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Analysis of OTFT Device Parameters based on Measurement and Simulation of IV and CV Characteristics — •Christoph Erlen and Paolo Lugli — Munich University of Technology

Advances in fabrication techniques have led to organic TFTs (OTFTs), which are increasingly interesting for electronic applications. We have used different methods including finite element device simulations in a commercial environment (ISETCAD)[1] in order to extract relevant material and transistor parameters from experimental data. Dynamic CV measurements have been analyzed to crosscheck results for e.g. interface charges and trap densities obtained by simulation. These measurements are additionally employed to address dynamic OTFT characteristics. It is shown that next to material properties, device layout plays an important role in determining the transient transistor behavior. The research is conducted in close cooperation with M. Fiebig, S. Schiefer, M. Huth, U. Beierlein and B. Nickel, Department fuer Physik, Ludwig-Maximilians Universitaet, Munich, who provided the experimental data for bottom contact Pentacene TFTs.

[1] Bolognesi et al. IEEE Trans. Elect. Dev., 51(12):1997, 2004.

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Charge mobility in Pentacene TFTs: a comparison of I-V and capacitance measurements — •Matthias Fiebig, Stefan Schiefer, Martin Huth, Udo Beierlein, and Bert Nickel — Department für Physik and CeNS, Ludwig-Maximilians-Universität, München

Pentacene is one of the most promising materials for organic thin film transistors (OTFTs). We have prepared bottom contact Pentacene TFTs on SiO_2 by deposition in UHV. The high structural quality of the devices has been characterized by AFM and synchrotron x-ray diffraction. Transistor behavior has been tested by IV-measurements and mobilities of the order of 1 cm^2/Vs have been archieved. Complementary capacitance measurements have been performed to address dynamic properties of the charge transport. The experimental results are simulated and analysed in collaboration with C. Erlen and P. Lugli, Institute for Nanoelectronics, TU München.

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The influence of SiO2 dielectric interface modification on ambipolar transport in Pentacene TFTs — •Niels Benson[1], Marcus Ahles[1], Thomas Mayer[1], Eric Mankel[1], Andrea Gassmann[1], Roland Schmechel[2], and Heinz v. Seggern[1] — [1]TU Darmstadt, Institute of Materials Science, Petersenstraße 23, D-64287 Darmstadt, Germany — [2]Forschungszentrum Karlsruhe (FZK) Institut für Nanotechnologie, PF 3640, 76021 Karlsruhe, Germany

Recently an n-type Pentacene OFET, using traces of Calcium between SiO2 and Pentacene has been demonstrated. This OFET exhibits electron transport properties similar to those of holes observed in a corresponding p-type OFET. Results on XPS measurements unveiling the influence of Ca on the SiO2 surface are presented. According to these measurements, the first deposited Ca performs a chemical reaction with the SiO2 interface. Metallic Ca is found only at higher nominal thickness. Moreover, characteristics of OFETs are presented, where thin intermediate polymer dielectrics selected with respect to functional end groups and their polarity have been employed between SiO2 and Pentacene. A clear correlation between the occurrence of ambipolar transport and the molecular polarity has been revealed. From the present results, interface modifications with different polymer dielectrics as well as traces of Ca result in different interfacial electron trap densities, allowing a modification of the OFET threshold. This is a step toward to a better control of the device properties for organic integrated circuits and ambipolar OFETs.

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P(VDF/TrFE) as ferroelectric insulation layer for organic field effect transistors — •Klaus Müller, Karsten Henkel, Ioanna Paloumpa, and Dieter Schmeisser — Brandenburgische Technische Universität Cottbus, Angewandte Physik-Sensorik, Konrad-Wachsmann-Allee 1, 03046 Cottbus

The ferroelectric polymer poly(vinylidene fluoride trifluoroethylene) (P(VDF-TrFE)) is used as insulating material for organic field effect transistors (OFET) and metal-insulator-semiconductor (MIS)-structures. For the MIS-structures, we find the typical hysteresis in the CV characteristic upon increasing the voltage scan window. Based on these results, we fabricate OFET with regioregular poly(3-hexlythiophene) (P3HT) as organic semiconductor. The transistors are constructed in bottom gate architecture with thin layers of spincoated P(VDF-TrFE) as gate insulation (100nm). The drain-source current of the OFET is reversible affected by the polarized gate, which gives opportunities for organic nonvolatile memory elements. We present characteristic features like the hysteretic drain current response or the data retention. Furthermore, we present measurements with Kelvin probe force microscopy, a method which gives informations on the lateral distributions of the surface potential.

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Toward the fabrication of a monomolecular insulator film — •Michael Zharnikov, Yian Tai, Hiroyuki Noda, Andrey Shaporenko, and Michael Grunze — Angewandte Physikalische Chemie, Universität Heidelberg, Im Neuenheimer Feld 253, Heidelberg

Progress in fabricating smaller and more efficient structures in electronic and spintronic devices depends on better dielectric materials for nanofabrication. A perspective nanoinsulator is a molecular thin organic film - self-assembled monolayer (SAM), which provide an alternative to commonly used oxide dielectrics. A so far unresolved technological problem for insulator applications of SAMs is the difficulty of fabricating stable metal layers on their surfaces, i.e. at the SAM-ambient interface. Such a film is generally leaky for metal adsorbates, which makes it impossible to integrate it into a multilayer assembly (e.g. in a tunnel junction magnetic memory cell) or to fabricate metal electrodes on its surface (e.g. in an organic thin film transistor). Using nickel as a test metal adsorbate and several different substituted and non-substituted SAMs as test substrates, we show that this difficulty can be overcome by the combination of a special design of the SAM constituents and their extensive cross-linking by low-energy electron irradiation. The properties of the SAM insulator and the metal overlayer were monitored by several complementary experimental techniques, including X-ray absorption spectroscopy and electrochemical measurements. The approach represents an important step toward the technological applications of monomolecular dielectric layers.

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Top emitting organic light emitting diodes with improved outcoupling efficiency by organic capping layer — •Qiang Huang[1], Karsten Walzer[1], Martin Pfeiffer[1], Gufeng He[1], Karl Leo[1], Michael Hofmann[2], and Thomas Stübinger[2] — [1]Institut für Angewandte Photophysik, TU Dresden, D-01062 Dresden, Germany — [2]Novaled GmbH, Tatzberg 49, D-01307 Dresden, Germany

The improvement of light outcoupling from organic LEDs is a significant way for increasing the device efficiency. One way to reach this is the use of organic outcoupling layers. We study the emission properties of top emitting OLEDs with different organic capping layer thickness to understand the effect of the capping layer. The distribution pattern of the emitted light from a top emitting OLED depends strongly on the capping layer thickness, with a maximum enhancement of current efficiency by 38%, and quantum efficiency by 35%. This enhancement is not due to the redistribution of emitted light but mainly due to the improvement of outcoupling efficiency by changing the overall optical device structure. At 90 nm capping layer thickness, the device has optimum performance, showing 78 cd/A at 1000 cd/m2 in forward direction as well as a quantum efficiency of 17.8 % and power efficiency of 69 lm/W.

[1]V. Bulovic, G. Gu, P. E. Burrows, V. Khalfin, V. G. Kozlov, and S. R. Forrest, Nature (London) 380, 29 (1996). [2]H. Riel, S. Karg, T. Beierlein, B. Ruhstaller, and W. Rieß, Appl. Phys. Lett. 82, 466 (2002). [3]G. F. He, M. Pfeiffer, K. Leo, M. Hofmann, J. Birnstock, R. Pudzich, and J. Salbeck, Appl. Phys. Lett. 85, 3911 (2004).

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Efficient polymer electrophosphorescent devices with interfacial layers — •Xiaohui Yang[1], Frank Jaiser[1], Burkhard Stiller [1], Dieter Neher[1], Frank Galbrecht[2], and Ulli Scherf[2] — [1]Universität Potsdam,Am Neuen Palais 10, 14469 Potsdam — [2]Bergische Universität Wuppertal, Fachbereich Chemie, Makromolekulare Chemie,Gaußstr. 20, 42097 Wuppertal

We show that several large band-gap hole-transporting polymers can form insoluble interfacial layers on PEDOT:PSS. The thickness of the interlayer is dependent of the characteristics of underlying PEDOT:PSS and the molecular weight of the polymers. It is further shown that the electronic structures of the interlayer polymers have a significant effect on the properties of red-emitting polymer-based electrophosphorescent devices. Upon increasing the HOMO and LUMO level positions, a sig-