O 57: Surface dynamics II

Time: Wednesday 15:00–17:30 Location: H40

O 57.1 Wed 15:00 H40

Time-Resolved XUV pump probe measurements on Surfaces using High Harmonic Radiation — •Thorben Haarlammert[1], Carsten Winter[1], Luca Bignardi[2], Petra Rudolf[2], and Helmut Zacharias[1] — [1]Physikalisches Institut, Westfälische Wilhelms Universität, Münster — [2]Zernike Institute for Advanced Materials, University of Groningen

We have developed an experimental set-up for time-resolved photoelectron spectroscopy at surfaces using High Order Harmonics of a Ti:Sapphire laser. By employing a LN_2 cooled laser amplifier system operating with repetition rates of up to 10 kHz fast and stable delay scans can be collected. The set-up allows for time-resolved pump and probe measurements with ultra-short pump pulses in the IR, visible or UV spectral range and ultra-short XUV probe pulses at the 25th harmonic order at 39 eV. The duration of the XUV pulses was estimated using the laser assisted photoelectric effect (LAPE). Measurements were performed on single layer Graphene on a Ni (111) crystal surface. First time-resolved results will be presented. In addition, a combination of a toroidal grating and the mirror monochromator allows for conventional angle resolved photoelectron measurements (ARUPS) at different photon energies in the spectral range between 20 eV and 110 eV by applying different Harmonic Orders.

O 57.2 Wed 15:15 H40

Dependence of thermal CO diffusion on Cu(111) on local coverage — •Christopher Zaum, Kastur Meyer-auf-der-Heide, and Karina Morgenstern — Institut für Festkörperphysik, Abteilung ATMOS, Gottfried Wilhelm Leibniz Universität, Appelstr. 2, D-30167 Hannover, Germany

Because of its importance as reactant in several catalytic reactions, carbon monoxide is often used in exemplary surface science studies. In order to investigate the diffusion of this molecule, we deposited CO molecules on a clean Cu(111) surface held at 22K and recorded several image series for dynamic analysis in a temperature range from 40K to 60K with a low-temperature scanning tunneling microscope. The diffusion of single CO molecules at low local coverages follows an Arrhenius law. At higher local coverages next-neighbor interactions influence the diffusion by increasing the local diffusion rates. We will discuss quantitatively the dependence of the diffusivity of single CO molecules on their local environment.

O 57.3 Wed 15:30 H40

Desorption of ionic species from ice/graphite by femtosecond XUV free electron laser pulses — •Björn Siemer[1], Tim Hoger[1], Robert Frigge[1], Sebastian Roling[1], Rolf Mitzner[2], Rolf Treusch[3], Stefan Düsterer[3], and Helmut Zacharias[1] — [1]Westfälische Wilhelms-Universität, Münster,Germany — [2]Helmholtz Zentrum Berlin, Berlin,Germany — [3]DESY, Hamburg, Germany

The interaction of high-energy photons in the soft x-ray regime with surface systems may lead to new and unexpected results due to the large number of accessible product states. In the past this photon energy regime has mainly been investigated using synchrotron radiation sources. The development of the Free Electron Laser at Hamburg (FLASH) now opens a new area in this spectral range. It provides pulsed radiation in the photon energy range from 20 to 200 eV, with pulse energes of tens of microjoule and a pulse duration of 20 to 50 fs.

We want to present first results from our recent measurement session. Highly-oriented pyrolytic graphite (HOPG) surfaces covered with D_2O are irradiated and desorbing products are analyzed. Ionic species are formed by the FEL radiation on the surface and directly emitted from the graphite. The O_2^+ yield shows a highly nonlinear dependence on the FEL intensity. This opens the way to non-linear correlation measurements with an autocorrelator using two FEL pulses synchronized on a femtosecond time scale. First results from these two-pulse correlation measurements in the soft x-ray regime are reported.

O 57.4 Wed 15:45 H40

ZEITAUFGELÖSTE ELEKTRONENBEUGUNG AN DÜNNEN METALLFILMEN — •Manuel Ligges, Carla Streubühr, Thorsten Brazda, Ping Zhou und Dietrich von der Linde — Fakultät für Physik, Universität Duisburg-Essen, Duisburg, Deutschland

Bei der Bestrahlung von Festkörpern mit ultrakurzen (fs) Laserimpulsen wird primär das elektronische System angeregt, währen das Gitter zunächst kalt bleibt. Die Elektron-Phonon-Wechselwirkung bewirkt einen Energiübertrag an das Gitter, so dass dieses sich aufheizt. Diese Aufheizung erfolgt typischerweise innerhalb von einigen Pikosekunden. Die zeitliche Entwicklung der Gitteranregung lässt sich durch Beugungsexperimente mit Hilfe des Debye-Waller-Effektes verfolgen.

Wir haben in zeitaufgelösten Elektronenbeugungsexperimenten die schnelle Gitteraufheizung in dünnen Gold-, Silber- und Kupferfilmen nachgewiesen [1]. Die aus den experimentellen Daten ermittelten Zeiten für den energetischen Austausch stimmen mit theoretischen Rechnungen [2] im Rahmen eines einfachen Zwei-Temperatur-Modelles [3] überein.

[1] M. Ligges, I. Rajkovic, P.Zhou, O. Posth, C. Hassel, G. Dumpich, and D. von der Linde, Appl. Phys. Lett 94, 101910 (2009) [2] Z. Lin, L. V. Zhigilei, and V. Celli, Phys. Rev. B. 77, 075133 (2008) [3] S. I. Anisimov, B. L. Kapeliovich, and T. L. Perelman, Sov. Phys. JETP 39, 375 (1974)

O 57.5 Wed 16:00 H40

Ultrafast melting of orbital and charge order in magnetite — •Niko Pontius[1], Torsten Kachel[1], Hermann A. Dürr[1], Christian Schüssler-Langeheine[2], Bill Schlotter[3], Martin Beye[3], Florian Sorgenfrei[3], Alexander Föhlisch[1,3], and Wilfried Wurth[3] — [1]Helmholtz-Zentrum Berlin, BESSY II, 12489 Berlin — [2]Physikalisches Institut, Universität zu Köln, 50937 Köln — [3]Institut für Experimentalphysik, Universität Hamburg, 22761 Hamburg

At 120K magnetite (Fe_3O_4) undergoes a metal-to-insulator transition (the famous Verwey transition [1]) which is accompanied by a transition from a charge and orbital ordered state below the transition temperature to a state without electronic order [2]. Until today the question whether this transition is driven by the lattice or by electronic degrees of freedom remains unanswered. We studied this transition using time-resolved resonant soft x-ray diffraction (RSXD) at the free electron laser FLASH in Hamburg. Thus we get direct insight into the "melting" of charge and orbital order after selectively exciting the electronic system by an infrared fs-laser pulse from below the transition temperature. The experimental data reveal an unexpectedly slow melting on a time scale of $\approx$ 500 fs. This suggests that the melting process is limited by a rearrangement of the lattice. Moreover, by performing time-resolved spectroscopy on the RSXD-reflection peak at the oxygen K-edge we observe the narrowing of the band gap during the melting process.

[1] E.J.W. Verwey, Nature 144, 327-328 (1939)
[2] J. Schlappa et al. , Phys. Rev. Lett. 100, 026406 (2008)

O 57.6 Wed 16:15 H40

Investigation of thin Cu films on Fe/Pd and their dynamics with Positron annihilation induced Auger electron spectroscopy — •Jakob Mayer[1,2], Klaus Schreckenbach[1,2], and Christoph Hugenschmidt[1,2] — [1]TU München, Lehrstuhl E21, James-Franck Straße, 85748 Garching — [2]ZWE FRM-II, Lichtenbergstr. 1, 85747 Garching

Positron annihilation induced **A**uger **E**lectron **S**pectroscopy (PAES) is a powerful technique to investigate the topmost atomic layer of a sample. This is due to the different hole creation process by positron electron annihilation and due to the trapping of the positron at the surface of the sample. With conventional positron beam setups the measurement time for one PAES-spectrum amounted to several days. Now, with the highly intense positron beam NEPOMUC at the FRM-II in Munich ($9 \cdot 10^8 \frac{e^+}{s}$), it is possible to record a PAES spectrum within less than one hour. For the first time we succeeded to observe dynamic processes at the surface with PAES. Measurements of thin Cu layers (0.3-4ML) on Fe and Pd samples will be presented and the higher surface selectivity of PAES compared to conventional EAES will be shown. Furthermore, diffusion of Cu into the bulk of Pd was observed.

O 57.7 Wed 16:30 H40

Vibrational Spectroscopy of Copper on Cu(111) — •Olaf Skibbe, Heiner Maslosz, Jan Pischel, Diana Vogel, and Annemarie Pucci — Kirchhoff-Institut für Physik, Im Neuenheimer Feld

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It is known from literature that on some stepped copper surfaces vibrations exist at energies significantly above that of the bulk phonon band [1]. By use of high-resolution electron energy loss spectroscopy (HREELS) we found for sub-monolayer amounts of copper evaporated to the cooled Cu(111) surface vibrations at even higher energies (50% above the highest bulk phonon energy). It could be shown that the vibration is polarized perpendicularly to the surface. The vibrational energy shifts slightly upon annealing, and the peak disappears at temperatures above 200 K. Additional measurements of the work function change upon annealing have been performed.

In addition, to clarify data analysis, we examine the interaction of typical molecules from the residual gas (such as CO and O_2) with the roughened surface.

Since it is known that roughened surfaces provide a higher chemical activity than pristine single crystal surfaces, we hope to gain deeper insight in the interaction of molecules with defect-rich surfaces via the observation of the extra-ordinary high energy vibrational mode.

[1] A. Kara, P. Staikov, T.S. Rahman, J. Radnik, R. Biagi, and H.-J. Ernst. Phys. Rev. B 61(8):5714-5718, 2000.

O 57.8 Wed 16:45 H40

Vanadium Oxide on Rh(111): Formation of stripe patterns under reaction conditions — •Florian Lovis[1], Ronald Imbihl[1], Benjamin Borkenhagen[2], and Gerhard Lilienkamp[2] — [1]Institut f. Physikalische Chemie u. Elektrochemie, Leibniz-Universität Hannover, Callinstr. 3-3A, 30167 Hannover — [2]Institut f. Energieforschung u. Physikalische Technologien, Technische Universität Clausthal, Leibniz-Str. 4, 38678 Clausthal-Zellerfeld

Ultrathin films (< 1 ML) of vanadium oxide (VO_x) have been deposited on Rh(111). When subjected to the $H_2 + O_2$ reaction at 500°C in the 10^{-4} mbar range, stripe patterns on a micrometer scale form on the surface, consisting of VO_x-covered metal with bare Rh(111) in between. These are investigated under reaction conditions employing PEEM (PhotoEmission Electron Microscopy) and LEEM (Low Energy Electron Microscopy) as spatially resolving methods. The characteristic lenght depends on p and T, while the direction of the stripes on the isotropic Rh(111) surface is controlled by the step direction: While the stripes are initially formed perpendicular to the step direction, certain reaction conditions may also enforce a stripe direction parallel to the step edges. Since the stripe patterns have an intrinsic wavelenght and only form under reaction conditions, they are considered as a Turing-like non-equilibrium structure.

O 57.9 Wed 17:00 H40

Mechanically induced grain boundary motion in Al-bicrystalls — •Tatiana Gorkaya, Dmitri A. Molodov, and Günter Gottstein — Institut für Metallkunde und Metallphysik der RWTH Aachen, Aachen, Deutschland,

The mechanically induced migration of planar grain boundaries in Al-bicrystals was experimentally measured. The novel tensile/compression module for scanning electron microscope was utilized for in-situ measurements of grain boundary motion at elevated temperatures. From the measured temperature dependence of boundary mobility the migration activation parameters for investigated boundaries were determined. Normal boundary motion was observed to be coupled to a shear of the crystal in the region traversed by the grain boundary during its motion. The measured ratios of the normal grain boundary motion to the lateral translation of grains were compared with geometrical models of stress induced boundary migration.

O 57.10 Wed 17:15 H40

Stochastic field equation for pattern formation on ion-beam eroded surfaces — •Karsten Dreimann and Stefan Linz — Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Straße 9, 48149 Münster

A recently proposed continuum model [1] for the formation of surface patterns on semiconductor surfaces generated by low-energy ion-beam erosion under normal ion incidence is studied in numerical detail. After transformation, this model takes on the form of a stochastic damped isotropic Kuramoto-Sivashinsky equation. Primary focus of our investigation [2] is the theoretical analysis of the impact of stochastic fluctuations on the competition of flat, rough and hexagonal surface structures observed in the deterministic case. In particular for the dependence of the surface roughness on the fluctuation strength, we identify distinct regimes with different scaling behavior that reflect different surface patterns.

[1] S. Vogel, S.J. Linz, Europhys.Lett. **76**, 884-890 (2006)
[2] K. Dreimann, S.J. Linz, unpublished