SYOO 5 Optoelectronic Devices

Zeit: Montag 17:15–18:00 Raum: TU HE101

SYOO 5.1 Mo 17:15 TU HE101

APPROACHING THE QUANTUM LIMIT WITH POLYMER ELECTROPHOSPHORESCENT DEVICES — •D. Neher[1], X.H. Yang[1], Th. Däubler[2], N. Reckfuss[3], D. Müller[3], and K. Meerholz[3] — [1]Institute of Physics, University of Potsdam, Am Neuen Palais 10, 14469 Potsdam — [2]Schott AG, Hattenbergstrasse 10, 55122 Mainz — [3]Institute of Physical Chemistry, University of Köln, Luxemburger Str. 116, 50939 Köln

Until very recently, the quantum efficiencies of polymer-based electrophosphorescent LEDs lacked well behind those of corresponding small-molecule LEDs. Here, we demonstrate that by (a) choosing appropriate preparation conditions of the active layer, (b) optimizing charge injection and (c) confining the charge carrier recombination zone, highly efficient dye-doped polymer electrophosphorescent devices can be achieved. With commercially available Ir-dyes, peak external quantum efficiencies are 19 % for green-emitting and 13 % for red-emitting phosphors. These values are comparable to the best efficiencies achieved with small molecule devices. Also, processes limiting the EQE in blue-emitting phosphorescent diodes based on PVK are evaluated with respect to triplet-confinement and exciton back transfer processes.

(1) X.H. Yang, D. Neher, D. Hertel, Th.K. Däubler, Adv. Mater. 16 (2004) 161.
(2) X.H. Yang, D. Neher, Appl. Phys. Lett. 84 (2004) 2476.

SYOO 5.2 Mo 17:30 TU HE101

Recent progress on the way to high efficiency organic stacked p-i-n solar cells — •M. Pfeiffer[1], C. Uhrich[1], R. Schüppel[1], A. Petrich[1], J. Drechsel[1], B. Maennig[1], K. Leo[1], and P. Bäuerle[2] — [1]Institut für Angewandte Photophysik, TU Dresden, Germany — [2]Abteilung Organische Chemie II und Sektion Massenspektrometrie, Universität Ulm, Germany

We have recently introduced organic solar cells based on a p-i-n heterostructure where a photoactive layer is embedded between doped organic layers with high conductivity and wide band gap. Such cells reach internal quantum efficiencies around 80%. With a tandem cell comprising two p-i-n diodes with a blend of ZnPc and C60 as active layer, we achieve an AM 1.5 power efficiency of 3.7+/-0.2%. To reach even higher values, we have to incorporate additional photoactive layers with absorption spectra complementary to ZnPc and improve the ratio of optical gap and open circuit voltage. Therefore, we developed a new class of acceptor-type oligomers with strong absorption in the green featuring excellent pi-stacking and low Stokes-shift. Heterojunctions of such an oligomer with a TPD-derivative as donor show efficient charge separation and open-circuit voltages of up to 0.9V. These results suggest that tandem cell efficiencies in excess of 5% can soon be achieved. Moreover, we present a new concept for organic solar cells based on light absorption by an oligomer, singlet transfer to C60, inter-system crossing to the triplet and back transfer of the triplet to the oligomer leading to long lived triplet excitons that can diffuse to an exciton separating interface.

SYOO 5.3 Mo 17:45 TU HE101

Influence of Morphology on the Photovoltaic Action of Polymer-Fullerene Composites — •Vladimir Dyakonov, Dana Chirvase, and Michael Pientka — Laboratory for Energy and Semiconductor Research, University of Oldenburg, Department of Physics, 26111 Oldenburg, Germany

Composites of polyhexylthiophen (P3HT) and methanofullerene (PCBM) are promising for polymer photovoltaics. External quantum efficiences above 70% and power conversion efficiencies above 3% were demonstrated recently. Decisive step to achieve such high values is a thermal annealing, strongly improving the electrical performance. The exact nature of this effect is still under discussion. We apply photoinduced absorption, light induced electron spin resonance and photoluminescence spectroscopy for the investigation of the photogenerated states and their transformation upon annealing. The heat treatment leads to a number of effects: increase of the photoluminescence previously suppressed, energy shift of polaronic absorption band together with a strong increase in the density of charge separated states. We have studied the performance of photovoltaic devices with a different weight ratio of P3HT:PCBM, namely, 1:3, 1:2, 1:1.5, 1:1, 1:0.9, 1:0.8, 1:0.7. The photocurrent and the power conversion efficiency showed a maximum between 1:1 and 1:0.9. We conclude the changes observed result from molecular diffusion of PCBM out of the polymer matrix upon annealing.