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Morphology Development During Deposition in OPV Low Band Gap Polymer:Bis-Fullerene Heterojunctions: Effect of a Second Solvent HUIPENG CHEN, YU-CHE HSIAO, BIN HU, MARK DADMUN, University of Tennessee — Polymer based bulk-heterojunction solar cells, based on blends of conjugated polymers and fullerenes are one potential option for low cost renewable power generation. One way to improve power conversion efficiency (PCE) of this cell is to increase the open-circuit voltage (V_{oc}). It has been reported that replacing PCBM with bis-adduct fullerenes (i.e. ICBA) significantly improves V_{oc} and PCE in P3HT device. However, for the most promising low band-gap polymer (LBP) system, replacing PCBM with ICBA gives very poor short-circuit current (J_{sc}) and PCE although V_{oc} is significantly improved. As J_{sc} and PCE strongly depend on the morphology, we therefore tried to optimize the morphology of as-cast LBP/ICBA mixture by adding a second solvent with varying solubility to LBP and ICBA to the deposition solution. The results show that there is no change of LBP ordering by adding the second solvent regardless of its solubility. The morphology of all the as-cast samples is then determined by neutron scattering. A homogenous dispersion of ICBA in LBP is found in the sample where the second solvent is selective to LBP, giving poor PCE. Aggregates of ICBA are formed in those samples where the second solvent is selective to ICBA. The resultant morphology improves PCE by up to 246%. A quantitative analysis of neutron data shows that the interfacial area between ICBA aggregates and LBP/ICBA mixed phase is improved in these samples, which appears to facilitate charge transport and reduce the recombination of free charge carriers.

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