

HL 72: Joint Session: Organic Electronics and Photovoltaics I

Time: Thursday 10:15–11:45

Location: GER 38

HL 72.1 Thu 10:15 GER 38

Structuring of Organic Conductors by Laser Ablation — ●ALEXANDER ESSER, MORITZ SCHAEFER, JENS HOLTKAMP, and ARNOLD GILLNER — Fraunhofer ILT, Steinbachstraße 15, 52074 Aachen

PEDOT:PSS is a transparent organic polymer with a sheet resistivity of about 200ohm/sq. These attributes make it an ideal candidate for substituting ITO in organic LEDs and organic photovoltaic cells: making them fully organic, flexible, lightweight and cheap to produce. Organic thin-film photovoltaics are a low cost alternative to state of the art silicon and other inorganic semiconductor-based solar cells. OLEDs can be made more flexible without the use of transparent conducting oxides.

We present structuring of organic conductors by laser ablation from spin coated films of PEDOT:PSS. We have investigated ablation characteristics of PEDOT:PSS depending on laser wavelength in the deep UV and required fluence. The smallest structuring resolution by UV laser patterning has been found.

In further measurements we have determined the conductivity depending on layer thickness and structure size. Especially the influence of laser radiation on conductivity and electrical properties in the vicinity of the ablated area has been studied. Therefor we have performed AFM measurements as well as four-point probing.

HL 72.2 Thu 10:30 GER 38

Investigation of the origin of the memory effect in devices based on C₆₀ — ●PHILIPP SEBASTIAN, ALEXANDER ZAKHIDOV, BJÖRN LÜSSEM, and KARL LEO — Institut für Angewandte Photophysik, George-Bähr-Straße 1, 01069 Dresden, Germany

Besides their application in organic solar cells and organic light emitting diodes, organic semiconductors also show much potential in the field of flexible and lightweight electronics, such as organic memory. In particular, the development of organic memory devices has turned out to be challenging. So far, many different approaches for organic memory devices have been reported in literature [1].

In this contribution, we report on an organic memory device comprising SiO₂ layer on top of a indium tin (ITO) ground contact, followed by electron accepting C₆₀ layer, a n-doped (Cs) 4,7-diphenyl-1,10-phenanthroline (BPhen) layer and an Al top electrode. IV measurements reveal a reproducible hysteresis of our devices with a maximum ON-OFF ratio of about one order of magnitude. The memory devices also demonstrate a remarkable switching cycle durability of more than 10⁴ successfully applied write read erase read cycles, whereas the ON-OFF ratio remains constant at about 10. Retention times of several weeks underline a reasonable non-volatility. Further, the memory mechanism has been investigated by impedance spectroscopy. A hysteresis in capacitance-voltage measurements expresses the accumulation of electrons in the C₆₀ and at the interface to the SiO₂ layer.

[1] J. Scott, L. Bozano, *Advanced Materials* 19, 1452 (2007)

HL 72.3 Thu 10:45 GER 38

Growth and morphology of aluminium contacts on P3HT films — ●GUNAR KAUNE^{1,2}, ROBERT MEIER¹, EZZELDIN METWALLI¹, VOLKER KÖRSTGENS¹, KAI SCHLAGE³, SEBASTIEN COUET³, STEPHAN V. ROTH³, and PETER MÜLLER-BUSCHBAUM¹ — ¹TU München, Physik-Department, Lehrstuhl für Funktionelle Materialien, James-Franck-Straße 1, 85747 Garching — ²Martin-Luther-Universität Halle-Wittenberg, Institut für Physik, Fachgruppe Photovoltaik, Von-Danckelmann-Platz 3, 06120 Halle — ³HASYLAB at DESY, Notkestraße 85, 22603 Hamburg

The characteristics of organic electronic devices are strongly influenced by the type and structure of the metal electrodes needed to inject or extract charge carriers. Therefore understanding of the metal growth process and its relation to the interactions at the metal-organic interface are necessary. We investigate the growth of an aluminium layer on the surface of a P3HT thin film by in-situ application of grazing incidence small-angle X-ray scattering (GISAXS). By subsequent modelling of the scattering data the structural parameters of the growing film are extracted and a growth process is found, which proceeds two-dimensional by stacking single atomic layers on top each other. This process results in a homogeneous film with a large contact area to the polymer and is explained by a strong chemical interaction between

aluminium and P3HT, which suppresses clustering of the metal on the polymer surface. The diffusion of single aluminium atoms into the P3HT and the formation of an intermixing layer is revealed by X-ray reflectivity measurements.

HL 72.4 Thu 11:00 GER 38

Effect of high-k substrates on the photocurrent of organic semiconductors: Tailoring the Coulomb interaction — ●MIRIAM ENGEL¹, DORU C. LUPASCU², NIELS BENSON¹, and ROLAND SCHMECHEL¹ — ¹Nanostrukturtechnik, Universität Duisburg-Essen, 47057 Duisburg — ²Institut für Materialwissenschaft, Universität Duisburg-Essen, 45117 Essen

A major difficulty for organic photovoltaic cells is the dissociation of excitons into free charge-carriers. This is caused by high exciton binding energies, due to the low permittivity of the organic material. There are approaches to use acceptor-donor systems in the form of bulk-heterojunctions, which leads to successful exciton dissociations per volume. However, re-trapping may occur even after efficient charge-carrier separation due to Coulomb interaction (CI). Our aim is to use inorganic high-k materials to increase the exciton dissociation and to lower CI. In our proof of principle experiments devices are based on substrates with different permittivities. Pentacene is deposited as the active organic layer on them. Silver electrodes are used as top-contacts. For the electrical characterization we performed I(V) measurements in the dark and under illumination. Because of the known influence of the pentacene morphology on the mobility of the charge-carriers, we corrected the current under illumination by the dark current to obtain the pure contribution from the photo-effect. We obtained an improvement of the photocurrent using high-k substrates. The final goal is to transfer the layered system into an organic-inorganic composite system with high-k nanoparticles embedded in a photoactive organic matrix.

HL 72.5 Thu 11:15 GER 38

Organic pin-Diodes with Adjustable Current-Voltage Performance Applicable at Ultra-High-Frequencies — ●HANS KLEEMANN, CHRISTOPH SCHÜNEMANN, PAUL PAHNER, ALEXANDER A. ZAKHIDOV, BJÖRN LÜSSEM, and KARL LEO — Institut für Angewandte Photophysik, Technische Universität Dresden, George-Bähr-Straße 1, 01069 Dresden, Germany

Organic diodes have been intensively studied during the past years and great progress has been achieved in the field of organic light-emitting diodes (OLEDs) and organic solar cells (OSC). Moreover, the development of other organic devices like thin film transistors, vertical transistors, memory arrays, and high-frequency diodes which are required for an electronic circuitry will allow the design and integration of complete organic electronics. In this contribution we present organic *pin*-diodes with adjustable forward and reverse current-voltage performance applicable in the ultra-high-frequency region. Key parameters to design these diodes are the doping concentration, the intrinsic interlayer thickness and the material properties. In this way the reversible backward breakdown can be shifted from $-3V$ to more than $-20V$ independently of the forward performance [1]. Due to the high rectification ratio (10^5) and since the diodes contain high mobility materials like pentacene and C₆₀ we present high-frequency properties of these *pin*-diodes above 13.56MHz required for RFID-tags.

[1] H. Kleemann et al., *Organic Zener Diodes: Tunneling across the Gap in Organic Semiconductor Materials*, *Nano Letters* 2010, published online.

HL 72.6 Thu 11:30 GER 38

Photoinduced degradation process of Fir6 emitter molecules: a laser desorption/ionization time-of-flight mass spectrometry investigation — ●INES RABELO DE MORAES¹, RUBEN SEIFERT^{1,2}, SEBASTIAN SCHOLZ^{1,3}, BJÖRN LÜSSEM¹, and KARL LEO¹ — ¹Institut für Angewandte Photophysik, Technische Universität Dresden, George-Bähr-Str. 1, 01062 Dresden, Germany — ²Von Ardenne Anlagentechnik GmbH, Plattelleite 19/29, 01324 Dresden, Germany — ³Fraunhofer-Institut für Keramische Technologien und Systeme, Winterbergstraße 28, 01277 Dresden, Germany

Phosphorescent Organic Light Emitting diodes (OLEDs) have attracted much interest for their potential application in the field of full color displays and as next generation of lighting sources. One of

the major problems related to the OLED technology is the short lifetime of the blue phosphorescent emitters. For improving the lifetime of the OLEDs a deep understanding of the intrinsic chemical degradation is required. Our work is focused on the photoinduced degradation process of single layer of the Fir6 molecule used as blue phosphorescent emitter by laser desorption/ionization time-of-flight mass spectrometry (LDI-TOF-MS). The LDI-TOF spectra collected at the laser

intensity of $114 \mu\text{J}/\text{pulse}$ indicate that the Fir6 molecule dissociates into $[\text{Ir}(\text{F2ppy})_2]^+$ and $[\text{Fir6}-(\text{pyrazole})_1]^+$. The reaction between the Fir6 fragments and the Fir6 molecule itself resulting in the formation of $[\text{Fir6}+(\text{pyrazole})_1]^+$, and $[\text{Fir6}-(\text{pyrazole})_1+\text{Ir}(\text{F2ppy})_2]^+$ could be observed as well. Additionally, the degradation processes of full processed OLEDs based on Fir6 emitter will be presented.