O 62: Surface Dynamics

Time: Tuesday 18:30–20:30 Location: P2-OG2

O 62.1 Tue 18:30 P2-OG2

Photon-induced desorption from interstellar ices using XUV free-electron laser pulses — •John Thrower, Tushar Suhasaria, Robert Frigge, Sebastian Roling, and Helmut Zacharias — Physikalisches Institut, Westfälische Wilhelms-Universität Münster, Germany

Solid state processes occurring on grain surfaces play an important role in the chemistry of the interstellar medium. In dense molecular clouds, the low temperature (ca. 10 K) grains are coated with a layer of H_2O dominated ice doped with additional species such as CO, CO_2, CH_4 and NH_3. In photon-dominated regions, as well as in accretion disks, these ices are bathed in a flux of UV photons which can lead to the formation of more complex species as well as promoting desorption.

We have used the XUV pulses (40.8 eV) from the FLASH facility to promote photon-induced desorption from such ice films, namely CO and D_2O:CH_4, adsorbed at 18 K on a graphite substrate. Desorbing CO molecules were state-selectively detected, revealing that desorbing neutral CO molecules display a relatively low degree of rotational excitation (T_{rot} = 160 K) but are vibrationally hot ($T_{vib} \sim$ 1500 K), suggesting desorption via a CO^- intermediate.

Irradiation of D_2O:CH_4 ice resulted in the desorption of simple ionic fragments from the deposited species, methane recombination products up to $C_3H_x^+$, and carbon clusters, C_n, up to n=11. The latter display a highly non-linear (m=5) dependence on the incident laser intensity, permitting investigation of the underlying ultrafast dynamics using two-pulse time-correlated desorption.

O 62.2 Tue 18:30 P2-OG2

Energy dissipation at metal surfaces: The surprisingly high non-adiabaticity of Na diffusion on Cu(111) — •Simon P. Rittmeyer and Karsten Reuter — Technische Universität München

The role of electron-hole pair excitations during dynamical surface processes on metal substrates has been controversially discussed. With high-level non-adiabatic calculations still intractable for extended metal surfaces, the concept of electronic friction within the local density friction approximation (LDFA) offers approximate, but numerically highly efficient insight.

We have recently shown this approach to yield reasonable results for the vibrational damping of high-frequency adsorbate vibrations on various metal surfaces [1]. With this confidence we now apply it to thermal surface diffusion, where non-adiabatic energy losses are expected to clearly compete with energy losses due to phononic coupling. In order to quantitatively disentangle these dissipation channels, we compare LDFA-based Langevin molecular dynamics simulations for Na on Cu(111) to experimental signatures obtained from state-of-the-art ^{3}He spin echo measurements [2]. Despite the minimal electronic friction coefficient of Na and the relatively small mass mismatch to Cu promoting efficient phononic dissipation, we find that a surprisingly high amount of about 20% of the total energy loss is attributable to electronic friction.

[1] S.P. Rittmeyer *et al.*, Phys. Rev. Lett. **115**, 046102 (2015).
[2] S.P. Rittmeyer *et al.*, Phys. Rev. Lett. **117**, 196001 (2016).

O 62.3 Tue 18:30 P2-OG2

A test experiment to determine the long term behaviour of work function and quantum efficiency of gold surfaces — •Kerstin Schönung and KATRIN Collaboration — Max-Planck-Institut für Kernphysik, Postfach 10 39 80, 69029 Heidelberg

The KArlsruhe TRItium Neutrino experiment KATRIN will perform a model-independent measurement of the effective neutrino mass by examining the β-electron energy spectrum of a gaseous molecular tritium source (WGTS). To achieve the desired sensitivity of 0.2 eV/c^2 (90 % C.L.) the plasma potential of the tritium gas must be temporally and spatially stable within 20 meV. In order to achieve this stringent stability requirement the work function of the so called Rear Wall, which terminates the tritium volume at its rear end and defines the plasma potential therein, must be known even more precisely. The temporal fluctuations must be investigated. In addition to the work function fluctuations, the charge of the plasma in the tritium source could increase over time by the remaining positive ions produced by the tritium decays. In order to prevent this charging and the subsequent inhomogeneity of the plasma potential, the gold surface of the Rear Wall will be used to emanate electrons by the photoelectric effect. For a proper design of the required light source the quantum efficiency of the Rear Wall surface and its stability has to be determined.

A new experiment which investigates both, the in-situ work function and the quantum efficiency of the Rear Wall surface, is currently built up at KIT. In addition to the setup, first results will be presented. We acknowledge the support of the BMBF (05A14VK2).

O 62.4 Tue 18:30 P2-OG2

Charge density wave domain growth in 1T-TaS2 mapped by ultrafast LEED — •Theo Diekmann[1], Simon Vogelgesang[1], Gero Storeck[1], Sebastian Schramm[1], Max Gulde[1], Gerrit Horstmann[1], Kai Rossnagel[2], Sascha Schäfer[1], and Claus Ropers[1] — [1]IV. Physical Institute - Solids and Nanostructures, University of Göttingen, Germany — [2]Institute for Experimental and Applied Physics, University of Kiel, Germany

We developed an ultrafast low-energy electron diffraction (ULEED) setup for the study of time-resolved structural dynamics at surfaces, extending our previous ULEED-experiments operating on ultrathin films in transmission [1]. To this end, a nanoscopic needle emitter is utilized in a miniaturized electrostatic lens geometry as a high-brightness source providing well-collimated electron pulses with a minimal duration of 16 picoseconds at the sample and electron energies in the range of 50-200 eV.

In a first application of this setup, we study the structural phase transition from the room-temperature nearly commensurate (NC) to the incommensurate (IC) charge density wave phase at the surface of 1T-TaS2 [2]. Following intense optical excitation, we observe the formation and consecutive growth of IC domains by a thorough analysis of time-dependent diffraction spot profiles. Our results demonstrate the potential of ULEED for the study of complex ultrafast structural and electronic processes at surfaces.

[1] M. Gulde et al., Science 345, 200 (2014)
[2] K. Haupt et al., Phys. Rev. Lett. 116, 016402 (2016)