Project Summary 12

Influence of electric fields on morphology and performance of compatibilized all-polymer solar cells

This proposal is concerned with the use of a special cell configuration based on substrates struc-tured in the sub-micrometer range (“Nanoelectrodes”) to investigate the effects of electric fields and incompatibility on the morphology and performance of compatibilized all polymer solar cells. In the nanoelectrode configuration both electrodes are in place prior to the deposition of the photoac-tive material and offer therefore the unique possibility to apply an electric field during application and drying of the photoactive layer.
The materials to be synthesized consist of an electron-donating (D) poly(3-(2-ethylhexyl)thiophene) (P3EHT) and of an electron-accepting (A) fluorene/ thiophene-benzothiadiazole-thiophene (F8TBT) copolymer segment.
Different side chains in the F8TBT copolymer will be introduced in order to alter incompatibility and dielectric contrast between A and D. Homopolymers of F8TBT and P3EHT, and block copolymers F8TBT-*b*-P3EHT will be synthesized using Suzuki and Kumada polycondensations. Purification of the block copolymers will be carried out with a preparative GPC. Dielectric constants and incompatibility of homopolymer blends will be investigated by impedance spectroscopy and transmission electron microscopy (TEM), respectively.
From these results, components with maximized dielectric contrast and incompatibility will be selected, and block copolymers with varying molecular weight and composition will be synthesized using a combination of Suzuki and Kumada polycondensations. Structure formation in binary or ternary block copolymer/homopolymer mixtures will be investigated in the bulk first using small-angle X-ray scattering and TEM. Nanoelectrode substrates will be used to align appropriate compositions of binary or ternary blends under an electric field, and the resulting morphologies in the device, will be correlated with processing parameters and performance. The experimental results will finally be corroborated by simulations. The overall aim is to gather a deeper insight into the factors determining the morphology of the active layer in a bulk heterojunction all polymer solar cell and to evaluate its impact on the resulting photovoltaic performance.