Thermoelectric characterization of doped organic semiconductors

Bernhard Nell*†[1] and Koen Vandewal[1]

[1]Institut für Angewandte Photophysik, Technische Universität Dresden (IAPP) – George-Bähr-Strasse 1, 01062 Dresden, Germany

Abstract

The introduction of p- and n-doped layers into the device architecture of organic optoelectronic devices can greatly improve their performance. Charge carrier extraction or injection from or into the organic photo-active layer is enhanced by doping, resulting in a reduction of ohmic losses. Hole and electron selective layers can be realized by molecular doping of organic host materials moving the Fermi level to the appropriate position, enabling electron or hole selectivity. In this work, we use thermovoltage (Seebeck effect) and temperature-dependent conductivity measurements to determine the dominating type of charge carriers introduced by the dopant and to gain insight into the position of the transport level with respect to the Fermi level. The investigation of fullerene dopants with a high degree of fluorination in various amorphous host materials allows us to tune the energy level offset between host and dopant and to study their influence on Fermi level position and overall doping efficiency systematically. We find that even low HOMO materials can be doped efficiently by highly fluorinated fullerenes. Moreover, we observe a clear influence of the energy level offset between matrix and host on the thermoelectric properties and the conductivity. This work provides guidelines for future dopant-matrix combination with a maximum doping efficiency.

*Speaker

†Corresponding author: bernhard.nell@iapp.de