"Hybrid Materials for Efficient Energy Generation and Information Technologies"

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Title: Charge transfer and charge transport in Si-based hybrid structures

Recent studies showed that a simply hybrid device comprising an n-doped crystalline wafer passivated with an ultrathin SiO_2 layer and a spincoated film of a polythiophene derivative exhibits efficiencies close to 10%. This result is remarkable as only simple processing steps are involved in device fabrication. Preliminary studies implicate that free charges are generated mostly in the silicon layer, while very little is known about the processes following generation, including charge transfer across the hybrid heterojunction and extraction to the electrodes.

The aim of the PhD thesis is to investigate these processes, thereby identifying the factors that limit the short circuit current and determine the open circuit voltage. This goal will be achieved by careful characterization of transient and steady state properties of these cells, with proper control and syntheses of the organic conjugated material with regard to its energetics (HOMO and LUMO position), optical properties (optical gap) and electrical conductivity. The latter will be achieved by molecular doping, which was also shown to be crucial for an optimum electric field distribution throughout inorganic/organic stacks [1]. With the knowledge gained from these studies, we aim at a significant improvement of the efficiency of these novel devices.

[1] S. Schäfer, S. Albrecht, D. Neher, T. F. Schulze, E. Conrad, L. Korte, B. Rech, J. Wördenweber, A. Gordijn, et al, Electric Field Distribution in Hybrid Solar Cells Comprising an Organic Donor Polymer and Amorphous Silicon, Organic Photonics and Photovoltaics, in press