

solving the rate equation for charge transport, we analyze the link between the secondary structure and charge carrier mobility [1]. This analysis eventually provides a pathway to rational design of columnar assemblies of PDI derivatives with high charge mobilities.

[1]V.Marcon et al., J. Am. Chem. Soc., 131, 2009

CPP 27.10 Wed 17:30 Poster C

Crystallization induced phase separation in a double crystalline donor-acceptor diblock copolymer — ●PETER KOHN¹, MICHAEL SOMMER², MUKUNDAN THELAKKAT², and THOMAS THURN-ALBRECHT¹ — ¹Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, 06099 Halle, Germany — ²Angewandte Funktionspolymere, Makromolekulare Chemie I, Universität Bayreuth, 95440 Bayreuth, Germany

A high density of donor-acceptor interfaces ensuring nanoscale domains is of major importance for bulk hetero-junction organic solar cells. Fully functionalized block copolymers consisting of donor- and acceptor-subchains are an attractive class of materials as they inherently carry the desired heterogeneity on the molecular level. We studied the structure formation in a poly(3-hexyl thiophene-*b*-perylene acrylate) diblock copolymer by temperature dependent small- and wide-angle X-ray scattering. At high temperatures the block copolymer is in the disordered, non-microphase separated state. During cooling separate crystallization of both blocks induces a donor-acceptor phase separation. The resulting morphology of donor- and acceptor crystals separated on the nanoscale demonstrates the potential applicability of this class of materials for organic solar cell devices.

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Mobility Measurements of aza-BODIPY for Organic Solar Cells — ●MORITZ HEIN, ROLAND GRESSER, TORBEN MENKE, KARL LEO, and MORITZ RIEDE — Inst. f. Angewandte Photophysik, Dresden, Deutschland

For organic electronics applications, e.g. organic solar cells, new appropriate materials, in particular with high charge carrier mobilities are crucial. This contribution focuses on the promising absorber material class of aza-BODIPY. A series of this new donor material, with four different substituents and increased molecular rigidity has been analyzed in respect of mobility. Depending on the electron donor strength of the substituents, the HOMO (highest occupied molecular orbital) energy of the materials can be tuned from 5.1 eV to 5.7 eV. Structural modification, increasing the rigidity of the molecule and extending the planar pi-conjugated system lead to a better molecular orbital overlap of two adjacent molecules in the crystal structure. We investigate the influence of this structure variation on the mobility. Two different methods are used: field effect transistor (OFET) and space charge limited current (SCLC) measurements. A comparison of the mobilities of the different materials and techniques is presented. Furthermore, the film morphology has a huge influence on the mobility. To study this, the effect of heating the substrate during evaporation is used.

CPP 27.12 Wed 17:30 Poster C

Breakdown of perturbative weak coupling approaches for the biomolecular energy transfer — ●PETER NALBACH and MICHAEL THORWART — Freiburg Institute for Advanced Studies (FRIAS), Albert-Ludwigs-Universität Freiburg, Albertstraße 19, 79104 Freiburg, Germany

We show that the biomolecular exciton dynamics under the influence of slow polarization fluctuations in the solvent cannot be described by approaches which are perturbative in the system-bath coupling. For this, we compare results for the decoherence rate of the exciton dynamics of a resumed perturbation theory with numerically exact real-time path-integral results. We find up to one order in magnitude difference in the decoherence rate for realistically slow solvent environments even in the weak coupling regime, while both results coincide for fast environmental noise. This shows explicitly the nonperturbative influence of the bioenvironmental fluctuations and might render current perturbative approaches to biomolecular exciton transport questionable.

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Proton Transport in Self-Assembling Organic Compounds — ●MANUEL SCHRADER and DENIS ANDRIENKO — Max Planck Institute for Polymer Research, Ackermannweg 10, 55128 Mainz

Organic phosphonic acid derivatives are promising materials as proton-conducting electrolytes in water-free proton exchange membrane fuel cells. In this work atomistic molecular dynamics simulations of

phosphonic-acid functionalized organic conjugated compounds have been carried out. In order to conduct simulations, force fields for these molecules have been developed with the aid of first-principle calculations. In the simulations supramolecular self-assembly in columnar structures and formation of hydrogen bond networks leading to proton transport could be observed.

CPP 27.14 Wed 17:30 Poster C

Imaging the ageing dynamics of polymer solar cells — ●MARCO SEELAND, RÖSCH ROLAND, and HOPPE HARALD — Institute of Physics, Ilmenau University of Technology, Weimarer Str. 32, 98673 Ilmenau, Germany

Nowadays, many attempts are existing on the route towards higher power conversion efficiencies in polymer solar cells. In addition, the lifetimes of such devices play a key role for the market entry as commercial products. To investigate the timescale of degradation processes, we applied long-time stability measurements with devices stored in the dark and under illumination and compare the results with luminescence images. The application of those techniques allows us to investigate the ageing dynamics in our devices consisting of an interpenetrating network of P3HT and PCBM, sandwiched between the ITO/PEDOT:PSS and aluminium electrode.

CPP 27.15 Wed 17:30 Poster C

Temperature dependent photoinduced absorption measurements on oligothiophene derivatives — ●CHRISTIAN KÖRNER¹, HANNAH ZIEHLKE¹, KARL LEO¹, ROLAND FITZNER², EGON REINOLD², PETER BÄUERLE², and MORITZ RIEDE¹ — ¹Institut für Angewandte Photophysik, Technische Universität Dresden — ²Institut für Organische Chemie II und Neue Materialien, Universität Ulm

Oligothiophenes are among the most promising small molecules for use in organic photovoltaic devices (OPV). The current efficiency world record of 6.1% on an area of >2cm² is based on using an oligothiophene derivative as one of the absorber materials. Notwithstanding this success, the underlying processes e.g. for charge generation at the donor-acceptor heterointerface are still subject of intense discussions.

By small variations of the molecule structure we are able to systematically tune the electrical and optical properties of these molecules. The energy levels which are mainly determined by the backbone length and the terminating end groups are supposed to strongly correlate with energy and charge transfer processes like the initial charge separation step at the donor-acceptor heterojunction in OPV.

Here we present temperature dependent PIA measurements of dicyanovinyl end-capped oligothiophenes with various backbone lengths. The nature and recombination dynamics of the long living triplet excitons and cations present in optically excited oligothiophene single layers and in mixed layers with the acceptor C₆₀ are determined and compared.

CPP 27.16 Wed 17:30 Poster C

Substituted Perylene Diimides as Electron Acceptors in Organic Solar Cells: Suppressing aggregate and formation to increase device efficiency — ●VALENTIN KAMM, IAN A. HOWARD, CHEN LI, KLAUS MÜLLEN, and FRÉDÉRIC LAQUAI — Max-Planck-Institut für Polymerforschung, Mainz, Deutschland

Perylene diimide (PDI) is a promising candidate as electron acceptor material for high open circuit voltage organic solar cells. Its strong absorption in the visible region combined with high electron mobility in the solid state renders it a potential alternative to the weakly absorbing PCBM that is typically used in state-of-the-art organic solar cells. However, PDI molecules tend to aggregate and form intermolecular excited states that can act as exciton traps. These traps effectively limit the diffusion of excitons to the interface where charge separation occurs and thus strongly reduce the charge generation efficiency in bulk heterojunction solar cells.

We investigate the effect of different bulky side groups attached to the terminal and to the bay positions of PDI molecules on the formation of aggregates by time-resolved optical spectroscopy. In particular transient photoluminescence and transient absorption spectroscopy are used to study, whether the increased spacing between the PDI molecules, caused by the bulky side groups, can prevent aggregation and intermolecular excited state formation leading to more efficient exciton transport. Furthermore, we correlate the photophysical properties of these materials with the efficiency of bulk heterojunction organic solar cells.

CPP 27.17 Wed 17:30 Poster C

Time-resolved luminescence spectroscopy of biomimetic, self-assembling porphyrins — ●JONAS CONRADT^{1,2}, HENDRIK KUHN¹, PETER MAREK³, MANUEL REINHARDT^{2,5}, OLIVER LÖSCH⁵, ALEXANDER COLSMANN^{2,5}, ULI LEMMER^{2,5}, TEODOR SILVIU BALABAN^{3,4}, and HEINZ KALT^{1,2} — ¹Karlsruhe Institute of Technology (KIT), Institute for Applied Physics (AP), Karlsruhe, Germany — ²Karlsruhe Institute of Technology (KIT), Center for Functional Nanostructures (CFN), Karlsruhe, Germany — ³Karlsruhe Institute of Technology (KIT), Institute for Nanotechnology (INT), Karlsruhe, Germany — ⁴Université Paul Cézanne Aix-Marseille III, ISM2 - Chirosciences, Marseille, France — ⁵Karlsruhe Institute of Technology (KIT), Institute for Light Technology (LTI), Karlsruhe, Germany

Self-assembling porphyrins represent a promising candidate in order to mimic natural bacteriochlorophylls, the light-harvesting system found in photosynthetic bacteria exhibiting chlorosomes. Such biomimetic porphyrins with a central zinc or magnesium atom show interesting photophysical properties. We performed time-resolved spectroscopy on these porphyrins in order to investigate the properties of monomers as well as self-assembled aggregates. An improved fitting algorithm is developed to identify more reliably the decay-associated spectra and the corresponding decay times. The large extinction coefficient of the porphyrins makes them an interesting candidate for photovoltaic application. They can help to improve the external quantum efficiency of hybrid and dye-sensitized solar cells. Their photovoltaic suitability is investigated.

CPP 27.18 Wed 17:30 Poster C

Morphological degradation of fullerene polymer solar cells — ●VIDA TURKOVIC, CHETAN RAJ SINGH, SEBASTIAN ENGMANN, MAIK BÄRENKLAU, ROLAND RÖSCHI, GERHARD GOBSCH, and HARALD HOPPE — Ilmenau University of Technology, Weimarer Straße 32, Ilmenau 98693

Typical acceptor materials such as fullerene derivatives tend to diffuse and finally agglomerate in blends with polymeric donors, depending on the chemical structure of the donor. This process eventually leads to a morphological destruction of the organic solar cells. The changes in the blend morphology of the thin films accelerate when thermally annealed at increased temperatures. Tapping-mode atomic force microscopy (AFM) measurements provide deeper insight into the nano and micrometer scale of the phase separation observable on the surface of the film. Furthermore, to prove the coarsening of phase separation on various length scales, optical microscopy, UV-Vis, photoluminescence and spectral ellipsometry measurements were conducted. Of special interest is tracking down the formation of fullerene aggregates and correlation of their growth in time.

CPP 27.19 Wed 17:30 Poster C

Influence of electron transport on the efficiency of polymer-based solar cells — ●VIKTOR KUXHAUS¹, FRANK JAISER¹, DIETER NEHER¹, and FRANK VOGES² — ¹Institute of Physics and Astronomy, University Potsdam, Karl-Liebknecht-Str. 24-25, 14476 Potsdam, Germany — ²Merck KGaA, 64271 Darmstadt, Germany

Recently, we showed that the mobility of electrons in polymer-based solar cells has a large influence on the overall performance of such devices [1]. Here, we investigate the correlation between electron mobility and charge generation efficiency in organic bilayer solar cells for a series of electron transporting materials (ETMs) with comparable HOMO and LUMO levels. The electron mobility was measured by transient electroluminescence. Here, a thin M3EH-PPV was used as a sensing layer. The interface between M3EH-PPV and ETM acted as a recombination zone of electrons transported through the ETM layer and holes that are blocked at the interface. Therefore, the electron mobility can easily be determined from the onset of M3EH-PPV emission which is spectrally well separated from the ETM emission. To determine the charge generation efficiency, the different ETMs were combined in bilayer solar cell with PFB as donor.

[1] M. Schubert, R. Steyrlauthner, S. Bange, A. Sellinger, D. Neher, pss(a), DOI: 10.1002/200925312

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Organic magnetoresistance effect in unipolar and bipolar devices of conjugated polymers — ●THOMAS MANICKE, FRANK JAISER, SERGEY BAGNICH, and DIETER NEHER — Institut für Physik und Astronomie, Universität Potsdam, Potsdam, Deutschland

For the last few years, several origins of the organic magnetoresistance (OMaR) effect have been discussed. There are three main models to

describe this effect, namely the polaron pair, bipolaron and excitonic model. The bipolaron model is mutually exclusive to the other two models and predicts an OMaR effect also for unipolar currents.

We present the results of measurements of the OMaR in unipolar and bipolar devices. Experiments were performed both on a hole-conducting polymer (MEH-PPV) and an electron-conducting polymer (F8BT). We also tested the influence of the cathode material in electron-only devices on the OMaR. The results of these experiments suggest that the bipolaron model is not suited to explain this intriguing effect consistently for all device configurations.

CPP 27.21 Wed 17:30 Poster C

Charge Generation and Recombination in Dye-sensitized Solar Cells — ●MICHAEL MEISTER, HENRIKE WONNEBERGER, CHEN LI, KLAUS MÜLLEN, and FRÉDÉRIC LAQUAI — Max-Planck-Institute for Polymer Research, Mainz, Germany

Charge recombination is one of the efficiency limiting processes in bulk heterojunction and dye-sensitized organic solar cells. To determine the presence of charges and the dynamics of charge generation and recombination photoinduced absorption spectroscopy (PIA) and transient absorption spectroscopy (TAS) are particularly useful techniques, since most of the investigated states are non-emissive. These methods allow to investigate all important mechanisms that lead to photocurrent generation beginning with the excitation of the dye, followed by charge transfer to a metal oxide semiconductor and regeneration of the dye by an electrolyte or an organic solid state hole conductor. In this study, we present spectroscopic experiments on dye-doped titanium dioxide films using novel all-organic perylene monoimide dyes as sensitizer with and without solid state hole conductor and on real device structures. We correlate the observed charge generation and recombination dynamics with the device efficiency to understand the relation between dye-structure, photophysics and device performance.

CPP 27.22 Wed 17:30 Poster C

Band bending at interfaces between polymers and electrodes — ●ILJA LANGE — Universität Potsdam, Institut für Physik und Astronomie, Karl-Liebknecht-Strasse 24/25, 14476 Potsdam-Golm

There is an ongoing discussion on whether band bending is present in organic semiconductors near metallic contacts and how it affects device properties. Here, we present Kelvin Probe studies on various polymers coated with different thickness on the well known polymeric anode poly(3,4-ethylenedioxythiophene): poly(styrenesulfonate) (PEDOT:PSS). Band bending was detected for poly(3-hexylthiophene) (P3HT), poly{3-hexylthiophene-co-[1,4-(2,2-dithienyl)-5,5-2,3,5,6-tetrafluorbenzene]} (P3HTTFT), poly[2,5-dimethoxy-1,4-phenylene-1,2-ethylene-2-methoxy-5-(2-ethylhexyloxy)-(1,4-phenylene-1,2-ethylene)] (M3EH-PPV) and poly[2-methoxy-5-(2'-ethyl-hexyloxy)-1,4-phenylene vinylene] (MEH-PPV). The experimental results can be well fitted with a model that explicitly takes into account a Gaussian density of transport sites [1]. This analysis is based on iterative numerical solution of the carrier density according to Fermi statistics and the one-dimensional Poisson equation. By comparing these results with measurements on films of the same materials on different metals, a consistent picture of band bending in conjugated polymers is developed.

[1] J.C. Blakesley and N.C. Greenham, J. Appl. Phys. 106, 034507 (2009)

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Encapsulation of thin fluorescent polymer films with graphenes — ●PHILIPP LANGE¹, MARTIN DORN¹, NIKOLAI SEVERIN¹, DAVID VANDEN BOUT², and JÜRGEN P. RABE¹ — ¹Humboldt-Universität zu Berlin, Department of Physics, Newtonstr. 15, 12489 Berlin, Germany — ²The University of Texas at Austin, Department of Biochemistry and Chemistry, Austin, Texas 78712, USA

Conjugated polymers are widely used as active layers in organic electronics. While they exhibit a high potential for new device concepts and low cost fabrication, they suffer from fast degradation under ambient conditions due to reactions with oxygen and moisture. To achieve reliable and long time operation, commercial organic devices are protected with multilayer encapsulation techniques. Graphene has recently been attracting increasing interest due to its remarkable mechanical, optical and electronic properties, which qualifies it for potential application in future electronic devices. This work addresses the question in how far graphenes deposited on top of a thin organic film can protect it sufficiently from degradation by moisture and oxygen. The polymer films are produced by spincoating on mica after which a