O 16: Organic, polymeric, biomolecular films - also with adsorbates

Time: Monday 15:00–17:30 Location: H46

O 16.1 Mon 15:00 H46

Initial growth of crystalline rubrene thin film growth on mica (001) — •Harald Zaglmayr[1], Lidong Sun[1], Günther Weidlinger[1], Shaima'a Abd Al-Baqi[2], Dmitrii Nabok[3], Peter Zeppenfeld[1], Helmut Sitter[2], and Claudia Ambrosch-Draxl[3] — [1]Institute of Experimental Physics, Johannes Kepler University Linz, Altenbergerstraße 69, A-4040 Linz, Austria — [2]Institute of Semiconductor and Solid State Physics, Johannes Kepler University Linz, Altenbergerstraße 69, A-4040 Linz, Austria — [3]Department of Material Physics, Montanuniversity Leoben, Franz-Josef-Straße 18, A-8700 Leoben, Austria

Epi-fluorescence and laser scanning confocal microscopy (LSCM) have been used to investigate the morphology and optical properties of rubrene thin films at the early stage of crystallization and rubrene single crystals with a diameter of several tens of micrometers. The films were prepared on a muscovite mica substrate by hot wall epitaxy. The initial growth proceeds via the formation of a wetting layer and the nucleation of islands with an amorphous structure. Crystallization starts when the amorphous islands coalesce and needle like crystalline fibers are formed in the gap between the islands. The crystalline fibers then grow on top and in between the original amorphous islands leading to an "open network" of islands. The latter acts as a basis for the growth of semi-crystalline spherulites. For the rubrene single crystals, the spatially resolved photoluminescence spectrum shows a strong dependence on the orientation, which can be attibuted to the optical anisotropy of the crystals.

O 16.2 Mon 15:15 H46

Photoisomerization of azobenzene on layer compound surfaces studied by photoelectron spectroscopy — •Eric Ludwig[1], Jaroslaw Iwicki[1], Kai Rossnagel[1], Felix Köhler[2], Rainer Herges[2], and Lutz Kipp[1] — [1]Institut für Experimentelle und Angewandte Physik, Universität Kiel, D-24098 Kiel, Germany — [2]Otto-Diels-Institut für Organische Chemie, Universität Kiel, D-24098 Kiel, Germany

Photoswitchable azobenzene and its derivative Disperse Orange 3 (DO3) molecules were deposited *in situ* under UHV conditions on the surfaces of the metallic and semiconducting layered crystals TiTe$_2$ and HfS$_2$, respectively. Due to weak van der Waals-like coupling between the layers these materials serve as excellent substrates for the analysis of adsorbed molecules and their possible photoswitching behavior. Coverages from sub-monolayer to several monolayers were realized. Photoelectron spectroscopy (PES) experiments were performed using a He discharge lamp and a SPECS Phoibos 150 analyzer. Results imply Stranski-Krastanov-like film growth of azobenzene on TiTe$_2$. Comparison of PES spectra to outer valence green function calculations suggests dimer formation of DO3. To photoisomerize the adsorbed molecules, the samples were irradiated with a LED Power Pen (wavelength 365 nm, 3.5 W/cm^2). Experimental data of azobenzene adsorbed on HfS$_2$ shows that the molecules can be partially switched from the *trans* to the *cis* orientation. On TiTe$_2$ no switching has been observed, presumably due to stronger molecule-substrate coupling. This work was supported by the DFG through SFB 677.

O 16.3 Mon 15:30 H46

Light effective mass of the valence band hole of rubrene single crystal observed by angle-resolved photoelectron spectroscopy — •Satoshi Kera, Steffen Duhm, Shunsuke Hosoumi, Qian Xin, Nobuo Ueno, Shinichi Machida, Akihiro Funakoshi, Naoki Ogawa, Yasuo Nakayama, and Hisao Ishii — Grad. School of Advanced Integration Science, Chiba University

The mechanism of the carrier transport in organic semiconductor has remained in puzzling at room temperature region, especially. Rubrene (C$_{42}$H$_{28}$) single crystal has been recognized to exhibit the highest hole mobility among all organic semiconductors [1]. To comprehend the transport nature as well as to improve the device performance, information on the electronic structure is indispensable. In the present study, we successfully observed the valence electronic structures of rubrene single crystal by angle-resolved ultraviolet photoelectron spectroscopy with laser illumination to avoid sample charging. A clear energy dispersion of the highest occupied molecular orbital band was observed, where the dispersion width is 0.4 eV along the well conjugated direction. Effective mass of holes is estimated to be 0.7 m$_0$. The present results suggest that the carrier conduction mechanism in a rubrene single crystal should be described as band transport of a delocalized light quasiparticle [2].

[1] T. Hasegawa and J. Takeya, Sci. Technol. Adv. Mater. 10, 024314 (2009). [2] S. Machida et al, submitted.

O 16.4 Mon 15:45 H46

Self-assembled monolayers of perfluoroterphenyl-substituted alkanethiolates on coinage metal substrates — •Frederick Chesneau[1], Björn Schüpbach[2], Katarzyna Szelagowska-Kunstman[3], Nirmalya Ballav[1], Piotr Cyganik[3], Andreas Terfort[2], and Michael Zharnikov[1] — [1]Angewandte Physikalische Chemie, Universität Heidelberg, 69120 Heidelberg, Germany — [2]Institut für Anorganische und Analytische Chemie, Goethe-Universität Frankfurt, 60438 Frankfurt, Germany — [3]Faculty of Physics, Astronomy, and Applied Computer Science, Jagiellonian University, 30059 Krakow, Poland

Self-assembled monolayers (SAMs) formed by perfluoroterphenyl-substited alkanethiols (FTPn, with n being the number of the methylene units) with variable length of the aliphatic linker (n = 2 and 3) on (111) Au and Ag were characterized by a combination of several complementary spectroscopic and microscopic techniques. The SAMs were found to be well-defined, highly ordered, and densely packed, which suggest a strong correlation between the orientations of the analogous rings in the adjacent molecules. In addition, the SAMs exhibited pronounced odd-even effects, i.e. dependence of the molecular orientation and packing density on the length of the aliphatic linker, with parity of n being the decisive parameters and the direction of the effects on Au opposite to that on Ag. The presence of the odd-even effects in the FTPn system, characterized by distinctly non-planar conformation of the FTP moieties, brings new aspects into the discussion about the origin of these effects.

O 16.5 Mon 16:00 H46

Fast and non-invasive optical study of protein films on surfaces — •Franz-Josef Schmitt[1], Heinrich Südmeyer[2], Kai Reineke[1], Insa Kahlen[1], Joachim Börner[1], Max Schöngen[1], Patrick Hätti[1], Hans Joachim Eichler[1], and Hans-Joachim Cappius[2] — [1]Berlin Institute of Technology, Berlin — [2]Laser- und Medizintechnologie GmbH, Berlin

Thin films of proteins, bacteria and diverse biochemical compounds are always found on surfaces exposed to the environment. Optical methods deliver innovative tools for the study of protein films. Residue of proteins, which exhibit fluorescence when exited in the UV wavelength range, can easily be investigated optically. The results show that protein films are structured inhomogeneously. Ring shaped structures often found after surface drying can be explained by the influence of surface tension during the evaporation process of the protein solvents. We present a specially designed handheld measuring device that can analyse organic contamination levels below 1μg/cm^2 within seconds. By using time-correlated methods the fluorescence detection of contamination level on surfaces is possible even if the fluorescence spectra of contamination and base material overlap.

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O 16.6 Mon 16:15 H46

Protein resistant ethylene glycol terminated self-assembled monolayers by vapour deposition in vacuum — •Laxman Kankate[1], Helge Grossmann[2], Udo Werner[1], Robert Tampé[2], Andrey Turchanin[1], and Armin Gölzhäuser[1] — [1]Department of Physics, Physics of Supramolecular Systems, University of Bielefeld — [2]Institute of Biochemistry, Johann Wolfgang Goethe-University, Frankfurt am Main

Vacuum vapour deposition (VD) is a method of choice for the preparation of organic interfaces for the in situ characterization and nanofabrication. However, it is usually difficult to prepare the self-assembled monolayers of thiols on gold by vacuum VD with the degree of quality sufficient for applications. Therefore, most of the SAM preparation is usually undertaken in solvents. In this contribution we report the first vacuum VD study of the protein resistant 11-(mercaptoundecyl)-

triethylene glycol (C11EG3OH) SAM on gold surfaces. We present a comparison of C11EG3OH SAMs prepared by VD and by solution method using X-ray photoelectron spectroscopy and Fourier transform infrared reflection absorption spectroscopy. Using surface plasmon resonance spectroscopy we demonstrate that SAMs prepared by both methods have comparable protein resistivity to the adsorption of various proteins (bovine serum albumin, trypsin and myoglobin). These results show a new path to the in situ engineering of protein resistant surfaces and patterns by standard nanofabrication techniques.

O 16.7 Mon 16:30 H46

One- and Two-dimensional Polyamide Films by Vapor Deposition Polymerization — •Christoph H. Schmitz, Julian Ikonomov, and Moritz Sokolowski — Institut für Physikalische und Theoretische Chemie, Universität Bonn, Germany

Long-range ordered structures on surfaces are mainly based on weak adsorbate-adsorbate interactions, such as van der Waals-forces, dipole interactions and hydrogen bonds. Though, technical applications (*e.g.*, coatings, sensors, catalysis) require more robust and durable layers, which may be realized by covalent networks on the surface.

We herein report on the formation of covalently interlinked structures of a polyamide via condensation polymerization directly on the Ag(111) surface at room-temperature. The vapor deposition polymerization technique was combined with ultra-high vacuum preparation methods to obtain polymer monolayers. Depending on the symmetry (*i.e.* the substitution pattern) of the deposited aromatic amine and acid chloride monomers, one- or two-dimensional polymers can be prepared, which are stable at elevated temperatures up to 620 K. The structures have been characterized by variable temperature scanning tunneling microscopy.

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O 16.8 Mon 16:45 H46

Investigation of Cellulose Model-Systems for Paper Fiber-Fiber Bonds with FTIR and AFM — •Eduard Gilli[1,2], Mario Djak[1,2], Oliver Miskovic[1,3], Franz Schmied[1,3], Christian Teichert[1,3], Eero Kontturi[4], and Robert Schennach[1,2] — [1]CD-Laborarory for Surf. Chem. and Phys. Fund. of Paper Strength — [2]Institute for Solid State Physics, TU-Graz, Austria — [3]Institute of Physics, University of Leoben, Austria — [4]TKK Helsinki, Finland

Spectroscopic investigation of the properties of fiber-fiber bonds in a sheet of paper often fails due to incorrect interpretation of the spectra, which are influenced heavily by geometrical effects, and scattering. Simulating the geometry as a multi-layer stack can help understanding the properties of paper, but the complex stochastic behavior of fibers cannot be modeled by these means. Investigation of model film systems from cellulose and hemicelluloses on Si can improve the situation, and close the gap between theory and experiment.

The cellulose model films were prepared by spin coating from trimethylsilyl cellulose solution and subsequent hydrolyzation. Further layers of hemicelluloses can be attached by spin coating or by adsorption. From atomic force microscopy measurements comprehensive knowledge of the layer roughness can be obtained, which is used as a prerequisite for spectral simulation. By spectral simulation optical effects can be identified, yielding a better understanding of the chemistry, going on between cellulose and hemicelluloses. Finally bonding strength tests on the model films can correlate the chemistry to the mechanical properties of fiber-fiber bonds.

O 16.9 Mon 17:00 H46

Growth of alpha-Sexithiophene films on Cu(110)-(2x1)O at elevated substrate temperatures — •Günther Weidlinger, Harald Zaglmayr, Lidong Sun, Daniel Roman Fritz, Thorsten Wagner, and Peter Zeppenfeld — Johannes Kepler Universität Linz, Institut für Experimentalphysik, Altenberger Straße 69, A-4040 Linz

alpha-Sexithiophene (6T) films were grown on the Cu(110)-(2x1)O surface in UHV with the substrate held at 380 K. Ex-situ atomic force microscopy (AFM), fluorescence microscopy (FM) and laser scanning confocal microscopy (LSCM) reveal elongated 6T islands with a height of up to a few hundred nanometers. These needles consist of crystallites of two distinct orientations with respect to the main axes of the substrate surface. However, polarization dependent FM shows that the 6T molecules in the needles are always aligned along the [001] direction of the substrate. Comparing AFM and FM images, regions of maximum fluorescence emission correspond to defects, e.g. needle ends or grain boundaries, at which light can couple out of the needles whereas defect-free parts appear darker due to a waveguiding effect inside the islands. Photoluminescence spectra obtained by LSCM are in qualitative agreement with reference spectra of single crystalline 6T. No wetting layer of 6T was observed with LSCM. This is in agreement with results from reflectance difference spectroscopy measurements where a quenching of the characteristic wetting layer signal was observed after exposure to air.

O 16.10 Mon 17:15 H46

Crystalline Inverted Membrane Growth by Electrospray Ion Beam Deposition — •Stephan Rauschenbach[1], R. Thomas Weitz[1], Ludger Harnau[2], Nikola Malinowski[1,3], Theresa Lutz[1], Nicha Thontasen[1], Zhitao Deng[1], and Klaus Kern[1,4] — [1]MPI Festkoerperforschung, Stuttgart, Germany — [2]MPI Metallforschung, Stuttgart, Germany — [3]Central Laboratory of Photographic Processes, Bulgarian Academy of Sciences, Sofia, Bulgaria — [4]Institut de la Matière Condenseé, EPFL, Lausanne, Switzerland

Amphiphilic molecules assembled in 2D membranes stabilize interfaces by the interplay of intermolecular- and hydrophobic- interactions. The latter interaction is canceled, when the surfactant molecules are transferred to an interface in vacuum.

Ion beam deposition of sodium dodecyl-sulfate (SDS) onto surfaces in vacuum is used as a model system for the assembly of amphiphilic molecules in the absence of solvents. To this end, cluster ion beams of SDS with excess Na+ as charge carrier are deposited on graphite and silicon samples which are analyzed ex-situ by AFM.

Our samples show stable, extended, flat islands of heights corresponding to single and double layers of upright standing SDS molecules. The relative strengths of the ionic- and van-der-Waals-interaction between the molecules without the presence of water suggests an inverted internal structure of the membranes with respect to their liquid grown counterparts. The shape of the islands is found to be characteristic for a crystalline phase of SDS.