**HL 85: Organic Semiconductors: Transistors and OLEDS**

**Time:** Thursday 15:00–17:30  
**Location:** EW 203

**New material combinations for ion gel gated organic thin film transistors**  
**Joanna Schlictholz, Karlsruhe Institute of Technology, Germany**  
**Heiko B. Weber, Universität Erlangen-Nürnberg, Erlangen, Germany**  
**Ahmad Shazada, Universität Heidelberg, Germany**

Ion gels can efficiently gate thin film transistors made from small molecules. Sharing the same benefits as ionic liquids, they are easier to handle and promise better reproducibility and reliability. In type II-transistors fabricated from PCBM and custom-made pentacene dimer derivatives, PdF/ [BF4]- and PdF/ [EMIm]-[TF2N]-ion gels were used as top gates, using P3HT as a standard semiconductor for comparison.

**IR spectroscopy at the ITO-organic interface**  
**Milan Alt, Universität Heidelberg, Germany**  
**Akemi Tamanai, Universität Heidelberg, Germany**  
**Danny Reuter, Universität Heidelberg, Germany**  
**Jens Tönshoff, Universität Heidelberg, Germany**

Thin films of P3HT have been prepared by spin coating and electrochemical polymerization on platinum- and ITO-coated substrates. Additionally, P3HT-films on silicon substrates have been prepared by spin coating only. The measured IR spectra of the spin coated films allowed for an elaboration of a detailed optical model for P3HT, which has been used to simulate IR reflection-absorption spectra on ITO and Pt substrates. Comparison of simulated spectra with measurements revealed no substrate influence on the IR spectra for the spincoated films.

In case of spincoated P3HT-films on ITO-substrate, the obtained IR spectra correspond to simulation data very well up to 6000 wavenumbers. In the electropolymerized P3HT films we have identified residuals in the spectra of the electropolymerized P3HT films on Pt substrate could be explained reasonably well as a superposition of chemically doped P3HT and the ionic electrolyte, the IR spectra of electropolymerized P3HT films on ITO substrates showed strongly dependence-time dependent deviations. These were most likely related to varying properties of the ITO surface between reference and sample measurement due to an interaction of ITO and the electrolyte at the film-substrate interface.

**Bio-functionalization of electrolyte-gated organic transistors**  
**Felix Buth, Andreas Donner, Ayshwarya Pillai, Martin Stutzmann, Jose Antonio Garido, Walter Schottky Institut, Technische Universität München, Garching, Germany**

Electrolyte-gated organic field-effect transistors (EGOFETs) can be operated at low voltages in aqueous environments, paving the way to the use of organic semiconductors in bio-sensing applications. However, it has been shown that these devices exhibit inherently a rather weak sensitivity to relevant electrolyte parameters such as pH and ionic strength. In order to increase this sensitivity and add specificity to the device surface would be desirable. In this contribution we demonstrate the successful attachment of different silane molecules, which serve as linker molecules for the subsequent grafting of bio-molecules, to the surface of a-sciithiophene-based thin film transistors. Using surface characterization techniques like X-ray photoemission and infrared spectroscopy we could confirm the presence of functional groups on the surface, which are stable under standard electrolytic conditions. As expected, the presence of these amphoteric groups (e.g. amino or carboxylic moieties) increases the pH-sensitivity of the EGOFETs. In addition, they can serve as anchoring sites for further bio-functionalization steps. These results confirm the potential of the EGOFETs for chemical- or biochemical-sensing applications.

**Tuning the Surface Properties of Gold Electrodes in Organic Field-Effect Transistors Using Self-Assembled Monolayers**  
**Janusz Schinke, Universität Heidelberg, Germany**  
**Sebastian Beck, Universität Heidelberg, Germany**

In organic electronic devices, charge injection at the contacts is crucial for better electrical performance. In bottom-contact p-channel organic field-effect transistors (OFET), Au electrodes are very often used for drain and source contacts. A smart way of enhancing the device’s performance is the use of self-assembled monolayers (SAMs) to tune the electrodes’ work function or substrate conditions for deposition of the organic semiconductor. We have studied the properties of SAM-treated gold surfaces via Atomic Force Microscopy (AFM), Kelvin Probe (KP) and contact angle measurements. SAMs used for this work include fluorinated and non-fluorinated alkyl thiols. We compare the characteristics of SAM-treated OFETs using TIPS-pentacene as an organic semiconductor to standard devices. The gold electrode is subsequently treated by several SAM solutions to manipulate the effective work function and the device performance. Comparing to untreated OFETs, we see an enhancement of the mobility by two orders of magnitude and a significant reduction of the threshold voltage.

**Investigation of Triplet Exciton Dynamics in Fluorescent Polymer Light-Emitting Diodes**  
**Boho Wallukewan, Simon Gélianos, Dinesh Kabra, and Richard Friend — University of Cambridge, Optoelectronics Group, Cavendish Laboratory, JJ Thomson Avenue, Cambridge, CB3 0HE, UK**

We report on fluorescent, polymer light-emitting diodes with a high external quantum efficiency of 6.5 %. To understand the high efficiency of these PLEDs, we investigated excited state dynamics on working polymer light-emitting diodes using transient, time-resolved optical absorption spectroscopy and transient, time-resolved electroluminescence measurements. By fitting a model for triplet decay to the experimental transient and electroluminescence dynamics, we are able to quantitatively characterize triplet-triplet annihilation as the dominant triplet decay mechanism. Singlet states generated from triplet-triplet annihilation contribute up to 33% of the total amount of singlets generated in these fluorescent devices. To model these results, we require that triplet states can undergo bimolecular annihilation several times. With this model, we show that singlets can reach a maximum fraction of 40% of all excitons generated by charge recombination, without...
violating spin statistics. Singlet states generated from triplet-triplet annihilation are one important explanation for high external quantum efficiencies found in these fluorescent devices.

**HL 85.7 Thu 16:45 EW 203**

**Extraction of trapped modes in organic light-emitting diodes via high-index coupling** — ÓBert Jürgen Scholz, Jörg Frischeisen, and Wolfgang Brütting — Institute of Physics, University of Augsburg, Germany

The efficiency of organic light-emitting diodes (OLEDs) is still limited by poor light outcoupling efficiency. In particular, the excitation of wave-guided modes in the organic layers and surface plasmon polaritons at metal-organic interfaces represent major loss channels. By combining optical simulations and experiments on simplified luminescent thin-film structures we elaborate the conditions for the extraction of surface plasmons via coupling to high-index media. As a proof-of-concept, we demonstrate the possibility to extract light from wave-guided modes and surface plasmons usually trapped in the OLED by a high-index prism.

**HL 85.8 Thu 17:00 EW 203**


In this study we present the feasibility of detecting single electrically driven molecules at room temperature. Thereby, phosphorescent iridium based dye molecules were employed as dopants in organic light emitting diodes (OLEDs). To be sensitive on electroluminescent emission from single isolated guest molecules we chose concentrations sufficiently low to render distances between next-neighboring molecules larger than the optical diffraction limit. By spectrally separating host-guest emission, optical properties and photon emission statistics of single electrically driven phosphorescent molecules could be analyzed. Besides proving that spectral properties of the dopant molecules are identical in optical and electrical excitation mechanisms, sub-poissonian non-classical photon statistics can be observed in the electroluminescence light of a single phosphorescent dye molecule at room temperature. This approach thereby shows a possible strategy towards electrically driven single photon sources at room temperature based on phosphorescent emitters.

**HL 85.9 Thu 17:15 EW 203**

**Untersuchung der Degradationsmechanismen in organischen Licht-emittierenden Dioden** — ÓMustapha Al Helwi1,2,4, Alexander Badinski2, Ute Heinemeyer2, Soichi Watanabe2, Gerhardt Wagenblast2, Ingo Münster2 und Wolfgang Kowalski1,3,4 — KIP, Universität Heidelberg, Heidelberg, Deutschland — 2BASF SE, Ludwigshafen, Deutschland — 3IHF, Technische Universität Braunschweig, Braunschweig, Deutschland — 4Innovation Lab GmbH, Heidelberg, Deutschland