Solution-Processed Bulk Heterojunction Solar Cells Based on Monodisperse Dendritic Oligothiophenes

A novel family of soluble conjugated dendritic oligothiophenes (DOTs) as monodisperse 3D macromolecular architectures was characterized with respect to optical and redox properties in solution and in solid films. Band gaps of 2.5-2.2 eV, typical for organic semiconductors, were determined as well as HOMO/LUMO energy levels ideal for efficient electron transfer to acceptors such as [6,6]-phenyl-C61-butyric acid methyl ester (PCBM) identifying them as suitable materials for solar cell applications. Solution-processed bulk heterojunction solar cells using DOTs as electron donor and PCBM as acceptor were prepared and investigated. High open circuit voltages V_{OC} of 1.0 V and power conversion efficiencies up to 1.72% were obtained for the DOT-based devices. The higher generations DOTs provide the highest efficiencies. Based on the monodispersity of the DOTs, an analysis of the molar ratio between donor and acceptor in the blended film was possible leading to an optimal value of 5-6 thiophene units per PCBM.