. In this paper, we demonstrate longitudinal and transversal phase-space manipulation of low-energy electron pulses using synchronized RF fields in the gigahertz frequency range [4]. Furthermore, novel beam shaping concepts including electron pulse streaking, compression and deflection are discussed.

[1] van Oudheusden, et al., Physical Review Letter 105, 264801 (2010). [2] Kassier, et al., Applied Physics B 109, 249-257 (2012). [3] Epp, et al., Structural Dynamics 11, 024306 (2024). [4] Haindl, et al., Nature Physics 19, 1410*1417 (2023).

O 23.18 Mon 18:00 P2

Band-resolved studies of laser-induced ultrafast dynamics in gold — •Stephanie Roden, Tobias Held, Sebastian T. Weber, and Baerbel Rethfeld — Department of Physics and Research Center OPTIMAS, RPTU in Kaiserslautern

The irradiation of a metal with a short-pulsed optical laser leads to the excitation of electrons, which absorb energy in accordance with their orbital characteristics. To analyze the resulting state of thermodynamic non-equilibrium, the thermalization of the excited electrons and relaxation processes with the phonon system to a joint temperature can be calculated in a kinetic manner by coupled Boltzmann collision integrals.

In this work we extend our existing energy-resolved model based on one effective band for the electrons [1] to a two-band model for a thin metal film that distinguishes between the free sp- and more localized d-electrons [2]. By considering the different electron bands separately, we can investigate the influence of intra- and interband relaxation in the electron system on the dynamics of the entire sample. We are focusing especially on the effect on the band occupation and the coupling strengths between the electron systems and the phonons.

[1] B. Y. Mueller and B. Rethfeld, PRB 87, 035139 (2013)
[2] T. Held, S. T. Weber, and B. Rethfeld, Journal of Physics: Condensed Matter (2025)

O 23.19 Mon 18:00 P2

Ultrafast intra- and interlayer charge transfer at the FePc/WSe_2 interface — •Gregor Zinke[1], Sebastian Hedwig[1], Benito Arnoldi[1], Martin Anstett[1], Lu Lyu[1,2], Martin Aeschlimann[1], and Benjamin Stadtmüller[1,2] — [1]Department of Physics and Research Center OPTIMAS, RPTU Kaiserslautern - Landau, Erwin-Schroedinger-Straße 46, 67663 Kaiserslautern, Germany — [2]Experimental Physics II, Institute for Physics, University of Augsburg, Universitätsstraße 1, 86159 Augsburg

Tailoring the optoelectronic properties of 2D-van-der-Waals materials by material design is a promising approach for functionalizing charge and spin carriers in low-dimensional materials. In this work, we demonstrate how optically excited ultrafast charge carrier dynamics of TMDCs can be altered by the formation of molecule/2D material heterostructures. Here, we focus on an ordered FePc monolayer film deposited on the surface of a bulk WSe_2 crystal. Using time- and angle-resolved photoemission in a VIS-pump, XUV-probe setup, we will elucidate the ultrafast response of the electronic system to an optical excitation on fs-timescales. Of particular interest is the investigation of intra- and interlayer charge carrier dynamics at the FePc / WSe_2 interface, which can be disentangled by the characteristic momentum space signatures of the WSe_2 Bloch-like states and molecular orbitals. We will further illustrate the impact of ultrafast charge sepa-

ration across the interface on transient changes of the interfacial energy level alignment.

O 23.20 Mon 18:00 P2

Influence of ballistic electrons on temperature equilibration in bulk gold — •Lukas Jonda, Tobias Held, Markus Uehlein, Christopher Seibel, Sebastian T. Weber, and Baerbel Rethfeld — Department of Physics andResearch Center OPTIMAS, RPTU Kaiserslautern-Landau

During femtosecond laser irradiation of gold, electrons are excited to a state of non-equilibrium in space and energy. Highly excited electrons transport energy ballistically into the bulk due to their relatively long mean free path. On a picosecond timescale, electrons transfer energy to the crystal lattice via electron-phonon collisions.

The objective of this study is to analyze the influence of non-equilibrium electrons on energy transport. Therefore, a two-temperature model will be coupled with a kinetic Monte Carlo simulation. With the former we describe diffusive transport as well as the electron-phonon equilibration, while the latter describes the primary electron excitation by the laser pulse, secondary electron generation, and transport of non-equilibrium electrons above the Fermi level.

O 23.21 Mon 18:00 P2

Hot carrier dynamics and band gap formation in lead intercalated graphene on Ni(111) — Martin Mitkov[1], Lu Lyu[2], Eva Walther[1], Martin Anstett[1], •Alexander Schmid[2], Christina Schott[1], Gyula Halasi[3], Nikolett Oláh[3], Csaba Vass[3], Zoltán Filus[3], László Óvári[3], Martin Aeschlimann[1], and Benjamin Stadtmüller[2] — [1]RPTU Kaiserslautern-Landau — [2]University of Augsburg — [3]ELI ALPS, Szeged, Hungary

The intercalation of atoms between 2D materials and surfaces offers an intriguing opportunity to tune spin functionalities at surfaces. The combination of heavy metal atoms and magnetic surfaces allows to tune the band structure of 2D materials through the interplay of spin-orbit coupling and magnetic proximity effects. In this poster, we present our recent findings on the band structure and hot electron dynamics of a Pb-intercalated graphene layer on Ni(111).

The highly reactive Ni substrate causes a charge transfer into the graphene layer, which leads to n-doped Dirac cones. Pb intercalation leads to a decoupling of the graphene, resulting in a quasi-free standing graphene layer on Ni.

Our time-resolved momentum microscopy experiment allows us to determine the influence of Pb intercalation on the ultrafast carrier dynamics of the Gr/Ni(111) interface. We discuss the momentum space distribution of the optically excited carriers at the K-point for the bare and Pb intercalated graphene and present indications for a modification of the magnetization dynamics of the Ni substrate by energy and charge transfer from the Pb-intercalated graphene.