

O 81: Poster Focus Session: Molecular Nanostructures on Surfaces - New Concepts towards Complex Architectures

Time: Wednesday 18:15–20:30

Location: Poster A

O 81.1 Wed 18:15 Poster A

On-Surface Metalation of Corrole Ligands — ●JAN HERRITSCH, MALTE ZUGERMEIER, MIN CHEN, QITANG FAN, MARTIN SCHMID, and J. MICHAEL GOTTFRIED — Fachbereich Chemie, Philipps-Universität Marburg, Germany

The surface coordination chemistry of porphyrinoid transition metal complexes plays an important role in interface functionalization. Variation of the ligand skeletal structure offers the possibility to tune and control the reactivity. Corroles can be described as contracted porphyrins, which however differ in their electronic structure and can act as formally trianionic ligands. We have studied the characteristics of mono- and submonolayers of a free-base alkyl substituted corrole ligand system on the Ag(111) and the Cu(111) surface. Furthermore, we present two different ways for the on-surface syntheses of transition metal corrole complexes. On the one hand we were able to show the synthesis of cobalt corrole on the Ag(111) surface through metalation of a ligand monolayer by postdeposition of the corresponding metal. As a second route we studied the thermally controlled self-metalation of corrole with substrate atoms on the Cu(111) surface yielding a copper corrole complex. The reactions were investigated by XPS, UPS and STM studies and compared to a similar porphyrin as a reference system. DFT calculations were performed to obtain additional insight and to interpret the spectra.

O 81.2 Wed 18:15 Poster A

Growth and Electronic Properties of a Potential Organic Superconductor on Cu(111) — ●FELIX OTTO, BERND SCHRÖTER, ROMAN FORKER, and TORSTEN FRITZ — Institute of Solid State Physics, Friedrich Schiller University Jena, Helmholtzweg 5, 07743 Jena, Germany

Several polycyclic aromatic hydrocarbons (PAHs) become superconducting after the intercalation of alkali metal atoms. The number of promising candidates has increased in the last few years. Among them, K_{3.45}1,2:8,9-dibenzopentacene (trans-DBPen, C₃₀H₁₈) is the one with the highest critical temperature of 33.1 K reported so far [1]. Nevertheless, the microscopic mechanisms of superconductivity in K-doped PAHs are still under debate. One open question is, for example, the effect of structural order in bulk materials as well as two-dimensional layers.

Our work deals with the growth of trans-DBPen on Cu(111) in the monolayer (ML) regime. The self-assembled thin films were prepared using organic molecular beam epitaxy. The structure was characterized by means of low energy electron diffraction (LEED). X-ray and ultraviolet photoelectron spectroscopy (XPS, UPS) were used to study the interaction of the molecules with the substrate. In the sub-ML range we observe a 2D gas-like behavior, whereas the first ML is characterized by a highly ordered structure. The results are compared to measurements of trans-DBPen on Au(111) and Ag(111) in terms of the molecule-substrate interaction.

[1] M. Xue *et al.*, *Sci. Rep.* **2**, 389 (2012).

O 81.3 Wed 18:15 Poster A

Bilayer Formation vs. Monolayer Replacement in Organic Heterostructures: Strong Impact of Subtle Changes in Molecular Structure — ●QI WANG^{1,2}, ANTONI FRANCO-CANELLAS², PENGHUI JI¹, HAIMING ZHANG¹, ALEXANDER GERLACH², LIFENG CHI¹, STEFFEN DUHM¹, and FRANK SCHREIBER² — ¹Institute of Functional Nano & Soft Materials (FUNSOM), Soochow University, Suzhou, China — ²Institut für Angewandte Physik, Universität Tübingen, Tübingen, Germany

The electronic structure at the interfaces of copper-phthalocyanine (CuPc) on 6,13-pentacenequinone (P2O) or 5,7,12,14-pentacene-9,10-dione (P4O) pre-covered Ag(111) was investigated using ultraviolet photoelectron spectroscopy (UPS), X-ray photoelectron spectroscopy (XPS) and scanning tunneling microscopy (STM). Despite the similar chemical structure of P2O and P4O, their monolayers on Ag(111) are strikingly different: while P2O is physisorbed, P4O is strongly chemisorbed involving a net electron transfer from the substrate to the adsorbate.[1] Similarly, also CuPc interacts heavily with Ag(111)[2] leading to chemical core-level shifts. By combining our UPS, XPS and STM results for mono- and heterostructures we obtain a full picture of interface

energetics and can disentangle competing intermolecular and adsorbate-substrate interactions.

[1] G. Heimel, *et.al.* *Nat. Chem.* **2013**, *5*, 187.

[2] I. Kröger, *et.al.* *New J. Phys.* **2010**, *12*, 083038.

O 81.4 Wed 18:15 Poster A

Reversible switching of azobenzene tetramers molecules at a metal surface — ●CHRISTOPHE NACCI¹, MASSIMO BARONCINI², ALBERTO CREDI², and LEONHARD GRILL¹ — ¹Department of Physical Chemistry, University of Graz, 8010 Graz, Austria — ²Photochemical Nanosciences Laboratory, University of Bologna, 40126 Bologna, Italy

Molecular switches revealing reversible isomerization properties are potentially relevant building blocks in the fields of molecular electronics, functionalized surfaces and information storage. Azobenzene is a prototypical molecular switch owing to the trans-cis isomerization of the central double nitrogen bond. Here, we report a study on azobenzene tetramers which are comprised of four azobenzene units in a tetrahedral arrangement. By using low-temperature scanning tunneling microscopy and spectroscopy (STM/STS) we can image individual molecules and study their switching properties with high spatial resolution. After adsorption on a Ag(111) surface we find molecular aggregates with characteristic hexagonal shapes that can be assigned to periodic adsorption sites. Reversible isomerization of azobenzene tetramer molecules was then induced either by the microscope tip or laser illumination. By analyzing the switching behavior, we obtain insight into the coupling with the surface and the effect on the physical/chemical properties of the molecules.

O 81.5 Wed 18:15 Poster A

Coverage dependent self-assembly structures of Co (II) 5, 15-diphenylporphyrin on Cu (111) — ●FEIFEI XIANG, ANJA GEMEINHARDT, and M. ALEXANDER SCHNEIDER — Solid State Physics, Friedrich-Alexander-University Erlangen-Nürnberg (FAU), Erlangen, Germany

The self-assembly structure of Co (II) 5,15-diphenylporphyrin (Co-DPP) on Cu (111) as a function of molecular coverage is studied and compared with unmetalated 5,15-diphenylporphyrin (2H-DPP) by low temperature scanning tunneling microscopy. Both 2H-DPP and Co-DPP show chirality on the copper surface due to the distortion of the molecular skeleton. 2H-DPP can only form chain-like, 1D structures on the surface. The self-assembly structure of Co-DPP varies from low molecular coverage to very dense coverage. At very low molecular coverage, the Co-DPP forms triangular structures and 1-D chains, which follow the 3-fold symmetry of the substrate. When the molecular coverage is higher than half monolayer, Co-DPP forms square and rectangular 2D networks caused by the chirality of the molecular configurations. At full monolayer coverage the molecules are closely packed in a racemic mixture.

O 81.6 Wed 18:15 Poster A

Supramolecular networks of arylene-alkynyls on HOPG: STM studies — ●TRISTAN J. KELLER, GEORGIY POLUEKTOV, STEFAN-S. JESTER, and SIGURD HÖGER — Universität Bonn, Kekulé-Institut für Organische Chemie und Biochemie, Gerhard-Domagk-Straße 1, 53121 Bonn, Germany

We report about the synthesis and 2D supramolecular self-assembly of shape persistent arylene-alkynylene macrocycles at the solid/liquid interface on HOPG. The molecules form complex supramolecular architectures that are imaged by scanning tunneling microscopy with sub-molecular resolution. The flexible alkyl/alkoxy side chains interdigitate intermolecularly and stabilize the network formation. The investigation aims at detailed understanding on how the pattern structures and lattice constants depend on the exact shape of the backbones as an effect of the respective corner units and the strain induced by them. In addition, the role of experimental parameters (concentration, thermal annealing) is investigated. [1] P. Wilhelm, J. Vogelsang, G. Poluektov, N. Schönefelder, T. J. Keller, S.-S. Jester, S. Höger, J. M. Lupton, *Angew. Chem. Int. Ed.* **2017**, *56*, 1234-1238.

O 81.7 Wed 18:15 Poster A

Resolving intramolecular-distortion changes induced by the

partial fluorination of pentacene adsorbed on Cu(111) — ●ANTONI FRANCO-CAÑELLAS¹, QI WANG^{1,2}, KATHARINA BROCH¹, BIN SHEN², ALEXANDER GERLACH¹, HOLGER F. BETTINGER², STEFFEN DUHM³, and FRANK SCHREIBER¹ — ¹Institut für Angewandte Physik, Universität Tübingen, Germany — ²Institut für Organische Chemie, Universität Tübingen, Germany — ³Institute of Functional Nano & Soft Materials (FUNSOM) and Jiangsu Key Laboratory for Carbon-Based Functional Materials & Devices, Soochow University, People's Republic of China

We experimentally quantify the molecular bending of the partially-fluorinated pentacene (PEN) compound 2,3,9,10-tetrafluoropentacene (F4PEN) adsorbed on Cu(111). By means of the X-ray standing wave (XSW) technique, we directly measure the adsorption distance of three inequivalent carbon species, the fluorine atoms, as well as the total and backbone carbon average adsorption distances. This allows us to resolve two adsorption behaviors, namely, a PEN-like strong coupling between the backbone and the substrate and a repulsive interaction involving the fluorinated short molecular edges, which are 0.9 Å above the central benzene ring. This finding is further supported by additional ultraviolet photoelectron spectroscopy and low-energy electron diffraction measurements, thus showing that the selective fluorination of a PEN molecule has only a local conformational effect and it is not enough to modify its interface properties.

O 81.8 Wed 18:15 Poster A

One-dimensional molecular chains of Quinacridone on Ag(100) and Cu(111): STM- and SPA-LEED-investigations — ●NIKLAS HUMBERG, ALEXANDER ESLAM, and MORITZ SOKOLOWSKI — Institut für Physikalische und Theoretische Chemie der Universität Bonn, Wegelerstraße 12, 53115 Bonn, Germany

We report a structural analysis of Quinacridone (QA) on Ag(100) and Cu(111) by scanning tunneling microscopy (STM) and spot profile analysis low energy electron diffraction (SPA-LEED). On Ag(100) QA grows at room temperature in parallel homochiral one-dimensional chains, forming a metastable structure. Within these chains the molecules are closely packed and linked via hydrogen bonds. The distance between two neighboring chains varies with coverage. After annealing to 500 K a commensurate heterochiral structure is formed. It consists of homochiral dimers forming periodically identified chains. An oblique unit cell with cell parameters $a = (14.3 \pm 0.3)$ Å, $b = (16.9 \pm 0.3)$ Å and $\alpha = (112 \pm 0.5)^\circ$ was found.

SPA-LEED patterns of QA on Cu(111) suggest the presence of more disorder. The observed spots smear out, creating a highly symmetric diffraction pattern containing many lines with varying intensities.

O 81.9 Wed 18:15 Poster A

Synthesis of different experimental techniques in surface science: DBP films on graphitic surfaces — ●TINO KIRCHHUEBEL¹, FABIO BUSSOLOTTI², JINPENG YANG⁴, KEIICHIROU YONEZAWA², RYO SHIRAISHI², TAKUMA YAMAGUCHI², TAKA UEBA², RYOSUKE MORI³, SHOGO KUNIEDA³, TAKASHI YAMADA³, TOBIAS HUENPFNER¹, ROMAN FORKER¹, TOSHIKI MUNAKATA³, SATOSHI KERA^{2,4}, and TORSTEN FRITZ¹ — ¹FSU Jena, Germany — ²IMS Okazaki, Japan — ³Osaka University, Japan — ⁴Chiba University, Japan

We present a comprehensive study on highly ordered thin films of the lander molecule tetraphenylidibenzoperiflanthene grown on graphitic surfaces. The spectra from ultraviolet photoelectron spectroscopy (UPS) combined with inverse photoelectron spectroscopy (IPES), two-photon-photoemission (2PPE), and optical spectroscopy (DRS) are discussed in context with the film structure, investigated with scanning tunneling microscopy (STM) and low energy electron diffraction (LEED). The interpretation of different spectroscopic data is a challenging task. Here, the comparison reveals seeming discrepancies regarding the coverage dependent energy level alignment of DBP films. Facing this problem, a model based on charging and polarization effects is introduced, which explains the observations consistently.

O 81.10 Wed 18:15 Poster A

Determination of critical cluster size, diffusion barrier and cohesion energy of PTCDA on Cu(001) — ●JANINA FELTER, JANA WOLTERS, MARKUS FRANKE, GERBEN VAN STRAATEN, CAROLINE HENNEKE, and CHRISTIAN KUMPF — Peter Grünberg Institut (PGI-3), Forschungszentrum Jülich, 52425 Jülich, Germany Jülich Aachen Research Alliance (JARA) - Fundamentals of Future Information Technology, 52425 Jülich, Germany

Understanding the adsorption and growth mechanisms of large π -

conjugated molecules on noble metals is a key issue for designing and optimizing organic electronic devices. Here, we report on the growth of PTCDA on Cu(001) studied in situ and in real time with Low-Energy Electron Microscopy (LEEM). By analysing island size distributions within the aggregation regime and applying methods developed for atomic nucleation on surfaces, we were able to determine the critical cluster size i for the formation of stable clusters for temperatures between 300 K and 390 K. We find different values ($i = 1$ and $i = 3$) for two different temperature regimes. This allows us to determine the diffusion barrier for individual molecules and, with the help of pair-potential calculations, the cohesion energy of a cluster of two molecules.

O 81.11 Wed 18:15 Poster A

Fluorescence microscopic analysis on the orientation of PTCDA domains on KCl(100) in ultrahigh vacuum — ●NILS ROHBOHM¹, CHRISTIAN MARQUARDT¹, RUDOLF MERKEL², and MORITZ SOKOLOWSKI¹ — ¹Institut für Physikalische und Theoretische Chemie der Universität Bonn, Wegelerstraße 12, 53115 Bonn, Germany — ²Institute of Complex Systems, ICS-7: Biomechanics, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany

We report data obtained by an epi-fluorescence light microscope directly attached to a surface science UHV-chamber. We have studied the fluorescent and superradiant domains formed in the monolayer of PTCDA on a thin epitaxial film of KCl on a Ag(100) surface. The domains exhibit a brick-wall-type structure and nucleate in two perpendicular orientations. Using additional rotatable polarisation filters in the incident and detected beam paths, we can spatially discriminate the two types of differently oriented domains. At present the spatial size of one domain can be as large as $1000 \mu\text{m}^2$. From the microscopic images we deduce information on the domain growth in relation to the local surface morphology. Brightfield images of the underlying Ag(100) surface show a macroscopic corrugation which appear to be correlated with the pattern of the PTCDA domains detected by fluorescence. Supported by the DFG.

O 81.12 Wed 18:15 Poster A

Adsorption Conformation and Lateral Registry of Cobalt Porphines on Cu(111) — MARTIN SCHWARZ¹, MANUELA GARNICA¹, DAVID DUNCAN², ALEJANDRO PEREZ PAZ³, JACOB DUCKE¹, PETER DEIMEL¹, PARDEEP KUMAR THAKUR², TIEN-LIN LEE², ANGEL RUBIO⁴, JOHANNES V. BARTH¹, FRANCESCO ALLEGRETTI¹, and ●WILLI AUWÄRTER¹ — ¹Technische Universität München, Germany — ²Diamond Light Source, United Kingdom — ³Yachay Tech University, Ecuador — ⁴Max-Planck-Institut für Struktur und Dynamik der Materie, Germany

The tetrapyrrole macrocycle of porphine is the common core of all porphyrin molecules, an interesting class of π -conjugated molecules with relevance in natural and artificial systems [1]. The functionality of porphines on a solid surface can be tailored by the central metal atom and its interaction with the substrate [2]. Here, we present a local adsorption geometry determination for cobalt porphine on Cu(111) by means of complementary scanning tunneling microscopy, high-resolution X-ray photoelectron spectroscopy and X-ray standing wave measurements, and density functional theory calculations. Specifically, the Co center was determined to be at an adsorption height of 2.25 ± 0.04 Å occupying a bridge site. The macrocycle adopts a moderate asymmetric saddle-shape conformation. Based on these results, we will discuss the interfacial interactions for this archetypical metallotetrapyrrole/metal system.

[1] F. Bischoff et al., ACS Nano 7, 3139 (2013)

[2] K. Diller et al., Chem. Soc. Rev. 45, 1629 (2016)

O 81.13 Wed 18:15 Poster A

Tuning the band structures of graphene nanoribbons by functionalized edge groups — ●JINGCHENG LI^{1,2}, NÉSTOR MERINO-DÍEZ^{2,3}, EDUARD CARBONELL-SANROMA¹, JEREMY HIEULLE¹, MANUEL VILAS-VARELA⁵, ARAN GARCÍA-LEKUE³, PEDRO BRANDIMARTE², MARTINA CORSO^{2,4}, DANIEL SANCHEZ-PORTAL², DIMAS G. DE OTEYZA^{3,4}, AITOR MUGARZA⁶, DIEGO PEÑA⁵, and JOSE IGNACIO PASCUAL^{1,4} — ¹CIC Nanogune, 20018 San Sebastián, Spain — ²CFM, 20018 San Sebastián, Spain — ³DIPC, 20018 San Sebastián, Spain — ⁴Ikerbasque, 48013 Bilbao, Spain — ⁵CIQUS, 15782 Santiago de Compostela, Spain — ⁶ICN2, 08193 Barcelona, Spain

On-surface synthesis of atomically precise graphene nanoribbons (GNRs) allows engineering the band structures of GNRs by modifying the molecular precursors. Until now, most of the works are focused on

the chemical substitution of carbon atoms by heteroatoms in GNRs. Here in this work, we show that band structure of GNRs can be tuned by edge functionalization of GNRs. The effect of cyano (-CN) edge group on the band structure of armchair GNRs (aGNRs), and the effect of amino (-NH₂) and nitro (-NO₂) edge groups on the band structure of chiral GNRs (cGNRs) are studied. We found that cyano edge groups act as n-dopants, down-shifting the bands of aGNRs, while amino edge groups acts as p-dopants, up-shifting the bands of cGNRs. Due to the reactivity of nitro edge groups on surface, their effect on the band structures of cGNRs need to be further clarified.

O 81.14 Wed 18:15 Poster A

Adsorption of Porphyrin on Cu (111) - Chemisorption and physisorption — ●KONSTANTINOS KOUMPOURAS, JAKUB BARAN, and ANDREAS J. LARSSON — Applied Physics, Division of Materials Science, Department of Engineering Sciences and Mathematics, Lulea University of Technology, SE-971 87 Lulea, Sweden

In recent years, the investigation of porphyrin molecules on surfaces is of great interest due to their potential applications in several fields. The main characteristics which make them suitable candidates in these fields are that they possess an impressive variety of functional properties and are extraordinary stable. Since one research part of the porphyrins is focused on their use as elements for future molecular electronic systems, the interaction between them and solid surfaces is very important. The main advantage is the preservation of gas-phase flexibility during their deposition on metal surfaces where a number of distinct conformers are observed.

The Cu (111) surface is widely used as the adsorption "platform" for studying the different conformation of porphyrin molecules where the interactions are dominated by chemical interactions or attractive van der Waals interactions or both. Conformational changes due to the adsorption of the molecule can affect its properties but the mechanisms that drive these changes are often unclear, so detailed studies of different molecule - surface interactions by means of density functional theory is more than necessary for a comprehensive analysis and interpretation of experimental data.

O 81.15 Wed 18:15 Poster A

Self-assembly of cyano-substituted porphyrin-derivatives on bulk insulators — ●MIN-KEN LI, JIA LIU, MIRUNALINI DEVARAJULU, and SABINE MAIER — Department of Physics, Universität Erlangen-Nürnberg, Erlangen, Germany

The realization of molecule-based devices requires functional molecular building blocks integrated on suitable substrates. Due to the strong interaction between molecular building blocks and metal surfaces, most molecules lost their original functionality on metal surfaces. The weak interaction between organic molecular building blocks and bulk insulating surfaces makes it ideal for the fabrication of molecular devices. Hence, organic molecules adsorbed on insulating surfaces have been attracting more and more attention recently.[1] Here, we present a study on the self-assembly of cyano-substituted tetraphenylporphyrin derivatives on bulk KBr(001) and MgO(0001) by non-contact atomic force microscopy (AFM) at low temperature. We observed two-dimensional self-assembly of the cyano-substituted tetraphenylporphyrin derivatives. The interaction between intermolecular cyano and phenyl groups plays an essential role in the formation of the 2D self-assembly.[2] The structure of the self-assembly will be discussed in detail based on AFM images featuring sub-molecular resolution.

[1] P. Rahe, et al. *Advanced Materials*, 2013, 25-29, 3948-3956

[2] S. Maier, et al. *Small*, 2008, 4, 1115-1118

O 81.16 Wed 18:15 Poster A

On-surface self-assembly of tetratopic molecules with directional interactions: insights from computer modeling — ●DAMIAN NIECKARZ¹, PAWEŁ SZABELSKI¹, and WOJCIECH RZYSKO² — ¹Department of Theoretical Chemistry, Maria Curie-Skłodowska University, Lublin, Poland — ²Department for the Modeling of Physico-Chemical Processes, Maria Curie-Skłodowska University, Lublin, Poland

The Monte Carlo simulation method was used to explore structure formation in adsorbed assemblies comprising tetratopic molecules equipped with active terminal arm segments. Depending on the interaction directions assigned to the active sites, the simulations resulted in the formation of extended ordered, chain-like and glassy structures. In several cases, complex porous patterns have been observed, especially when polymorphic phases were formed. Our calculations demonstrated that the tetratopic building blocks can undergo spontaneous self-assembly to produce a wide range of molecular superstructures with tunable properties like, for example, nanopore shape and size, chirality and periodicity. These theoretical predictions may be helpful in experimental construction of new molecular architectures with precisely defined morphologies and functionalities using the bottom-up approach.

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O 81.17 Wed 18:15 Poster A

Effects of neutron irradiation on the frequency dependencies of electrical conductivity of nanocrystalline 3C-SiC particles — ●ELCHIN HUSEYNOV — Institute of Radiation Problems of Azerbaijan National Academy of Sciences, AZ 1143, B.Vahabzade 9, Baku, Azerbaijan

Nanocrystalline 3C-SiC have been irradiated by neutron flux up to 20 hours. On the 3C-SiC nanomaterial radiation-induced conductivity (RIC) has been observed after neutron irradiation. From the comparative analyses of frequency dependence of electrical conductivity at different temperatures it was determined that, numerical value of electrical conductivity increases after neutron irradiation. Numerical value of electrical conductivity of 3C-SiC nanomaterial increases up to 7.5×10^{-4} S/m or approximately 5.5 times after neutron irradiation. The main reason for RIC is the increase of concentration of carriers in nanocrystalline 3C-SiC after neutron irradiation. It has been determined from interdependence between real and imaginary parts of electrical conductivity that, the real part of electrical conductivity changes more than imaginary part after neutron irradiation. Ionic or dipolar type of conductivity has been found from interdependence between real and imaginary parts of electrical conductivity. Moreover, acceptor or donor defects are known as deep levels are generated in nanomaterial after neutron irradiation. The concentration of donor (n-type donor, 31P) atoms increases as a result of nuclear transformation within neutron irradiation in 3C-SiC nanomaterial and it is one of the factors leading to increase of conductivity.

O 81.18 Wed 18:15 Poster A

DHTAP thin layers deposited on Cu(110) and Cu(110)-(2×1)O surfaces — ●ANDREA NAVARRO-QUEZADA^{1,2}, MICHAEL GYÖRÖK², THORSTEN WAGNER², ANTHONY THOMAS³, THOMAS LEONI³, ALAIN RANGUIS³, CONRAD BECKER³, and PETER ZEPPEFELD² — ¹Solid State and Semiconductor Physics, JKU Linz, Austria — ²Experimental Physics, JKU Linz, Austria — ³CINAM, Marseille, France

Dihydro-tetraazapentacene (DHTAP) is a derivate of pentacene, which due to its two H-donor (N-H) and the two H-acceptor (N=C) sites, is expected to form well-ordered molecular structures on surfaces. Here, we study the morphology and the evolution of the optical properties during the deposition of DHTAP thin layers on Cu(110) and Cu(110)-(2×1)O surfaces using polarization-dependent differential reflectance spectroscopy (pol-DRS)[1] in combination with photoelectron emission microscopy (PEEM). We compare our results to those obtained by in situ reflectance differential spectroscopy (RDS) in a second experiment. Within the first monolayer, DHTAP absorbs in a flat-lying geometry on both surfaces. However, the orientation of the long molecular axis of the molecules in the first monolayer is aligned along the [1-10]-direction on the Cu(110) surface, while it is parallel to the [001]-direction on Cu(110)-(2x1)O. We find that, depending on the growth temperature, the DHTAP molecules on top of the first monolayer deposited on Cu(110) change their preferential alignment.

[1] A. Navarro-Quezada *et al.*, *Rev. Sci. Instr.* 86, 113108 (2015)