“Alloy-parallel” Morphology in Ternary Organic Solar Cells

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Morphology in organic solar cell is complicated especially the three and even more phases are taken into account. The hierarchical structure, consisting of molecular packing and multi-scale donor/acceptor phase separation, from nanometer to micrometer length scale, is considered to exist in the blends of organic solar cell. The morphology in three components ternary organic solar cells is even completed.

An “alloy-parallel” model is proposed of ternary organic solar cells. This finding is based on the detailed morphology investigation of a polymer/small molecules/fullerene ternary blend solar cell. It is interested to find that the better face-on molecular packing is achieved for both polymers and small molecules in the ternary blend than in the corresponding binary blend. Also, for the first time, the polymer and small molecular domains are successfully distinguished and the domain size and domain purity in the individual polymer: fullerene and small molecule: fullerene domains of the ternary blend are obtained. Further analysis reveals that the optimized domain size and domain purity is obtained in the ternary blend with the 40% small molecular. In addition, the vertical phase separation is found to be critical for charge transfer mechanism. Two different charge transfer models are observed when the composition ratio changes. These detailed studies reveal the morphology-performance relationship in polymer/small molecular/fullerene ternary organic solar cells, which provide important guidance to optimize morphology in ternary blends organic solar cells.

References

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