



Polymers under Multiple Constraints

# Kolloquium

Thursday,

17<sup>th</sup> January  
2013

at: 5.00 pm

Hörsaal für  
Theoretische  
Physik  
Linnéstr. 5  
04103 Leipzig



*Coffee will be  
served from  
4.30 pm!*

## Prof. Dieter Neher

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### Charge Carrier Generation and Transport in Organic Solar Cells

Over the past years, organic semiconductors evolved as a powerful alternative to classical inorganic materials. Today, solar cells based in semiconducting macromolecules and fullerenes exhibit power conversion efficiencies exceeding 10 %. These devices have, therefore, reached the performance level of cells made from amorphous silicon. Interestingly, the main processes governing the generation and extraction of charges in organic solar cells are very different from those in inorganic devices.

In my talk, I will present recent results regarding the understanding of charge carrier dynamics in organic solar cells. Here, one major step is the generation of free charges from Coulombically bound electron-hole pairs. Surprisingly, and in contrast to predictions by well-established theories, the photogeneration of charges in high performance solar cells is often not assisted by an electric field.<sup>[1]</sup> Also, the recombination of free carriers is significantly suppressed compared to the Langevin limit for recombination in homogeneous media. I will show that the efficiency and kinetics of the elementary processes in organic photovoltaics is strongly correlated to the morphology of the active multicomponent layer.<sup>[2]</sup> In particular, control of the size and purity of the electron- and hole-transporting phase results in drastic improvements of the solar cell properties.<sup>[3]</sup>

<sup>[1]</sup> J. Kniepert, M. Schubert, J.C. Blakesley, D. Neher, "Photogeneration and recombination in P3HT/PCBM solar cells probed by time-delayed collection field experiments", J. Phys. Chem. Lett. 2011, 2, 700.

<sup>[2]</sup> S. Albrecht, W. Schindler, J. Kurpiers, J. Kniepert, J.C. Blakesley, I. Dumsch, S. Allard, K. Fostiropoulos, U. Scherf., D. Neher, "On the field dependence of free charge carrier generation and recombination in blends of PCPDTBT/PC70BM: influence of solvent additives", J. Phys. Chem. Lett. 2012, 3, 640.

<sup>[3]</sup> S. Albrecht, S. Janietz, W. Schindler, J. Frisch, J. Kuipers, J. Kniepert, S. Inal, P. Pingel, K. Fostiropoulos, N. Koch, D. Neher, "Fluorinated Copolymer PCPDTBT with enhanced open-circuit voltage and reduced recombination for highly efficient polymer solar cells". J. Am. Chem. Soc. 2012, 134, 14932.

