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ABSTRACT

The efficiency of bulk heterojunction organic photovoltaic cells can be enhanced through heat treatment of the components of the blend solution. The morphology of films spun from the heat treated blend solution reveals a more favorable diffusion of [6,6]-phenyl-C61-butyric acid methyl ester into the Poly(3-hexylthiophene-2,5-diyl) matrix than observed in the separate heating of the individual solutions. Heat treatment of a Poly(3-hexylthiophene-2,5-diyl) solution showed an enhanced Raman intensity associated with structural ordering. Heating of the blend solution after pre-heating P3HT solution to form a bulk heterojunction (P3HT: PCBM) with a ratio of 1:1 leads to limited diffusion of the [6,6]-phenyl-C61-butyric acid methyl ester phase into the crystalline Poly(3-hexylthiophene-2,5-diyl) phase. This study showed that solution heat treatment of a P3HT:PCBM blend leads to structural ordering of the Poly(3-hexylthiophene-2,5-diyl) polymer which modified the optical, morphological, PL and Raman characteristics relative to highly ordered Poly(3-hexylthiophene-2,5-diyl). The high Poly(3-hexylthiophene-2,5-diyl) polymer crystallinity enhanced the red shifted optical absorption, narrowed the full width at half maximum of Raman peaks and decreased the photoluminescence intensity upon solution heat treatment. The efficiency of the Bulk heterojunction made from a solution heat treated blend has yielded maximum power