

CPP 12: Poster: Electronic and Optical Properties of Organic Systems

Time: Monday 16:30-18:00

Location: Poster C

CPP 12.1 Mon 16:30 Poster C

Photo-Induced Phase Changes in Azobenzene-Containing Materials — Hubert Audoirff¹, Lothar Kador¹, Roland Walker², and Hans-Werner Schmidt² — ¹University of Bayreuth, Institute of Physics and BIMF, D-95440 Bayreuth, Germany — ²University of Bayreuth, Macromolecular Chemistry I and BIMF, D-95440 Bayreuth, Germany

The photo-induced formation of liquid-crystalline phases in azobenzene-containing amorphous materials is demonstrated. Liquid-crystalline polymers and low-molecular-weight glass formers can be quenched into a stable amorphous phase at room temperature. During the inscription of holographic intensity gratings, the illuminated areas become liquid-crystalline, which stabilizes the orientation of the azobenzene units, leading to stable gratings. Another advantage of the quenched polymeric materials is that the writing times are shorter by several orders of magnitude as compared to liquid-crystalline azobenzene compounds. With a series of low-molecular-weight tri-azobenzene derivatives, a remarkably stable light-induced orientation of the chromophores in initially amorphous thin-film architectures is demonstrated for the first time. The liquid-crystalline character is caused by spacers between the tris-functionalized benzene core and the three azobenzene moieties as well as polar end groups. The formation of the liquid-crystalline phase manifests itself in a pronounced post-development of the inscribed gratings, i. e., an increase of the diffraction efficiency after the end of the writing process.

CPP 12.2 Mon 16:30 Poster C

Frequency-Domain FLIM Measurements of Fluorophore Mixtures with a Custom-Built Low-Cost Setup — Thomas Bezd and Lothar Kador — University of Bayreuth, Institute of Physics and Bayreuther Institut für Makromolekülforschung (BIMF), 95440 Bayreuth, Germany

Fluorescence lifetime imaging microscopy (FLIM) in the frequency domain is applied to different binary mixtures of fluorophores. The custom-built setup is based on a confocal microscope and employs standard communications-type radiofrequency electronics. Excitation is performed with a cw laser which is amplitude-modulated with an acousto-optic modulator (AOM). Modulation frequencies between 25 and 50 MHz are generated with a computer-controlled direct digital synthesizer (DDS). The fluorescence signal of the sample is demodulated at the exact frequency of 70 MHz with an I-Q demodulator. Its modulation amplitude and phase shift with respect to the excitation yield information about the fluorescence lifetime(s) in the sample. Single- and bi-exponential fluorescence decays are analysed with a polar-plot technique [1].

[1] G. I. Redford and R. M. Clegg, *J. Fluor.* 15, 805 (2005).

CPP 12.3 Mon 16:30 Poster C

Soft x-ray dichroism to explore the molecular orientation using scanning x-ray transmission microscopy (STXM) — Stephan Wenzel, Andreas Späth, Christian Hub, and Rainer H. Fink — ICMM, Univ. Erlangen, Egerlandstraße 3, 91058 Erlangen, Germany

Scanning transmission soft X-ray microspectroscopy (STXM) has proven excellent spatial resolution (< 20 nm) in combination with spectroscopic information to investigate ultrathin samples. The superior information relies on the photon-energy specific absorption which offers high elemental and chemical contrast. Soft x-ray linear dichroism is established to analyze the molecular orientations in thin film or bulk samples from the angle-dependent absorption. In conventional STXM, the incident angle is fixed by the microscopy geometry. We demonstrate how a rotational device can be used to derive the molecular orientations in organic nano- and microcrystals. We present microspectroscopic studies of TCNQ, NTCDA and NDC1-nanocrystals prepared on commercial Si₃N₄ membranes. We compare the derived structures from different spectral analysis routines, i.e. stack analysis of images and from line scans. The work is funded by the BMBF under contract 05KS7WE1.

CPP 12.4 Mon 16:30 Poster C

Optical analysis of trap states in amorphous organic semiconductor films — Harald Graaf¹, Frank Friedriszk^{1,2}, and

Christian von Borczyskowski¹ — ¹Center of nanostructured Materials and Analytics, Chemnitz University of Technology, 09126 Chemnitz, Germany — ²Institut für Physik, Universität Rostock, 18051 Rostock, Germany

Increasing interest is drawn on thin organic semiconductor films in opto-electronic devices. While for applications like field-effect transistors and photovoltaic cells highly ordered morphologies resulting in higher charge carrier mobilities are requested, for other purposes like organic light emitting diodes amorphous arrangement of the molecules is needed. Here lower mobilities increase the recombination rate leading to a higher photon yield. In such systems trap states can influence dramatically the luminescence in its intensity and spectral regime.

We will show recent results on amorphous films of a perylene dye with a rather high concentration of trap states. These trap states act as sinks for the excitons and leads therefore to a clear shift of the luminescence to the red compared to the monomer emission. Temperature depended and time resolved measurements give a clear hint for the population of the traps from the exciton band. Comparisons with previous electrical measurements lead us to the assumption, that these traps are also dominating the charge carrier mobility within the material.

CPP 12.5 Mon 16:30 Poster C

Enwrapping of tubular J-aggregates using dye-labeled polyelectrolytes — Omar Al-Khatib^{1,2}, Helmut Mähwald¹, Jürgen P. Rabe², Christoph Böttcher³, and Stefan Kirstein² — ¹Max-Planck-Institute of Colloids and Interfaces, Potsdam, Germany — ²Humboldt University Berlin, Department of Physics, Germany — ³Freie Universität Berlin, Researchcenter for Electron Microscopy, Germany

In this contribution we demonstrate the coating of tubular J-aggregates with dye-labeled polyelectrolytes. The tubular J-aggregates are formed by an amphiphilic cyanine dye in aqueous solutions [1]. Due to the amphiphilic character of the molecules their aggregates possess a negatively charged surface, which can be utilized for the adsorption of oppositely charged polyelectrolytes. Poly(diallyldimethylammonium chloride) (PDAC) and poly(allylamine hydrochloride) (PAH) labeled with different fluorescent dyes may act as donors or acceptors within a Förster energy transfer (FRET) process.

The enwrapping is verified by cryogenic transmission electron microscopy (cryo-TEM). The FRET is investigated by means of optical absorption and fluorescence spectroscopy. These experiments provide evidence for energy transfer between the aggregate and the dye-labeled polyelectrolyte shell.

[1] S. Kirstein, S. Dähne, *International Journal of Photoenergy*, Volume 2006, Article ID 20363, 1-21

CPP 12.6 Mon 16:30 Poster C

Spectroscopic and Theoretical Investigations on Pd(II) and Pt(II) Dithiocarbamates — R. Wenzel¹, D. Forrer², S. Gross², M. Casarin², D. Montagner², A. Vitadini², M. Helm¹, E. Tondello², and S. Gemming¹ — ¹FZ Dresden-Rossendorf, Dresden, Germany — ²Dept. of Chemistry Univ. Padua, Padua, Italy

In coordination chemistry, the nature and strength of the metal-ligand interaction has attracted much interest. Metal-sulfur complexes, in particular in comparison with their oxygen-based analogues, are intriguing as the sulfur atoms are polarized more easily. The use of specifically tailored sulfur-based ligands allows for tuning the complex functional properties. Among them, electronic properties are very sensitive to changes in the sulfur coordination sphere, suggesting potential uses as molecular switches in optoelectronic devices. Metal dithiocarbamates [R₂NCS₂]_nM have been extensively studied by IR and UV-vis. spectroscopy, ESR and to a limited extent XPS and UPS. Here, we present experimental and theoretical studies investigating the electronic properties of a series of dithiocarbamates of Pd(II) and Pt(II): the pyrrolidine-based one and the 1-pyrrolidinecarbodithioate methyl ester (PyDTM). MX₂(PyDTM) (M = Pt/Pd; X = Cl/Br) were analyzed by XPS and by FT-IR spectroscopy. DFT calculations yielded details on the electronic structure and allowed for unambiguous assignment of the IR spectral features. Ionization energies were evaluated with the asymptotically correct LB94 potential and the two components ZORA.