

applied field. Considering the  $z$ -stacking direction the measured effect can be directly related to a change in the electric transport. The observed changes in structure are reversible and the current-voltage cycle can be repeated several times. For X-ray reflectivity major changes have been found close to critical angle of total external reflection indicating the film becomes less dense and increases in surface roughness with increase of the voltage. This change in surface behaviour could be confirmed by in-situ AFM measurements.

CPP 21.7 Wed 11:15 H37

**Thickness dependent structural order in P3HT films - a key parameter for high OFET mobility** — ●BENEDIKT GBUREK, RICHAR SHARMA, TORSTEN BALSTER, and VEIT WAGNER — School of Engineering and Science, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany

Applications of organic electronics require cheap and fast production methods on flexible substrates. Following these goals, top-gate OFETs on PET foils were used to analyze the dependence of the device characteristics on the crucial parameter of semiconductor layer thickness. The organic semiconductor, regio-regular P3HT, and the gate insulator were deposited by spin-coating under atmospheric conditions.

The charge carrier mobility was found to be rather low for extremely thin layers of several nanometers only. However, with increasing layer thickness, mobility increases by two orders of magnitude until a "saturation thickness" of 50 nm, above which it remains constant.

Further details of the ordering were extracted according to the Vissenberg-Matters model with gate-voltage dependent mobility  $\mu = \mu_0 ((V_{GS} - V_{th})/1V)^\gamma$ , where  $\gamma$  is directly related to the width of the density of states. The analysis reveals that the disorder parameter  $\gamma$  decreases from 3.1 to 1.0 over the examined thickness range, which explains the low mobility of thinner films by higher energetic disorder.

This analysis proves to be highly advantageous as it represents the whole transfer curve, gives better comparability and offers more physical insight. Our study demonstrates the crucial role of layer thickness tuning for improved film structure and optimum material performance.

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**Deposition of P3HT via dip coating onto transistors with channel lengths below 1  $\mu\text{m}$**  — ●SILVIU BOTNARASH, STEVE PITNER, and VEIT WAGNER — School of Engineering and Science, Jacobs University Bremen, Campus Ring 1, D-28759, Germany

A high quality interface between the organic semiconductor and the oxide is crucial for the high performance of an OFET. A good surface treatment is imperative, but it will lower the surface energy of the oxide, making it difficult to spin coat on it uniform semiconductor layers from solvents like chloroform or toluene. We report on the usage of the dip coating technique to achieve highly ordered layers of regioregular poly(3-hexylthiophene) (rr-P3HT). By varying the removal speed of the silicon substrate from solution, the concentration of the solution or both, one can achieve ultrathin layers of rr-P3HT which permit to analyze OFET properties in the sub-monolayer regime. Decreasing the channel length of the transistors down to the range of the contour length of the rr-P3HT is expected to improve the characteristics of the OFET's. An additionally applied electric field between the source and drain electrodes during dip coating facilitates the trapping of P3HT molecules on the electrodes increasing the performance of the device. We used rr-P3HT with an average contour length of 80-100 nm. Compared to previously reported results for chloroform based solutions, the same concentration range of rr-P3HT in toluene displayed better characteristics, which is believed to be due to lower evaporation rate of toluene. Subsequent drying in a nitrogen rich atmosphere over a period of up to 24 h positively influences the performance of the OFET's.

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**Semitransparent small-molecule organic solar cells** — ●JAN MEISS<sup>1</sup>, CHRISTIAN UHRICH<sup>2</sup>, STEFAN SONNTAG<sup>2</sup>, WOLF-MICHAEL GNEHR<sup>2</sup>, MARTIN PFEIFFER<sup>2</sup>, KARL LEO<sup>1</sup>, and MORITZ RIEDE<sup>1</sup> — <sup>1</sup>Institut für Angewandte Photophysik, Technische Universität Dresden, 01062 Dresden, Germany — <sup>2</sup>heliatek GmbH, Liebigstraße 26, 01187 Dresden, Germany

Semitransparent, colourful solar cells are of interest for a wide range of applications, e.g. sun shading of residential and office buildings or cars. Previously, among organics-containing devices, only semitransparent dye-sensitized solar cells showed power conversion efficiencies (PCE) that allowed first meaningful applications, whereas semi-transparent small-molecule organic solar cells (OSC) were limited to PCE well below 1%.

We present small-molecule semitransparent OSC deposited by thermal vacuum evaporation on ITO-coated glass. The organic materials include absorber materials and doped dedicated charge transport layers. Due to our unique device architecture, the top electrode is ITO-free, consisting only of an ultra-thin multi-layer metal film.

The OSC exhibit light transmission in the visible range of 30-50% with PCE of over 2%. Organic capping layers are used to significantly lower reflection and increase transmission without significant loss of PCE. Furthermore, we have achieved first large-area semitransparent tandem OSC with 3.5% PCE at 20-40% transmission in the visible range on 4cm<sup>2</sup>, which show the potential of this type of device for large-scale building integration.

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**Stability optimisation of small molecule organic solar cells** — ●MARTIN HERMENAUE, KARL LEO, and MORITZ RIEDE — Institut für Angewandte Photophysik, George-Bähr-Str. 1, 01069 Dresden

In addition to high efficiency and low cost, a long device lifetime is a crucially important factor for the commercialisation of small molecule organic solar cells. Previous results mostly covered unencapsulated devices and showed low lifetimes under 1000 hours even without permanent illumination.

Here, we present results on improving the intrinsic stability of glass-glass-encapsulated p-i-n solar cells containing small molecules. Zinc-Phthalocyanine and the fullerene C<sub>60</sub> are used as photoactive materials. Doped layers of wide gap materials and C<sub>60</sub> are used as hole and electron transport layer, respectively. All devices are illuminated with monochromatic or white LEDs and IV characteristics are automatically recorded during the entire measuring period.

In contrast to polymer solar cells, we do not observe an influence of different types of top contact materials on the lifetime. All variations of Gold, Silver and Aluminium lead to stable cells for about 1500 hours of continued illumination.

However, by changing the type and even the thickness of the hole transport material we are able to enhance the extrapolated lifetime (t<sub>80</sub>) from about 1100 hours with 30nm PV-TPD up to more than 5000 hours with 60nm Di-NPB. These results are achieved with encapsulated devices and illumination intensities up to 840 mW/cm<sup>2</sup> from high-power white LEDs at controlled temperatures of 50°C.

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**Self organized molecular electronic junctions using two phase liquid structures in microfluidic channels** — ●SHASHI THUTUPALLI<sup>1</sup>, MARK ELBING<sup>2</sup>, MATTHIAS FISCHER<sup>2</sup>, DAVID MUÑOZ<sup>3</sup>, RALF SEEMANN<sup>1,4</sup>, MARCEL MAYOR<sup>2,3</sup>, and STEPHAN HERMINGHAUS<sup>1</sup> — <sup>1</sup>MPI for Dynamics and Self Organization, Göttingen, Germany — <sup>2</sup>Forschungszentrum Karlsruhe GmbH, Institute for Nanotechnology, Karlsruhe, Germany — <sup>3</sup>University of Basel, Department of Chemistry, Basel, Switzerland — <sup>4</sup>Experimental Physics, Saarland University, Saarbrücken, Germany

Using a combination of microfluidics and molecular design, we demonstrate self assembled, reconfigurable molecular electronic junctions. To construct metal-molecule-metal junctions, we employ liquid mercury as the electrode contact in crossed microfluidic channels. Self assembled monolayers (SAM's) of conducting molecular rods are created on the surface of the mercury, which are then bridged to the other mercury electrode via microfluidic control. By precise flow control, we create rectifying molecular junctions using asymmetric molecules. We report on the electrical properties of these microfluidic metal-molecule-metal junctions. Also, we use surfactant stabilized foam-like water-in-oil emulsions to form variable molecular junctions. Here, molecules synthesized with hydrophobic conducting cores and hydrophilic ends self-insert into the lamellae between aqueous droplets. Using the aqueous droplets then as the molecular contacts, we report on the conducting properties of the inserted molecules and demonstrate the possibility of reconfigurable circuits using topological droplet rearrangements.

CPP 21.12 Wed 12:30 H37

**DNA Based Molecular Electronics Using Mercury Droplets in Microfluidic Channels** — ●SHUANG HOU, SHASHI THUTUPALLI, and STEPHAN HERMINGHAUS — Max Planck Institute for Dynamics and Self Organization, D-37073, Göttingen, Germany

Mercury droplets in microfluidic channels are used as electrodes to investigate the electronic properties of single strand DNA (ssDNA) molecules. In this system, a self assembled monolayer (SAM) of thiolated DNA oligomers (~ 5 nm length) of specific base sequences is formed on the surface of mercury droplets. Two such droplets are