

O 30 Adsorption an Oberflächen III

Zeit: Montag 10:45–13:00

Raum: TU EB301

O 30.1 Mo 10:45 TU EB301

Fully polarization resolved near edge x-ray absorption fine structure spectroscopy of hydrocarbons adsorbed on Si(001)-(2x1) — ●FRANZ HENNIES¹, ALEXANDER FÖHLISCH¹, ANNETTE PIETZSCH¹, MITSURU NAGASONO¹, NADINE WITTKOWSKI², STINA MATSSON³, MARIA-NOVELLA PIANCASTELLI³ und WILFRIED WURTH¹ — ¹Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, D-22761Hamburg — ²Laboratoire d'Optique des Solides, — ³Department of Physics, Uppsala University, Sweden

The adsorption of simple hydrocarbons on Si(001) has been used as a model system for the Si-C interaction and as such been focus of investigations for more than 20 years. Nevertheless the exact geometrical configuration and the symmetry of the electronic states of several of the investigated adsorbates are still under debate.

We present a fully polarization resolved near edge x-ray absorption fine structure spectroscopy (NEXAFS) study of the adsorption of ethylene, benzene and acetylene on the single domain Si(001)-(2x1) surface which was performed at MAXLab in Lund, Sweden. We give direct experimental proof for ethylene adsorbing in a rotated, so called "dimerized" structure [1]. For benzene, the "butterfly" adsorption model is correct [2]. Acetylene adsorbs at room temperature in more than one configuration [3]. This work has been supported by DFG Fo343/1-1.

[1] F. Hennies, A. Föhlisch et al., Surf. Sci. **529**, 144 (2003)

[2] N. Wittkowski, F. Hennies et al., Phys. Rev. B **68**, 115408 (2003)

[3] A. Pietzsch, F. Hennies et al., Surf. Sci. **562**, 65 (2004)

O 30.2 Mo 11:00 TU EB301

Calorimetric Measurements of the Heats of Adsorption of Aromatic Hydrocarbons on Pt(111) — ●J.M. GOTTFRIED^{1,2}, H. IHM², H.M. AJO², P. BERA², E.K. VESTERGAARD², and C.T. CAMPBELL² — ¹Lehrstuhl fuer Physikalische Chemie II, Universitaet Erlangen-Nuernberg, Egerlandstr. 3, D-91058 Erlangen — ²Department of Chemistry, Box 351700, University of Washington, Seattle, Washington 98195, USA

The heats of adsorption of benzene and naphthalene on clean Pt(111) at 300 K were measured by microcalorimetry [1]. The initial heats of adsorption were found to be 197 kJ/mol and 314 kJ/mol, respectively. Our data show that the initial and the integral heats are proportional to the number of carbon atoms in these aromatic systems, which lie parallel to the surface. Each bond between a sp² hybridized C atom and the surface contributes 30 kJ/mol to the initial heat and 23 kJ/mol to the integral heat at 0.75 ML. Thus, our results disagree with recent DFT calculations [2], in which an integral heat of only 11 kJ/mol per C atom at 0.75 ML was obtained. Sticking probabilities were measured by a modified King and Wells method, giving initial values of 0.97 (benzene) and 0.99 (naphthalene). For both molecules, the sticking probability shows a Kisliuk-type behavior with increasing coverage, which implies that there are precursors to sticking, whose energetics have also been addressed. [1] H.M. Ajo, H. Ihm, D.E. Moilanen, C.T. Campbell, Rev. Sci. Instrum. **75** (2004) 4471. [2] C. Morin, D. Simon, P. Sautet, J. Phys. Chem. B **108** (2004) 12084.

O 30.3 Mo 11:15 TU EB301

Structural transition in Cyclooctatetraene adsorbed on Ru(001) probed by thermal desorption and two-photon photoemission spectroscopy — ●P. TEGEDER, M. DANCKWERTS, S. HAGEN und M. WOLF — Freie Universität Berlin

The adsorption behavior of 1,3,5,7-Cyclooctatetraene (COT) on Ru(001) from sub-monolayer coverages up to the multilayer regime has been studied by temperature-programmed desorption (TPD) and work function measurements. The electron dynamics at the COT/Ru(001) interface has been investigated using time- and angle-resolved two-photon photoemission (2PPE) spectroscopy. The TPD data show that COT films grow at 115 K in a metastable phase when the coverage is increased from the chemisorbed monolayer to the bulklike molecular multilayer structure. The metastable states desorb at a temperature which is ~ 9 K lower than the multilayer, followed by an irreversible and thermally activated transformation into a stable multilayer phase. This transition occurs at 165±2 K and is accompanied by the appearance of image potential states and a pronounced increase of the total electron yield in 2PPE by more than one order of magnitude. The image states have

binding energies of -0.70 eV and -0.24 eV for the $n=1$ and $n=2$ states, respectively, and a lifetime of 20±5 fs for both states. Their appearance is interpreted as an indication of island formation in the stable multilayer regime. 2PPE spectroscopy of the image potential states provides a sensitive probe of structural transitions in the adsorbate layers.

O 30.4 Mo 11:30 TU EB301

Adsorption geometry of hexafluorobenzene on the Cu(111) surface: A polarization dependent NEXAFS study — ●SETHURAMAN VIJAYALAKSHMI¹, ALEXANDER FÖHLISCH¹, FRANZ HENNIES¹, ANNETTE PIETZSCH¹, MITSURU NAGASONO¹, PATRICK KIRCHMANN², MARTIN WOLF², and WILFRIED WURTH¹ — ¹Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — ²Department of Physics, FU Berlin, Arnimallee 14, 14195 Berlin

The orientation of hexafluorobenzene (C_6F_6) molecules adsorbed on the Cu(111) surface has been studied by C K-edge near edge x-ray absorption fine structure spectroscopy (NEXAFS) for different adsorbate coverages. Photoelectron spectroscopy and temperature programmed desorption studies indicate distinct multilayer, bilayer, monolayer and half a monolayer phases. NEXAFS on these different coverages shows that the π^* absorption resonance has maximum intensity for the electric field vector perpendicular to the surface whereas it is substantially suppressed for the electric field vector in plane. Thus we propose that C_6F_6 molecules adsorb with the molecular plane parallel to the surface for all the investigated coverages. This observation differs from the adsorption of benzene where the molecules have random orientation in multilayers, interacting only through Van der Waals force. For C_6F_6 our results indicate a significant interaction between the C_6F_6 molecules leading to a preferential orientation in multilayers.

This work was supported by the Deutsche Forschungsgemeinschaft SPP1093.

O 30.5 Mo 11:45 TU EB301

Circular Dichroism in Core Level Photoemission from Tartaric Acid Adsorbed on Cu(110) — ●JEONGWON KIM, JAN HUGO DIL, THORSTEN KAMPEN, and KARSTEN HORN — Fritz-Haber-Institut der MPG, Berlin

The adsorption of chiral molecules is an important step in the heterogeneous catalytic conversion of pro-chiral reagents into one of the possible optical isomers. Hence the occurrence of a chiral preference in adsorbed molecules has recently received considerable attention. While the arrangement of chiral molecules into a symmetry-breaking supramolecular structure has been demonstrated in scanning tunnelling microscopy, a direct identification of the presence of chiral centers has so far not been achieved. Here we demonstrate circular dichroism in carbon 1s core level photoemission from the (R,R) and (S,S) enantiomers of tartaric acid [$HOOC - (CHOH)_2 - COOH$] adsorbed on Cu(110). The asymmetry in the core level spectra excited with right- and left circularly-polarized light is readily observed, and changes sign with the handedness of the radiation, or upon changing the nature of the enantiomers. We characterize the circular dichroism in order to differentiate between that induced by the handedness of the experimental geometry (CDAD) and that induced by the chiral center in the adsorbed molecule.

O 30.6 Mo 12:00 TU EB301

Observing enantio selective adsorption: D and L cysteine on Au(17 11 9) — ●RICHARD SCHILLINGER¹, JOACHIM WIDER^{1,2}, CHRISTOPH QUITMANN², and THOMAS GREBER¹ — ¹Universität Zürich, Winterthurerstrasse 190, 8057 Zürich, Schweiz — ²Paul Scherrer Institut, 5232 Villigen PSI, Schweiz

The conformation of chiral D and L cysteine (CYS) on the chiral gold surface Au(17 11 9) is directly determined by angle scanned x-ray photo electron diffraction (XPD).

This is realized by the use of a third generation synchrotron light source (the swiss light source), where the sensitivity of the experiments is pushed forward by two orders of magnitude.

For D and L cysteine we find in the 2π half space above the surface one single scattering maximum, though on different emission angles for L and D CYS, respectively. This demonstrates chiral hetero recognition, i.e. enantio selectivity of the S-kinks on Au(17 11 9).

O 30.7 Mo 12:15 TU EB301

Employing molecules as atomic assemblers under the tip of an STM — •LEO GROSS¹, FRANCESCA MORESCO¹, CHRISTIAN JOACHIM², ANDRÉ GOURDON², and KARL-HEINZ RIEDER¹ — ¹Institut für Experimentalphysik, Freie Universität Berlin, Arnimallee 14, D-14195 Berlin, Germany — ²The Nanoscience Group, CEMES-CNRS, 29 rue J. Marvig, P.O. Box 94347, F-31055 Toulouse Cedex, France

Large organic, custom designed molecules, called HB-HPB (hexa-tert-butyl-hexaphenylbenzene) on Cu(111) are investigated by means of LT-STM. In combination with STM manipulation techniques, the self-ordering properties of the molecules can be exploited to assemble molecules in defined molecular structures. Moreover, the molecules can be utilized to move and aggregate Cu adatoms. This is an example of a single molecular nano-machine, performing the task of an atomic assembler under the operation of the STM tip.

O 30.8 Mo 12:30 TU EB301

XPS study on thiol adsorption on noble metal clusters supported on carbon substrates — •MICHAEL BÜTTNER and PETER OELHAFEN — Institute of Physics, University of Basel, Klingelbergstr. 82, 4056 Basel, Switzerland

Submonolayers (0.1A to 1A) of noble metals (Au/Ag) have been deposited onto carbon substrates by means of thermal evaporation. After deposition, thiol vapor was introduced into the vacuum chamber through a leak valve to allow the molecules to adsorb on the metal surfaces. Thiols with long (hexadecanethiol) and short (propanethiol) chains were studied in this work. Additional annealing experiments were performed to investigate thiol desorption as a function of temperature. Between each preparation step the samples were measured with monochromated X-ray Photoelectron Spectroscopy (MXPS) and core-level spectra of the metal and the sulfur were obtained. MXPS valence-band spectra were taken to estimate the metal particle size and to monitor changes in the valence band shape and the Fermi edge upon thiol adsorption.

Shifts towards higher binding energy and changes in the line shape could be observed in the Au 4f core-level spectra after thiol adsorption. We will compare these findings with results for silver particles and comment on the influence of the thiol chain length.

O 30.9 Mo 12:45 TU EB301

Study of the intramolecular deformation of a Lander molecule during its Low Temperature STM manipulation on Cu(211) — •MICOL ALEMANI, FRANCESCA MORESCO, LEO GROSS, and KARL-HEINZ RIEDER — Inst. für Exp.physik, FU Berlin, Arnimallee 14, D-14195 Berlin

A detailed Low-Temperature Scanning Tunneling Microscope study of the controlled manipulation of a Lander molecule C₉₀H₉₈ adsorbed on Cu(211) is presented. By recording the tunneling current signal I(x) during the manipulation in constant-height-mode and by comparing it with calculations, we demonstrate that I(x) provides information on the mechanical movements of parts of the molecule that are not directly in interaction with the tip apex during the manipulation sequence. This is due to the fact that the intramolecular deformation induced by the manipulation can open other tunneling paths which are not directly located on the point of the molecule in close contact with the tip apex.