

DS 62: Organic Thin Films I

Time: Friday 10:15–11:45

Location: GER 38

DS 62.1 Fri 10:15 GER 38

AFM based density-of-states measurements on organic thin films — ●MARKUS KRATZER¹, IGOR BEINIK¹, ASTRID WACHAUER¹, MUJEEB ULLAH², HELMUT SITTE², and CHRISTIAN TEICHERT¹ — ¹Institute of Physics, University of Leoben, Franz Josef Straße 18, A8700 Leoben, Austria — ²Institute of Semiconductor and Solid State Physics, Johannes Kepler University of Linz, A4040, Austria

The performance of electrical devices based on organic materials crucially depends on the charge transport properties. For the understanding of the charge carrier transport in organic molecular films knowledge on the density of states (DOS) is of fundamental importance. In this study, we present DOS measurements based on Kelvin Probe Force Microscopy (KPFM) [1, 2] of the organic n-type semiconductor C₆₀ and the p-type semiconductor Para-hexaphenyl (6P). For the n-type conductor, the electron DOS and for the p-type conductor the hole density of states can be derived from the KPFM data. For this purpose, organic thin film transistor structures were prepared utilizing Hot Wall Epitaxy. The substrate temperature during deposition was varied between 273 K and 423 K resulting in films of different degrees of crystallinity. KPFM was then applied in inert atmosphere to prevent degradation of the films by oxidation. The results are discussed.

Supported by Austrian Science Fund (FWF) NFN projects S9706-N20, S9707-N20 and P19636.

[1] M. Nonnenmacher, et.al Appl. Phys. Lett. 58, 2921, (1991).

[2] O. Tal, et.al Phys. Rev. Lett. 95, 256405 (2005).

DS 62.2 Fri 10:30 GER 38

Structure formation during deposition of organic films on inorganic substrates - experiments vs. modeling — ●FLORIAN SZILLAT and S. G. MAYR — Leibniz-Institut fuer Oberflaechenmodifizierung, Translationszentrum fuer regenerative Medizin und Fakultat fuer Physik und Geowissenschaften der Universitaet Leipzig, 04318 Leipzig

Organic-inorganic interfaces are of strongly increasing scientific interest, as they occur in a broad range of areas, including biomaterials and organic semiconductors. Detailed experimental and theoretical understanding - in particular of the inorganic/organic interaction and the resulting implications with respect to mechanical properties and structure - is still lacking. In the present study we investigate organic thin films which are grown from vapor on metal surfaces and focus on structure evolution during growth. Whereas poly(bisphenol A) carbonate - as a model system - is deposited via thermal evaporation. Characterization of structure formation is based primarily on atomic force microscopy measurements. Complementary, stochastic rate equations with surface free energy and interface potential driven surface diffusion as a central process are employed to model structure evolution. From an excellent agreement of experiments and simulations conclusions on the interface potential as well as underlying physics of structure formation can be drawn. This project is funded by the German BMBF, PTJ-BIO, Grant Number: 0313909

[1] C. Vree and S.G. Mayr, Applied Physics Letters 94 (2009) 093110

DS 62.3 Fri 10:45 GER 38

Templating effect for organic heterostructure film growth: Perfluoropentacene on Diindenoperylene — ●ALEXANDER GERLACH¹, ALEXANDER HINDERHOFER¹, TAKUYA HOSOKAI¹, CHRISTIAN FRANK¹, JIRÍ NOVÁK², and FRANK SCHREIBER¹ — ¹Institut für Angewandte Physik, Universität Tübingen, 72076 Tübingen, Germany — ²ESRF, BP 220, 38043 Grenoble Cedex 9, France

We present a systematic study of templating effects in organic heterostructure growth, i.e. the growth behavior of the top layer depends on the structural and morphological properties of the bottom layer [1,2]. We prepared thin films of the electron donor diindenoperylene (DIP) each with different crystal structure, grain size, and grain orientation. The electron acceptor perfluoropentacene (PFP) was evaporated on those template layers to form an organic heterostructure. Using x-ray reflectivity, grazing incidence x-ray diffraction, and atomic force microscopy we show that the structure and morphology of the PFP film varies with the properties of the DIP layer underneath. Two main structural effects are observed: PFP molecules in the top layer adopt partly the orientation of the DIP molecules in the bottom layer and the crystalline quality of the PFP layer correlates with the crys-

tallinity of the DIP layer in terms of the coherent in-plane island size. Moreover, we find that the morphology and particularly the shape of the PFP domains depend strongly on DIP template layer.

[1] A. Hinderhofer et al., *Europhys. Lett.* **91** 56002 (2010).

[2] A. Hinderhofer et al., *submitted* (2010).

DS 62.4 Fri 11:00 GER 38

Structure solution of organic surface-induced polymorphs by x-ray diffraction reciprocal-space mapping — ●INGO SALZMANN¹, DMITRII NABOK², MARTIN OEHZELT³, STEFFEN DUHM⁴, ARMIN MOSER⁵, GEORG HEIMEL¹, PETER PUSCHNIG², CLAUDIA AMBROSCH-DRAXL², JÜRGEN P. RABE¹, and NORBERT KOCH¹ — ¹Humboldt-Universität zu Berlin, Germany — ²Montanuniversität Leoben, Austria — ³Johannes Kepler Universität Linz, Austria — ⁴Chiba University, Japan — ⁵Graz University of Technology, Austria

Thin films of pentacenequinone (PQ) and perfluoropentacene (PFP) on silicon oxide (SiO_x) and highly oriented pyrolytic graphite (HOPG) were investigated by x-ray diffraction reciprocal space mapping (RSM) providing the unit cell parameters of the respective substrate induced polymorphs (SIPs). In contrast to the monoclinic single-crystal phases (SCPs), RSM yields triclinic unit-cells for PQ and PFP on HOPG and for PQ on SiO_x, the latter with only one molecule per unit cell. Therefore, in contrast to its SCP, PQ does not exhibit a molecular herringbone arrangement in the SIP. It is shown that the same PFP SIP as found on HOPG grows on Au(111), Ag(111) and Cu(111), therefore demonstrating that, owing to the fiber texture of HOPG, growth investigations on HOPG can act as technique for SIP determination on metallic single crystalline substrates, where RSM cannot be applied. For both SIPs on SiO_x full structure solutions are derived via force-field calculations and used for comparative electronic structure calculations of the two PQ polymorphs demonstrating significantly wider dispersion of the lowest unoccupied molecular orbital-derived band.

DS 62.5 Fri 11:15 GER 38

Reversible light-controlled capacity switching of chromophore based metal/polymer nanocomposites — ●CHRISTINA PAKULA¹, SRI WAHYUNI BASUKI¹, VLADIMIR ZAPOROJTCHEKNO¹, THOMAS STRUNSKUS¹, DORDANEH ZARGARANI², RAINER HERGES², and FRANZ FAUPEL¹ — ¹Institut für Materialwissenschaft - Materialverbunde, Technische Fakultät der Christian-Albrechts-Universität zu Kiel, Kaiserstr. 2, 24143 Kiel, Germany — ²Institut für Organische Chemie, CAU Kiel, Otto-Hahn-Platz 4, 24098 Kiel, Germany

Electro-optical switching based on photochromism is under extensive research nowadays, due to applications in the new generation of organic electronics ranging from non-linear optical devices and optical switches to information storage. We report on photo-switchable AC conductance of nano sheet capacitors which are produced by sandwiching some hundred nm or μm thick polymer films containing dissolved chromophores between transparent percolated Pt nanoparticle electrodes. The photoactive thin polymer films show a complete and fully reversible switching of the capacitance with changes > 50% [1]. This change is correlated to the azo dye concentration. We observe an increase in the capacitance change with increasing temperature below and also in a small range above the glass transition temperature of the polymer blend. The dependence of the capacitance changes on the irradiation wavelength and on application of an electrical field under irradiation is discussed.

[1] Zaporojtchenko, V, Pakula, C, Basuki, SW, Strunskus, T, Zargarani, D, Herges, R, Faupel, F Applied Physics A, accepted.

DS 62.6 Fri 11:30 GER 38

Electronic structure of diindenoperylene-fullerene heterojunctions — ●ANDREAS WILKE¹, JULIA WAGNER², MARK GRUBER², JOHANNES FRISCH¹, PATRICK AMSALEM¹, ANTJE VOLLMER³, BENJAMIN BRÖKER¹, ANDREAS OPITZ², WOLFGANG BRÜTTING², and NORBERT KOCH¹ — ¹Humboldt-Universität zu Berlin, Brook-Taylor-Str. 6, 12489 Berlin — ²Universität Augsburg, Universitätsstr. 1, 86135 Augsburg — ³Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Albert-Einstein-Straße 15,12489 Berlin

In organic photovoltaic cells (OPVCs) typically two organic materials with electron- acceptor and donor character are sandwiched between anode and cathode, forming either layered planar (PHJ) or bulk het-

erojunctions (BHJ), where charge separation occurs. We report on ultraviolet photoelectron spectroscopy (UPS) measurements on PHJ and BHJ of the donor diindenoperylene (DIP) and the acceptor C60. The results on energy level alignment at these heterojunctions are then discussed in comparison to the energy conversion efficiency achieved in corresponding OPVCs, which peaked at 4.1%. The offset between the highest occupied molecular orbital of DIP and the lowest unoccu-

pled molecular orbital of C60, an estimate for the maximum achievable open circuit voltage, is 1.3 eV and 1.35 eV for the PHJ and BHJ, respectively. For comparison, OPVCs exhibited open circuit voltages up to 0.93 V. Our results demonstrate close agreement between the donor/acceptor energy level alignment and the open circuit voltage in devices and that induced carriers at contacts are beneficial for the energy conversion efficiency of OPVCs.