

DS 16: Organic Thin Films I

Time: Tuesday 14:45–16:15

Location: H32

DS 16.1 Tue 14:45 H32

Finite size effects in the excitonic line-shape of 2D ordered molecular aggregates — ●ALEXANDER EISFELD¹, MATHIAS MÜLLER², and MORITZ SOKOLOWSKI² — ¹MPI-PKS Dresden — ²Institut für Physikalische und Theoretische Chemie der Universität Bonn, Wegelerstrasse 12, 53115 Bonn, Germany

We consider molecules that are regularly arranged in a two-dimensional layer. The molecules can exchange excitation energy via transition-dipole-dipole interaction, which leads to the formation of a exciton-band. The arrangement is such that a J-aggregate is formed, i.e. the dominant absorption is red-shifted with respect to the non-interacting molecules.

Usually the absorption line-shape of the J-aggregate is much narrower than that of the individual monomers. Recent experiments on PTCDA molecules on a KCl surface showed an absorption line-shape that is considerably broadened. We will discuss possible mechanisms responsible for this broadening.

DS 16.2 Tue 15:00 H32

Electronic and Geometric Structure of PTCDI-C13 Molecules on SAM Modified Noble Metal Surfaces — ●DANIEL GEBAUER¹, PHILIP SCHULZ², TOBIAS SCHÄFER¹, DOMINK MEYER¹, INGOLF SEGGER¹, CAROLIN JACOBI¹, CHRISTIAN EFFERTZ¹, and MATTHIAS WUTTIG¹ — ¹I. Inst. of Physics (IA), RWTH Aachen Univ. — ²Dept. of Elect. Engineering, Princeton Univ.

The molecule N,N'-Ditridecylperylene-3,4,9,10-tetracarboxylic diimide (PTCDI-C13) is a promising semiconductor for organic thin film transistors (TFTs). It is well known that the interfacial design is one crucial aspect of device tuning. We have shown before that the modification of electrodes with dithiocarbamate (DTC) self-assembling monolayers leads to a significantly enhanced transistor performance [1]. To gain a deeper understanding of this mechanism we have performed an investigation at the interface of PTCDI-C13 and noble metal surfaces, which are modified by DTCs. Therefore we have prepared thermally evaporated, ultra-flat samples with (111)-orientation of noble metals on mica and subsequently deposited PTCDI-C13 monolayers on the metals with and without SAM-modification. The energy level alignment between the PTCDI-C13 and the DTC modified metal surfaces has been determined by Ultraviolet Photoelectron Spectroscopy (UPS), while the chemical binding is investigated by X-ray Photoelectron Spectroscopy (XPS). The molecular orientations of the molecules are analyzed by Fourier Transform Infrared Spectroscopy (FTIR).

[1] P. Schulz et al., 2011 MRS Fall Meeting U13.17

DS 16.3 Tue 15:15 H32

Spectroscopy on N-Type Doped Manganese Phthalocyanine — ●MICHAEL LUDEMANN¹, FRANCISC HAIDU¹, PHILIPP SCHÄFER¹, BENJAMIN MAHNS², DANIEL LEHMANN¹, OVIDIU D. GORDAN¹, JENS KORTUS³, MARTIN KNUPFER², and DIETRICH R.T. ZAHN¹ — ¹TU Chemnitz, 09126 Chemnitz, Germany — ²IFW Dresden, 01069 Dresden, Germany — ³TU BA Freiberg, 09596 Freiberg, Germany

In the fabrication processes of organic semiconductor devices, n-type doping of organic thin films still remains challenging. Intercalated alkali metals act as electron donors and thus increase the electrical conductivity of transition metal phthalocyanines [1]. In this study, manganese phthalocyanine (MnPc) thin films (5–100 nm) are prepared by organic molecular beam deposition (OMBD) under ultra-high vacuum (UHV) conditions. Doping is achieved via subsequent potassium (K) evaporation afterwards. Electron energy loss spectroscopy (EELS) [2] and *in situ* spectroscopic ellipsometry (SE) reveal that the optical properties of MnPc change dramatically during K doping. Finally, *in situ* online monitoring of the vibrational properties provides deep insight into the doping dynamics. In this work, the results obtained by EELS, SE, and Raman spectroscopy are compared, showing a formation of consecutive potassium doped MnPc phases with distinct optical and vibrational properties.

[1] M. F. Craciun *et al.* J. Am. Chem. Soc. **127** (2005) 12210

[2] B. Mahns *et al.* J. Chem. Phys. **134** (2011) 194504

DS 16.4 Tue 15:30 H32

Changes in glassy polymers induced by light — ●IOAN

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We have experimentally compared the photoluminescence (PL) emission from a thin film of conjugated poly[2-methoxy-5-((2'-ethylhexyl)oxy)-1,4-phenylvinylene] (MEH-PPV) embedded in a polystyrene (PS) inert matrix, with and without exposure to light. A systematic variation of temperature, conjugated polymer content in the PS inert matrix and film thickness revealed an increase of PL of up to 30% for films exposed to light of wavelength shorter than 700 nm. The increase in PL was higher for thinner films containing 100% MEH-PPV and kept at 35 °C (at this temperature both MEH-PPV and PS are glassy) during 1 hour of illumination. All experiments were performed under nitrogen atmosphere. We tentatively propose that this enhancement of PL is due to changes in conformation induced even in the glassy state of conjugated molecules through photoexcitations. Deformation of conjugated molecules by light might lead to a reduced phonon-exciton coupling of these polymer chains, i.e. to better PL emission.

DS 16.5 Tue 15:45 H32

Encapsulated metal nanoparticles for absorption enhancement of thin film organic photovoltaic cells — ●VERENA KOLB^{1,2}, ANDREAS STEINDAMM^{1,3}, MICHAEL BRENDL^{1,3}, MARTIN KAMP⁴, and JENS PFLAUM^{1,3} — ¹Experimental Physics VI, Julius Maximilians University of Würzburg, 97074 Würzburg — ²Center for Nanosystems Chemistry, 97074 Würzburg — ³ZAE Bayern, 97074 Würzburg — ⁴Technical Physics, Julius Maximilians University of Würzburg, 97074 Würzburg

Utilization of plasmonic effects at metal nanoparticle surfaces provides an interesting approach to modify the optical properties of molecular thin films and thereby, to enhance their effective absorption. This enhancement is caused by an increase of the near-field component and the scattering of incident light and might be applied in e.g. organic photovoltaic (OPV) cells. However, as a drawback such metal particles are able to quench the photogenerated excitons and trap free charges. An encapsulation of the particles may help to reduce these loss mechanisms. In this contribution we present our latest results on preparation of encapsulated metal particles and their influence on thin layers of the organic semiconductor Diindenoperylene (DIP). Optical effects are measured via UV/VIS and photoluminescence spectroscopy. Finally DIP/C₆₀ OPV cells with embedded particles were built and electrically and optically characterized. Financial support by the Solar Technologies go Hybrid project is gratefully acknowledged.

DS 16.6 Tue 16:00 H32

Effect of fluorination: Optical properties of Rubrene in films and solution — ●FALK ANGER¹, REINHARD SCHOLZ², EVELYN ADAMSKI¹, KATHARINA BROCH¹, ALEXANDER GERLACH¹, YOICHI SAKAMOTO³, TOSHIYASU SUZUKI³, and FRANK SCHREIBER¹ — ¹Institut für Angewandte Physik, Auf der Morgenstelle 10, 72076 Tübingen — ²Institut für Angewandte Photophysik, TU Dresden, 01069 Dresden — ³Institute for Molecular Science, Myodaiji, Okazaki 444-8787, Japan

A promising way to modify the electronic levels of organic semiconductors is partial or complete fluorination, potentially with further opportunities opening up by mixing these compounds with the hydrogenated version [1]. We present the optical properties of newly synthesised fully (C₄₂F₂₈) and half-fluorinated (C₄₂F₁₄H₁₄) rubrene, both in thin films and as monomers in solution, and compare them to hydrogenated rubrene (C₄₂H₂₈, RUB) [2]. Remarkably, all three compounds show similar optical absorption bands and photoluminescence line shapes. The results are interpreted with density functional calculations of the orbital energies and time-dependent density functional theory for the HOMO-LUMO transition [3]. Red shifts induced by the surrounding solvent or organic thin films remain much smaller than for polyacenes, in keeping with previous observations for rubrene and existing models for the solvatochromic shifts. We discuss implications for applications of the new material.