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Morphology control in printable solar cells

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Nanostructured polymer-based solar cells (PSCs) have emerged as a promising low-cost alternative to conventional inorganic photovoltaic devices and are now a subject of intensive research both in academia and industry. For PSCs to become practical efficient devices, several issues should still be addressed, including further understanding of their operation and stability, which in turn are largely determined by the morphological organization in the photoactive layer. The latter is typically a few hundred nanometers thick film and is a blend composed of two materials: the bulk heterojunction consisting of the electron donor and the electron acceptor. The main requirements for morphology of efficient photoactive layers are nanoscale phase segregation for a high donor/acceptor interface area and hence efficient exciton dissociation, short and continuous percolation pathways of both components leading through the layer thickness to the corresponding electrodes for efficient charge transport and collection, and high crystallinity of both donor and acceptor materials for high charge mobility. In this contribution we review recent progress of our understanding on how the efficiency of a bulk-heterojunction PSC largely dependents on the local nanoscale volume organization of the photoactive layer.