

O 71: Surface Dynamics

Time: Wednesday 18:15–21:00

Location: Poster A

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Femtosecond Laser-induced Desorption of Atomic and Molecular Hydrogen Isotopes from Graphite — ●ROBERT FRIGGE, JOHN D. THROWER, and HELMUT ZACHARIAS — Physikalisches Institut, Universität Münster, Germany

In the interstellar cycle of matter the formation of molecular hydrogen by recombination of adsorbed atoms on dust particles is an important process. In photon dominated regions this process is likely to be induced by radiation. Here, we examine the desorption of H and H₂ from HOPG following surface excitation with fs-laser pulses at $\lambda = 400$ nm. Desorbed neutral species are analyzed by state-selective ionization and a time-of-flight detector. The desorbing H atoms show three different kinetic energy distributions, while for H₂ only a very low energy distribution with $\langle E_{kin} \rangle = 60$ meV is found. Electron scattering calculations [1] have been performed, taking into account different H-graphite adsorption potentials appropriate for different adsorption sites (para-, ortho- configuration) [2]. A nonlinear fluence dependence of the atomic desorption yield allows two-pulse correlation measurements. For the para-sites a FWHM of 600 fs can be explained by coupling the desorption to electrons, while the ortho-sites yield a distribution with a dip at 1 ps which cannot be explained by this model. We consider the possibility that the excitation of optical phonons, which occurs within 1 ps [3], is responsible for this dip.

[1] R. Frigge et al., Phys. Rev. Lett., **104**, 256102 (2010)

[2] L. Hornekær et al., Phys. Rev. Lett., **97**, 186102 (2006)

[3] M. Breusing et al., Phys. Rev. Lett., **102**, 086809 (2009)

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Thermal desorption studies of ammonia from single crystal and polycrystalline forsterite — ●TUSHAR SUHASARIA, JOHN THROWER, and HELMUT ZACHARIAS — Physikalisches Institut, WWU Münster, Germany

Olivine [Mg_{2-x}Fe_{2-2x}SiO₄] is an abundant silicate mineral that constitutes a major component of interstellar dust grains [1]. Forsterite [Mg₂SiO₄], the magnesium rich member of the olivine family, is the most abundant of crystalline silicates as suggested by the infrared space observatory (ISO) mission [2]. In cold, dense molecular clouds, various molecules collide with and stick to these dust grains and form icy mantles. Forsterite can thus be used as chemically simple dust grain model to understand the interaction between these adsorbed molecules and the grain surface. In the present work we use temperature programmed desorption (TPD) to investigate the desorption kinetics of ammonia (NH₃) ices on both single crystal and polycrystalline forsterite surfaces. A desorption energy of 25.8 kJmol⁻¹ was obtained for multilayer NH₃ desorption from both surfaces. For the low coverage regime, a distribution of binding energy sites on the forsterite surface was revealed, depending on the nature of the surface. These desorption kinetics parameter are useful to be incorporated into chemical models [3] to understand the gas-grain interaction in more details.

1. Campins, H., & Ryan, E. V. 1989, *Astrophys. J.*, **341**, 1059.

2. Molster, F. J., Waters, L. B. F. M., & Tielens, A. G. G. M. 2002, *Astron. Astrophys.*, **382**, 222.

3. Garrod, R. T., 2013, *Astrophys. J.*, **765**, 60

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The role of non-equilibrium dynamics in photo-induced phase transitions of correlated materials — ●S. EICH¹, S. MATHIAS¹, J. URBANCIC¹, A.V. CARR², A. STANGE³, S. MICHAEL¹, T. POPMINTCHEV², T. ROHWER³, M. WIESENMAYER¹, A. RUFFING¹, S. JAKOBS¹, S. HELLMANN³, P. MATYBA², C. CHEN², L. KIPP³, M. BAUER³, M.M. MURNANE², H.C. SCHNEIDER¹, K. ROSSNAGEL³, H.C. KAPTEYN², and M. AESCHLIMANN¹ — ¹TU Kaiserslautern and Research Center OPTIMAS, 67663 Kaiserslautern, Germany — ²JILA, University of Colorado and NIST, Boulder, Colorado 80309-

0440, USA — ³Institute of Experimental and Applied Physics, University of Kiel, 24098 Kiel, Germany

We use femtosecond extreme-ultraviolet time- and angle-resolved photoelectron spectroscopy to study the ultrafast photo-induced suppression of the charge-density wave (CDW) in 1T-TiSe₂. In the following non-equilibrium electron dynamics after femtosecond laser excitation, we see that hot-carrier multiplication is the primary driver for the ultrafast CDW suppression. As soon as the optically excited carriers have relaxed to a quasi-equilibrium hot Fermi-distribution electron gas, the CDW suppression stops. Theoretical calculations of the hot-carrier scattering processes and the screening properties further link the carrier multiplication to the observed CDW gap dynamics.

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Switching single azobenzene-based molecules by STM — ●SIMON JAEKEL¹, KNUD SEUFERT¹, CHRISTOPHE NACCI¹, STEFAN HECHT², and LEONHARD GRILL¹ — ¹Department of Physical Chemistry, University of Graz, Austria — ²Department of Organic Chemistry, Humboldt Universität zu Berlin, Germany

Molecular switches, i.e. molecules that exhibit at least two stable states * each with characteristic physical/chemical properties * that can be achieved reversibly by an external stimulus, represent an interesting class of functional molecules since they allow to get detailed insight in a basic chemical process, which is also relevant in biological processes. Furthermore, they are key in the field of Molecular Electronics that is based on the ultimate miniaturization of electronic devices down to the level of single molecules. Various molecular switches have been studied in the last years, many of them based on azobenzene, a prototype of a molecular switch that exhibits a trans and a cis isomer with different electronic structure and absorption behavior. The switching process can be induced either by light, by the tunneling electrons or the electric field in the junction of a scanning tunneling microscope (STM) [1,2]. Here, we present new results on a new type of azobenzene derivatives that are strongly decoupled from the metallic surface by additional side groups. Accordingly, we find a very different adsorption behavior since the molecule-surface interaction is strongly reduced and successfully observe switching processes.

[1] Choi et al., Phys. Rev. Lett. **96**, 156106 (2006); [2] M. Alemani et al., J. Am. Chem. Soc., **128** (45), 14446 (2006);

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The optical pump - X-Ray probe option of the LISA Liquid Surface Diffractometer — ●JONAS WARIAS¹, CHRISTOPH LEMKE¹, MATTHIAS GREVE¹, BRIDGET MURPHY^{1,2}, and OLAF MAGNUSSEN^{1,2} — ¹Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Germany — ²Ruprecht Haensel Laboratory, Christian-Albrechts-Universität zu Kiel, Germany

The study of liquid surfaces and interfaces is of crucial importance for understanding many physical, chemical and biological phenomena. The LISA diffractometer [1], installed at the P08 beamline at the PETRA III synchrotron radiation source Hamburg, is a specialized instrument for hard X-ray scattering studies of liquid surfaces and interfaces. In the poster we describe ongoing work on extending this instrument's capabilities by an optical pump - X-ray probe option, which allows investigations of ultrafast processes at liquid interfaces. This includes installation of a 200 μ J pulse energy fs-laser providing wavelengths from 210 nm to 2600 nm and optics for directing the laser pulse on the sample surface. The setup takes advantage of the specific design of LISA, where all scattering studies in the range from 6.5 keV to 29 keV can be performed without moving the sample. It will allow structural studies of non-equilibrium nanoscale processes at liquid interfaces and langmuir films. We thank the BMBF (05K13FK2) for funding this project. [1] B.M. Murphy et al. J. Synchrotron Rad. **21** (2014) 45-46