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Bulk heterojunction blends using a fullerene-free acceptor for photovoltaic applications

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Over the last decades organic electronics (OE) have attracted the focus of research due to their advantageous properties. Advantages, such as the flexibility of OE, the ease of processablility and the applicability of industrial up-scalable and low-cost processing methods, open up a wide range of possible application fields. Especially organic photovoltaics (OPV) have drawn much attention, due to much lower energy payback times compared to their conventional inorganic counterparts and power conversion efficiencies (PCE) surpassing 10 %, which makes them a promising candidate to tackle the increasing energy demand. The most widely studied bulk heterojunction system used for photovoltaic applications is P3HT:PCBM, which is already well understood, offers PCEs of about 4 to 5 %. In the last decades optimized low-bandgap polymers, such as PTB7, PTB7-Th and PBDB-T, emerged with optimized properties for usage as donor materials. Also their counterparts, the acceptors were investigated to replace the fullerene derivate by non-fullerene acceptor molecules, like ITIC, optimizing the photoactive properties of the active layers in photovoltaic devices. Another important step is the morphology present in the photoactive layer. Since it is known that the exciton diffusion length within the active layer of bulk-heterojunction devices is about 10 nm the inner morphology and extraction pathways are key to an efficient photovoltaic device. Within this study we investigate the morphological changes upon variation of the active layer composition of photoactive thin films based on the bulk heterojunction system of PBDB-T:ITIC. This is done by utilizing grazing incidence small angle X-ray scattering (GISAXS) [1]. This technique gives insight into the applied photoactive layer and offers the possibility to optimize the inner morphology of OPV devices in order to increase their power conversion efficiencies.

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