Understanding the charge-transfer state properties in DBP-C70 organic solar cells by means of sensitive external quantum efficiency (sEQE) and morphological studies

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Abstract

Organic solar cells (OSC)s have attracted research attention during the past years due to their potential advantages as compared to conventional inorganic solar cells[1]. These advantages include low fabrication cost, lightweight, semi-transparency and mechanical flexibility. Despite these advantages, OSCs have comparably low power conversion efficiencies and rather short lifetimes, which put a barrier between laboratory achievements and industrial scale requirements. Therefore, in order to close this gap and to obtain further improvements in the device performance, a detailed understanding of the device working mechanism is required. Charge transfer (CT) states, representing intermediate states between exciton dissociation and recombination at donor-acceptor interface, play hereby a crucial role.

In this work, we study CT states in DBP/C70 based OSCs as a less studied case for inverted and conventional structures. Results from electroluminescence (EL) and sensitive external quantum efficiency (sEQE) measurements show an unexpected difference in charge transfer state energies for each of the two common structures. Moreover, we observe different values for the reorganization energy, which determines the energy loss upon deformation of the molecule during charging. These results suggest morphological sensitivity of the D/A interface, depending on the deposition sequence, which is investigated amongst others by means of atomic force microscopy studies.

1. Cao, H. *et al.* Recent progress in degradation and stabilization of organic solar cells. *J. Power Sources* **264,** 168–183 (2014).

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