

## DS 2: Organic Thin Films II

Time: Monday 11:15–13:00

Location: H32

DS 2.1 Mon 11:15 H32

**Structural analysis of small organic hydrocarbon ring molecules on GaAs(001) surfaces** — ●R. PASSMANN<sup>1,2</sup>, T. BRUHN<sup>2</sup>, W. BRAUN<sup>3</sup>, M. KNEISSL<sup>2</sup>, W. RICHTER<sup>4</sup>, N. ESSER<sup>1</sup>, and P. VOGT<sup>2</sup> — <sup>1</sup>ISAS Berlin, Albert-Einstein-Str. 9, 12489 Berlin, Germany — <sup>2</sup>TU Berlin, Institute of Solid State Physics, Hardenbergstr. 36, 10623 Berlin, Germany — <sup>3</sup>BESSY GmbH, Albert-Einstein-Str. 15, 12489 Berlin, Germany — <sup>4</sup>Universita Tor Vergata, Via della Ricerca Scientifica 1, 00133 Rome, Italy

Organic molecules are capable to functionalize semiconductor surfaces. Therefore it is essential to understand the resulting structure of the organic molecules and the semiconductor surfaces. To get some insight into the question how this depends on the molecule properties and the substrate surface, we investigated the dependence of the number of double bonds within hydrocarbons to the adsorption process. We have studied the structural configuration of three different GaAs(001) surface reconstructions occurring with Cyclopentene (C<sub>5</sub>H<sub>8</sub>) and 1,4-Cyclohexadiene (C<sub>6</sub>H<sub>8</sub>) adsorbed on them. This was studied by reflectance anisotropy spectroscopy (RAS), soft X-ray photo electron spectroscopy (SXPS), scanning tunnelling microscopy (STM) and LEED. SXPS measurements show clear new contributions in the As3d and C1s core levels. Additionally the RAS line shape changed significantly for the surface related features. This indicates a bonding between C<sub>5</sub>H<sub>8</sub> (C<sub>6</sub>H<sub>8</sub>) and the top-layer dangling bonds. STM measurements support these results. Based on these experiments we can derive possible structure models for the bonding configuration.

DS 2.2 Mon 11:30 H32

**Self-assembled alkyl monolayers on Si(111) investigated by NEXAFS and HR-UPS** — ●M. HÄMING<sup>1</sup>, J. ZIROFF<sup>1</sup>, S. HAME<sup>1</sup>, A. SALOMON<sup>2</sup>, L. SEGEV<sup>2</sup>, T. BOECKING<sup>3</sup>, O. SEITZ<sup>2</sup>, D. CAHEN<sup>2</sup>, F. REINERT<sup>1</sup>, A. SCHÖLL<sup>1</sup>, and E. UMBACH<sup>1</sup> — <sup>1</sup>University of Würzburg, Experimental Physics II, 97074 Würzburg — <sup>2</sup>Weizmann Institute of Science, Department of Materials and Interfaces, Rehovot 76100 Israel — <sup>3</sup>The University of New South Wales, Sydney, NSW 2052, Australia

The electronic structure of organic condensates is of crucial importance for the charge transport properties in these materials. Inter- and intramolecular interactions have a strong impact on the electronic system, leading to energy shifts in all levels. Moreover, for oriented chains band dispersion may occur and in the case of long range order even lateral band dispersion is possible. Self-assembled monolayers (SAMs) are ideal model systems to systematically study the intramolecular electronic band dispersion along the chains as function of chain length. In this work we investigate alkyl SAMs of various chain lengths directly bound to Si(111) substrates via Si-C bonds. Near edge x-ray absorption fine structure (NEXAFS) measurements provide information on unoccupied states and the molecular orientation with respect to the surface (~40° for C<sub>14</sub>H<sub>29</sub>). Also, the influence of radiation damage is observed in the NEXAFS spectra by the formation of intra- or intermolecular  $\pi$ -bonds. The high resolution UV photoemission spectroscopy (HRUPS) data recorded with variable photon energy (UE112-PGM at BESSY) shows marked dispersion within the valence regime which is compatible with a tight binding model taking into account the film geometry.

DS 2.3 Mon 11:45 H32

**Arrays of crystalline C<sub>60</sub> and pentacene nanocolumns** — ●JIAN ZHANG<sup>1</sup>, INGO SALZMANN<sup>1</sup>, FUJUN ZHANG<sup>1,2</sup>, ZHENG XU<sup>2</sup>, SIEGFRIED ROGASCHESKI<sup>1</sup>, JÜRGEN RABE<sup>1</sup>, and NORBERT KOCH<sup>1</sup> — <sup>1</sup>Institut für Physik, Humboldt-Universität zu Berlin, Newtonstrasse 15, D-12489 Berlin — <sup>2</sup>Key Laboratory of Luminescence and Optical Information, Ministry of Education, Institute of Optoelectronic Technology, Beijing Jiaotong University, Beijing 100044, China

Organic nanocolumn arrays have been the focus of many research studies owing to the wide range of potential applications for these structures, particularly in the field of optoelectronics. In our work, crystalline nanocolumnar arrays of two widely studied organic semiconductors, i.e., Fullerene (C<sub>60</sub>) and pentacene were fabricated by glancing angle deposition (GLAD), and characterized by scanning electron microscopy and X-ray diffraction. For both materials, column diameters of typically 100 nm are found on the transparent conductive oxide ITO, essentially independent of column height (up to 360 nm for pentacene).

However, on Si-oxide only C<sub>60</sub> formed nanocolumns, while pentacene exhibited a morphology resembling that obtained by regular normal incidence deposition. The molecular surface diffusion length on the substrate is thus identified as critical parameter for the formation of columnar nanostructures by GLAD. Our results indicate that glancing angle deposition is a simple technique to fabricate organic crystalline nanocolumn arrays, and that controlling the molecular surface diffusion via chemical and/or morphological patterning may lead to entirely new functional organic nanostructures.

DS 2.4 Mon 12:00 H32

**Unusual narrow absorption bands of PTCDA submonolayers on potassium chloride** — ●THOMAS DIENEL, CHRISTIAN LOPPACHER, KARL LEO, and TORSTEN FRITZ — Institut für Angewandte Photo-physik, Technische Universität Dresden, 01062 Dresden, Germany

Here we report on the first observation of unusually narrow absorption bands of perylene-3,4,9,10-tetracarboxylic-dianhydride (PTCDA) on potassium chloride (KCl(001)) at room temperature. While submonolayers of the same compound deposited on muscovite mica exhibit absorption bands of similar width as in solution spectra [1], the full width at half maximum of a submonolayer PTCDA on KCl(001) is 3 times smaller. The molecular layer starts to crystallize immediately once a thickness of 1 monolayer (ML) is reached, accompanied with the absorption development towards the well-known spectrum of PTCDA crystallites.

As the spectral width is usually caused by inhomogeneous broadening, we are going to present low-temperature AFM measurements, which exhibit a very unusual structure of the PTCDA submonolayers on KCl, where all molecules are commensurately aligned in rows rather than in the common herringbone structure, therefore experiencing the very same local environment. On top of the aggregated islands one observes the herringbone arrangement, as reported for PTCDA islands on potassium bromide (KBr(001)) [2], which confirms nicely the optical assignment of polycrystalline PTCDA.

[1] H. Proehl et al., Phys. Rev. Lett., 2004, 93, 097403

[2] T. Kunstmann et al., Phys. Rev. B, 2005, 71, 121403

DS 2.5 Mon 12:15 H32

**Characterization and Modification of the Hexaphenyl Wetting Layer on Mica (001)** — ●PAUL FRANK<sup>1</sup>, GREGOR HLAWACEK<sup>2</sup>, CHRISTIAN TEICHERT<sup>2</sup>, and ADOLF WINKLER<sup>1</sup> — <sup>1</sup>Institute of Solid State Physics, TU Graz, Petersgasse 16, A-8010 Graz, Austria — <sup>2</sup>Institute of Physics, University of Leoben, Franz Josef Straße 18, A-8700 Leoben, Austria

In this contribution we investigate the hexaphenyl (6P) monolayer formation on mica (001) by surface science methods. The 6P films were prepared by organic molecular beam deposition (OMBD). TDS was used to get information on the monolayer formation. XPS and LEED were used to characterize the mica surface before 6P thin film deposition. All measurements were carried out under UHV conditions. In addition, the grown films were investigated ex-situ by AFM. The TDS measurements show that there exists a monolayer of flat laying 6P molecules on the untreated mica surface. The main goal of this work was to tailor the monolayer formation and for this purpose surface modifications were applied on the mica sample. The modifications have been realized through a change in surface composition or by a change of the surface structure. For this purpose, the surface was covered with a carbon layer via X-ray induced dissociation of 6P (change of surface composition) or sputtered, using low energy Ar<sup>+</sup> ion beams (change of surface structure). TDS and AFM investigations showed a significant change in the monolayer formation, from flat laying molecules on the untreated mica surface to upright standing molecules on the carbon covered as well as on the sputtered mica surface.

DS 2.6 Mon 12:30 H32

**Sub-nm control of the inter-layer spacing in thin films of intercalated rod-like conjugated molecules** — ●JÖRN-OLIVER VOGEL<sup>1</sup>, RICARDA OPITZ<sup>1</sup>, INGO SALZMANN<sup>1</sup>, STEFFEN DUHM<sup>1</sup>, BERT NICKEL<sup>2</sup>, JÜRGEN RABE<sup>1</sup>, and NORBERT KOCH<sup>1</sup> — <sup>1</sup>Humboldt-Universität zu Berlin, Berlin, Deutschland — <sup>2</sup>Ludwig-Maximilians-Universität, München, Deutschland

We present evidence for the mutual intercalation of three rod-like

molecular materials, which are widely used as active layers in molecular electronics:  $\alpha$ -sexithiophene (6T), its alkylated analogue  $\alpha,\omega$ -dihexylsexithiophene (DH6T), and p-sexiphenyl (6P). We co-deposited pairs of these molecular materials by organic molecular beam deposition on silicon oxide and Mylar (a polymeric gate insulator used in all-organic thin film transistors) and studied the properties of the resulting thin film samples by atomic force microscopy (AFM), X-ray diffraction (XRD), and infrared spectroscopy (IR). As a key result, we found evidence for mutual intercalation of the pairs 6T/DH6T and 6P/DH6T in thin films and no indications for phase separation. Furthermore, the inter-layer distance of neighbouring molecular layers could be varied almost linearly as function of the molecular mixing ratio in the range of ca. 2.3 nm to ca. 3.7 nm, which was brought about by the conformational flexibility of the DH6T hexyl-chains. Thus, vapour phase co-deposition of appropriate molecular material pairs appears to be a promising route towards controlling inter-layer spacing with sub-nm precision.

DS 2.7 Mon 12:45 H32

**Influence of gas molecules on the electrical characteristics of organic semiconductors** — ●HARALD GRAAF<sup>1</sup> and DERCK SCHLETTWEIN<sup>2</sup> — <sup>1</sup>Centre for nanostructured materials and analytics,

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The stability of the electrical characteristics of organic thin films under ambient conditions is one of the key issues on the way to a product. Gas molecules are an important factor to influence strongly the performance of a number of electronic devices.

We report here on the influence of some selected gas molecules on the electrical properties of organic thin films prepared from perylene dicarboxylic acid bis imides. Thin films of a crystalline (MePTCDI) and an amorphous representative (Cl<sub>4</sub>MePTCDI) were prepared by physical vapour deposition. As gas molecules oxygen was chosen as a typical ambient gas and ethanol, acetone and n-butane were chosen as representatives of processing solvents as well as volatile organic compounds in air quality monitoring. All studied gas molecules led to a change in the observed conductivity of the semiconducting films. Field effect measurements served to differentiate between changes in charge carrier mobility and charge carrier concentration and hence increase the selectivity of the measurements. The charge carrier mobility was found to decrease in all cases. Gas molecules which diffused into the bulk effected the mobility at least 10 times more efficiently than molecules whose interaction was restricted to the surface.[1]

[1] H. Graaf, D. Schlettwein, J.Appl.Phys. accepted