O 10: Metal substrates: Adsorption of organic / bio molecules II

Time: Monday 15:00–17:00 Location: TRE Phy

O 10.1 Mon 15:00 TRE Phy

Spin-sensitive tunneling through individual Terbium-Phthalocyanine Molecules by Spin-polarized Scanning Tunneling Microscopy — •Jörg Schwöbel[1], Yingshuang Fu[1], Andrew DiLullo[2], Jens Brede[1], Svetlana Klyatskaya[3], Mario Ruben[3,4], Germar Hoffmann[1], and Roland Wiesendanger[1] — [1]Institute of Applied Physics, University of Hamburg, Germany — [2]Nanoscale & Quantum Phenomena Institute, Ohio University, USA — [3]Karlsruhe Institute of Technology, Institute of Nanotechnology, Germany — [4]Université de Strasbourg, IPCMS, France

Terbium-Phthalocyanine double-decker molecules (TbPc2) belong to the class of single-molecule magnets, which could serve as the smallest building blocks of future information technology devices such as for quantum computers and data storage. Because of its high blocking temperature (>10 K), TbPc2 attracted considerable interests in recent years [1].

Here, we locally address TbPc2 adsorbed on a ferromagnetic surface (Co nanoislands) with spin-polarized scanning tunneling microscopy. We detect a significant spin contrast by tunneling through TbPc2 molecules with intramolecular resolution. Thereby, the spin-polarization depends on the energy and the position within the molecule.

We present our experimental data and discuss the origin of the magnetic contrast observed.

[1] Ishikawa, N.; Sugita, M.; Ishikawa, T.; Koshihara, S.; Kaizu, Y.; J. Am. Chem. Soc., 2003, 125 (29), pp 8694-8695

O 10.2 Mon 15:15 TRE Phy

Low Temperature Scanning Tunneling Microscopy Study of Co-Phthalocyanine Molecules on Au (111) and Cu (111) — •Samuel Bouvron[1], Philipp Erler[1], Stefan Ambrus[2], Mikhail Fonin[1], Frank Matthes[3], and Claus Michael Schneider[3] — [1]Fachbereich Physik, Universität Konstanz — [2]Fachbereich Chemie, Universität Konstanz — [3]Institut für Festkörperforschung, Forschungzentrum Jülich

Metal-phthalocyanines are complexes of great technological and fundamental interest which are already extensively used as pigments and are possible candidats for future applications in molecular electronic devices. For a better understanding of the interaction between metal-phthalocyanines and surfaces, we investigated Co-phthalocyanine molecules (CoPc) on Au (111) and Cu (111) at a submonolayer coverage by means of low-temperature scanning tunneling microscopy (STM) and spectroscopy (STS). The adsorption behavior of CoPc on both substrates is studied, and a direct observation of the molecular orbitals is reported. STS measurements performed above the CoPc molecules on Cu (111) show a reproducible feature directly below E_F, whose origin is discussed. Furthermore the impact of an external magnetic field (up to 6 T) on the electronic density of states close to E_F is studied.

O 10.3 Mon 15:30 TRE Phy

2D-self-assembly of chiral buckybowls — •Quirin Stoeckl[1], Tobias Bauert[1], Davide Bandera[2], Manfred Parschau[1], Jay S. Siegel[2], and Karl-Heinz Ernst[1] — [1]Empa, Nanoscale Material Science, Dübendorf, Switzerland — [2]Organisch-chemisches Institut, Universität Zürich, Switzerland

So-called buckybowls, quasi-fragments of buckminsterfullerene, are promising candidates for suface modifications for organic photovoltaics and controlled carbon nanotube growth. Corannulene (COR, $C_{20}H_{10}$) is the simplest curved fragment with a central C_5 ring, surrounded by five aromatic C_6 rings. We investigated the self-assembly of the C_5-symmetric pentaphenyl-corannulene (Ph_5Cor), a chiral derivative with five phenyl groups at the rim, on Cu(111). Fivefold symmetry is incompatible with the translational order in all 17 2D plane groups, and this system is therefore of fundamental interest for 2D self-assembly. STM shows packing motifs in which the five substituents are interdigitated and are compatible with LEED results. Workfuntion change measurements via UPS reveal an unusual large interface dipole. We compare our findings with those obtained for other penta-substituted COR derivatives on Cu(111) and present preliminary results for thermally-induced dehydrogenation into polymeric structures.

O 10.4 Mon 15:45 TRE Phy

Negative differential resistance of C60 islands in scanning tunneling spectroscopy — •I-Po Hong, Yongfeng Wang, and Richard Berndt — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel

Spectra of the differential conductance (dI/dV) of C_{60} layers on Cu(111) and on NaCl layers are investigated with a low temperature STM. In addition to various electronic states the spectra clearly show negative differential resistance (NDR). The presence of NDR depends on the thickness of the C_{60} layer. NaCl layers further modify the spectral structure. The experimental results are analysed using a double barrier model.

O 10.5 Mon 16:00 TRE Phy

Engineering Negative Differential Conductance in a single-C_{60} tunnel junction — •Benjamin W. Heinrich[1,2], Mircea V. Rastei[1], Deung-Jang Choi[1], Jean-Pierre Bucher[1], Thomas Frederiksen[3], and Laurent Limot[1] — [1]Institut de Physique et Chimie des Matériaux de Strasbourg, CNRS, Strasbourg, France — [2]Institut für Experimentalphysik, Freie Universität Berlin, Germany — [3]Donostia International Physics Center, San Sebastián, Spain

Negative differential conductance (NDC) occurs when a voltage increase across an electronic device produces a decreasing current. The last two decades have seen a revived interest in this field following the observation of NDC at the atomic scale and in hybrid metal-organic junctions, which are potentially interesting for molecular electronics. The NDC characteristics in molecular systems are usually attributed to localized energy states, but can also result from inelastic or chemical processes.

Here we use a cryogenic STM to engineer an NDC with a single C_{60} molecule attached to the tip of the microscope. The original aspect of the observed NDC is that it results from electrons tunneling between the LUMO+1 of C_{60} and the dispersive Shockley surface states of Cu(111). The NDC intensity can then be tuned by varying the barrier thickness or by changing the C_{60} orientation up to complete extinction. In particular, this study underlines how the k-dependence of the tunneling process may be altered through the orientation of a molecular orbital: a single molecule acts as a k-filter for tunneling electrons.

O 10.6 Mon 16:15 TRE Phy

Scanning tunneling spectroscopy and microscopy of α-sexithiophene films on Au(100) — •Rene Hammer, Anke Höfer, Klaus Duncker, and Wolf Widdra — Martin-Luther-Universität Halle-Wittenberg, Institute of Physics, Halle(Saale), Germany

The electronic and the structural properties of epitaxially grown ultrathin films of α-sexithiophene (6T) on Au(100) have been studied by scanning tunneling spectroscopy (STS) and microscopy (STM) at 80 K. The structure of the well-ordered first monolayer grown at 300 K and then cooled to 80 K is nearly identical to the structure reported at 300 K [1]. Subsequent growth proceeds layer-by-layer with flat-lying 6T molecules forming parallel molecular rows also in the second monolayer. Two rotational domains with an angle of 14° in between are found. The row direction in the second monolayer is parallel to the rows of the first layer underneath. STS spectra of the first and second 6T monolayer allow the determination of the lowest unoccupied molecular orbital (LUMO) at 1.2 eV, the LUMO+1 at 1.8 eV and the LUMO+2 at 2.4-2.5 eV with respect to the Fermi level. Additionally the second monolayer exhibits a strong STS feature at 2.15 eV. The highest occupied molecular orbital (HOMO) is found at -1.0 and -1.5 eV for the first and second monolayer, respectively. Mapping of the differential conductivity gives hints to the electron density within these orbitals which will be compared to calculated wavefunctions.

[1] A. Höfer, K. Duncker, M. Kiel, S. Wedekind, and W. Widdra, Phys. Rev. B (submitted)

O 10.7 Mon 16:30 TRE Phy

α-sexithiophene on silver: The influence of the surface miscut — •Thorsten Wagner, Daniel Roman Fritz, and Peter Zeppenfeld — Institute of Experimental Physics at the Johannes Kepler University Linz, Austria

The growth of α-sexithiophene (α-6T) on Ag(110) and Ag(441) was studied by means of scanning tunneling microscopy (STM) and photoelectron emission microscopy (PEEM). In contrast to (110) surfaces of other metals, α-6T molecules deposited on Ag(110) do not align exclusively along the close-packed atomic troughs but also perpendicular to them. The mixture of molecules arranged with their long axis parallel to the [001] and [1$\bar{1}$0] directions lead to strained checkerboard pattern as described by Yokoyama.[1] Besides the checkerboard phase, a well ordered homochiral phase was found. STM images show that although the molecules in the second layer are exclusively aligned in the [001] direction their arrangement is strongly influenced by the perpendicular molecules of the first layer. By using a Ag(441) surface, the molecules of the first layer can be forced to align exclusively along the [1$\bar{1}$0] direction. In this case, the molecules are parallel to the steps of the substrate. In addition, step bunching and faceting of the vicinal substrate surface was found upon adsorption of α-6T. For more than two monolayers of α-6T deposited on both, the Ag(110) and the Ag(441) surface, a 3D growth was observed by PEEM. The PEEM intensity curves recorded during film growth provide additional details on the complex growth of the molecules on both surfaces.

[1] T. Yokoyama, Applied Physics Letters **96**, 063101 (2010)

O 10.8 Mon 16:45 TRE Phy

Exciton dynamics at oligothiophene / Au(111) interfaces — •Erwan Varene, Isabel Martin, Christopher Bronner, Lea Bogner und Petra Tegeder — Freie Universität Berlin, Fachbereich Physik, Arnimallee 14, 14195 Berlin, Germany

Semiconducting materials based on organic molecules or polymers are promising candidates for applications in electronic devices such as organic photovoltaic cells. The electronic structure and carrier dynamics at interfaces between organic semiconductors and inorganic substrates are the most fundamental issues in order to understand the functionalities of organic films. Time-resolved two-photon photoemission (2PPE) spectroscopy is employed to determine the electronic structure, charge carrier dynamics and energetics at the sexithiophene (6T)/Au(111) interface. We found the HOMO and HOMO-1 to be located at -0.8 and -1.5 eV, respectively and two 6T-derived unoccupied states at 2.1 eV and 3.0 eV with respect to the Fermi level which we assign to the LUMO and LUMO +1. In addition an exciton state possessing a binding energy of 0.9 eV is observed. The timescale for the exciton breakup exhibits a strong 6T coverage dependency, i.e., the exciton lifetime increases with increasing coverage. For instance at a coverage 12 ML the decay times are around 700 fs for the fast component and ~ 5 ps for the slow component.