Title: Organic Photovoltaics: energy conversion with molecules

Elizabeth von Hauff
Department of Physics & Astronomy, Vrije Universiteit Amsterdam, The Netherlands

Record power conversion efficiencies of organic solar cells have now exceeded 10 % [1] which has long been considered a benchmark for market entry for low cost emerging photovoltaic technologies. Current research is focussed on further improving solar cell performance. Advances in this field require interdisciplinary approaches, as well as cooperation between fundamental and applied research.

The photovoltaic conversion process consists of 4 basic steps: light absorption, charge separation, charge transport and charge collection. The efficiency of each of these steps determines the overall power conversion efficiency of the device. Organic photovoltaics is based on a molecular donor-acceptor system for generation of photocurrent (**Figure 1**). The extended bulk heterojunction formed between the donor and acceptor molecules in thin film facilitates efficient charge separation, while forming closed pathways to the electrodes for the transport of photocurrent.

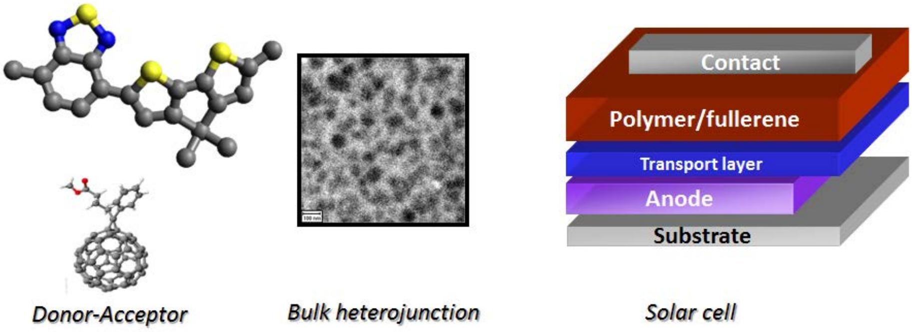

Figure 1:Molecular Donor-Acceptor system, electron microscopy image of the bulk heterojunction thin film active layer and the organic solar cell architecture.

The underlying physical mechanisms of energy conversion steps in organic photovoltaics, particularly charge separation and charge transport, are still not well-understood. In this lecture I will review the basic principles of organic photovoltaics, and discuss how the molecular environment influences carrier separation and recombination [2,3]. Additionally I will talk about current models and open questions about carrier transport in these systems.

References:

[1] M. A. Green, K. Emery, Y. Hishikawa, W. Warta, E. D. Dunlop, *Prog. Photovoltaics Res. Appl.* **2016**, *24*, 3.

[2] M. Hallermann, I. Kriegel, E. Da Como, J. M. Berger, E. Von Hauff, J. Feldmann, *Adv. Funct. Mater.* **2009**, *19*, 3662.

[3] S. Gélinas, A. Rao, A. Kumar, S. L. Smith, A. W. Chin, J. Clark, T. S. van der Poll, G. C. Bazan, R. H. Friend, *Science* **2014**, *343*, 512.