

## DS 65: Organic Thin Films IV

Time: Friday 16:00–17:30

Location: GER 38

DS 65.1 Fri 16:00 GER 38

**Changes in optical absorption during film growth** — ●HARALD GRAAF<sup>1</sup>, CHRISTOPHER KEIL<sup>2</sup>, and DERCK SCHLETTWEIN<sup>2</sup> — <sup>1</sup>Center for nanostructured Materials (nanoMA), Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz — <sup>2</sup>Institut für Angewandte Physik, Justus-Liebig-Universität Gießen, 35392 Gießen

The optical properties of organic thin films are mainly dominated by the (ordered) arrangement of the molecules in the solid. Beside this also the interface to the substrate influences the optical characteristics. This can be seen in absorption measurements taken during the growth of such thin films. Here a clear blue shift of the lowest energy transition with decreasing film thickness can be obtained.

In the literature different explanations are given: decrease in dimension of coupled aggregates [1], quantum confinement of the layer [2], missing nearest neighbour approximation [3] and microscopic polarizability [4]. We will show recent results on different organic materials with comparable optical properties in solution but diverse properties in the bulk. Also changes in the substrate will be presented and discussed with regard to the suggested models.

- [1] Chau et al. J.Phys.Chem. 97 (1993) 2699
- [2] Shen et al. Phys.Rev.B 55 (1997) 10578
- [3] Heinemeyer et al. Phys.Rev.Lett. 104 (2010) 257401
- [4] Beckers et al. J.Phys.:Condens.Matter 10 (1998) 1721

DS 65.2 Fri 16:15 GER 38

**In situ studies of real-time changes in the optical spectrum of organic semiconducting thin films during growth** — ●KATHARINA BROCH<sup>1</sup>, UTE HEINEMEYER<sup>1</sup>, ALEXANDER HINDERHOFER<sup>1</sup>, REINHARD SCHOLZ<sup>2</sup>, ALEXANDER GERLACH<sup>1</sup>, and FRANK SCHREIBER<sup>1</sup> — <sup>1</sup>Universität Tübingen, Institut für Angewandte Physik, Auf der Morgenstelle 10, 72076 Tübingen — <sup>2</sup>Technische Universität Dresden, Institut für Angewandte Photo-physik, 01062 Dresden

Fundamental issues related to organic semiconductors, such as interface effects and molecular coupling mechanisms, and in particular their influence on optical properties of the systems studied are still not thoroughly investigated. Real-time measurements are well suited for such studies since they enable the observation of possible transient structures and related features in the optical spectra of the films during growth. Using differential reflectance spectroscopy we performed real-time *in situ* studies of optical spectra during thin film growth of several prototype organic semiconductors (pentacene, perfluoropentacene, and diindenoperylene) on SiO<sub>2</sub>. These data provide insight into surface and interface effects that are of fundamental importance and of relevance for applications in organic electronics [1]. We observe spectral changes - such as energy shifts and new transitions in specific systems - that decay inversely proportional to the film thickness in the simplest approximation, caused by the different molecular environment and structural changes within the first few monolayers with respect to the bulk.

- [1] U. Heinemeyer et al., Phys. Rev. Lett. **104**, 257401 (2010)

DS 65.3 Fri 16:30 GER 38

**Online monitoring of the adsorption and release of proteins on thin organic functional surfaces using infrared spectroscopic ellipsometry** — ●DENNIS AULICH<sup>1</sup>, EVA BITTRICH<sup>2</sup>, KLAUS-JOCHEN EICHHORN<sup>2</sup>, PETRA UHLMANN<sup>2</sup>, MANFRED STAMM<sup>2</sup>, NORBERT ESSER<sup>1</sup>, and KARSTEN HINRICHS<sup>1</sup> — <sup>1</sup>Leibniz-Institut für Analytische Wissenschaften - ISAS - e.V., Albert-Einstein-Str.9, 12489 Berlin, Germany — <sup>2</sup>Leibniz-Institut für Polymerforschung Dresden e.V., Hohe Str. 6, 01069 Dresden, Germany

Infrared spectroscopic ellipsometry (IRSE) is a well established method for optical and structural analysis of ultra-thin organic films. However, *in-situ* measurements in the infrared range are limited in aqueous environments due to the low penetration depth of infrared radiation in water. An *in-situ* cell which was developed at ISAS in Berlin allows IRSE measurements of ultra-thin organic films in aqueous environments by probing the interface region through the back side of a silicon wedge. The adsorption and release of proteins such as human serum albumin (HSA) on functional surfaces was studied using *in-situ* IRSE. A polyelectrolyte brush prepared from poly(acrylic acid) was used for the controlled adsorption and release of the protein. The thickness of

this functional surface was about 5 nm. Adsorption and release was controlled by adjusting the pH of an aqueous solution and monitored by measuring the amid I and II bands of the protein.

DS 65.4 Fri 16:45 GER 38

**Electronic Coupling and Charge Transfer between Metals and Epitaxial Organic Layers** — ●ROMAN FORKER and TORSTEN FRITZ — Friedrich-Schiller-Universität Jena, Institut für Festkörperphysik, Max-Wien-Platz 1, 07743 Jena, Germany

When molecules are adsorbed on metals, several processes may occur, such as the “push-back-effect”, chemical interaction, the formation of interface states or even charge transfer (CT) between substrate and adsorbate. The strength and in part also the direction of such effects strongly depend on the molecule-metal combination and, additionally, on the specific structure(s) formed [1].

Here we investigate epitaxial mono- and multilayers of 3,4,9,10-perylene tetracarboxylic dianhydride (PTCDA) *in situ* on various metal surfaces by a variant of optical absorption spectroscopy. During film growth we observe pronounced changes in the spectra from the first monolayer (ML) to 2 ML and higher film thicknesses. While our results suggest the formation of radical cations in the *second* ML of PTCDA on Au(111) and Au(100) [2], the situation on Ag(111) is somewhat different. There, no clear indications for charged molecules were observed. On aluminum surfaces we conclude that the direction of the charge transfer is reversed, i.e., the spectral signature of PTCDA anions becomes visible. This gives rise to the interpretation that the electronic properties of the metal substrate, in particular the work function, determine the occurrence of charge transfer.

- [1] S. Braun *et al.*, Adv. Mater. **21** (2009), 1450.
- [2] R. Forker *et al.*, Org. Electron. **10** (2009), 1448.

DS 65.5 Fri 17:00 GER 38

**Coupling effects in mixed pentacene/perfluoropentacene thin films studied by Raman and photoluminescence spectroscopy** — ●FALK ANGER<sup>1,2</sup>, J. ORIOL OSSÓ<sup>2</sup>, UTE HEINEMEYER<sup>1</sup>, KATHARINA BROCH<sup>1</sup>, REINHARD SCHOLZ<sup>3</sup>, ALEXANDER GERLACH<sup>1</sup>, and FRANK SCHREIBER<sup>1</sup> — <sup>1</sup>Institut für Angewandte Physik, 72076 Tübingen — <sup>2</sup>Matgas 2000 AIE, Campus de la UAB, 08193 Bellaterra, Spain — <sup>3</sup>Walter Schottky Institut, TU München, 85748 Garching

One of the crucial issues in complex organic electronic device structures is the coupling between different organic components. Perfluoropentacene (PFP) and pentacene (PEN) form a donor-acceptor system and are expected to promote intermixing due to their structural similarity, which also raises the chance of spectral coupling [1, 2]. Blended PEN/PFP thin films (ratio 4:1, 1:1, and 1:2) are investigated by photoluminescence (PL) and resonant Raman spectroscopy using different wavelengths covering the main absorption features of pure and mixed films. The results point towards substantial coupling between the two components. Contrary to pure PEN and PFP, the mixtures reveal at low temperatures a pronounced PL-peak at around 1.4 eV. Raman spectroscopy shows a dependence of the strength of PEN and PFP peaks on the mixing ratio and the excitation wavelength. While both PEN and PFP peaks are observed for excitation at 488 nm and 514 nm, at 633 nm the strength of vibrational modes depends drastically on the mixing ratio.

- [1] A. Hinderhofer *et al.*, J. Chem. Phys. **127**, 194705 (2007)
- [2] K. Broch *et al.* *submitted*

DS 65.6 Fri 17:15 GER 38

**In Situ Surface Enhanced Raman Spectroscopy of Ultra-Thin CuPc Films** — ●MICHAEL LUDEMANN, OVIDIU D. GORDAN, and DIETRICH R. T. ZAHN — Semiconductor Physics, Chemnitz University of Technology

In order to characterize the vibrational properties of copper phthalocyanine (CuPc) films, specially designed substrates with metallic nanostructures are applied. Illuminating these substrates with a laser that meets the plasmonic resonance of the nanostructure gives rise to a dramatic enhancement of the Raman scattered intensity. This effect offers the possibility to detect ultra-thin films, even sub-monolayer coverage of CuPc molecules within short exposure times. For ultra-thin films strong enhancement is also found when the laser does not meet the designed resonance condition of the nanostructures.

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The samples are prepared by nanosphere lithography and CuPc is deposited by organic molecular beam deposition (OMBD) afterwards. The measurements are performed *in situ* under ultra-high vacuum (UHV) conditions. The focus of this work lies on the Raman inten-

sity dependence on the excitation wavelength and the influence of the CuPc layer thickness.