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Semiconducting block copolymers and their devices: the relationship between electronic properties, morphology and interfaces[1]

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For the optimal performance of organic opto-electronic applications, such as light emitting diodes (LEDs) and photovoltaic devices (PVDs), the morphology of the active layer is of crucial importance. One way to control the morphology of organic materials is by making use of the self- assembling properties of block copolymers. Their well-known microphase separation into highly ordered lattices occurs on the length scale of the radius of gyration of the two blocks, which is comparable to the exciton diffusion length. The morphology depends mainly on the block copolymer composition and can thus easily be adapted in order to optimize device performances. This control over morphology therefore allows one to study the relationship between active layer morphology, interfaces and device performance. In order to fully exploit this block copolymer concept, several rod-coil semiconducting diblock copolymers consisting of a conjugated block and a second coil block functionalized with electron transporting and/or accepting materials (such as oxadiazole or C_{60}) were synthesized. The conjugated block acting as light absorbing, electron donating and hole transporting material. The donor/acceptor photovoltaic devices, with active layer the above mentioned semiconducting block copolymers, were used to investigate the relation between the photovoltaic cell performance and the thin- film morphology involving the spatial distribution of donor and acceptor phases within the active layer.

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