Enhancing Phase Separation in Inverted Bulk-Heterojunction Organic Solar Cells for Improved Efficiencies

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Poster (2:20 PM)

The ever increasing demand for energy has spurred research in alternative technologies. Among these technologies, photovoltaics have become a subject of interest. Organic solar cells, in particular, are promising low-cost alternatives. Organic bulk-heterojunction solar cells based on interpenetrating networks of an electron donor and an acceptor, with high interfacial area between the donor and acceptor for efficient photo-induced charge separation, have thus seen considerable progress. The performance of these devices, however, are highly dependent on the nanoscale morphology of the electron donor and acceptor [1,2].

Starting with an inverted solar cell architecture, which provides unprecedented air stability, we demonstrate that we can improve solar cell device efficiencies by almost 2-fold through the incorporation of small amounts of transition metal complexes within the photoactive layer. These complexes selectively partition into the electron donor phase, effectively enhancing phase separation between the donor and acceptor. This phase separation in turn increases the short circuit current of solar cell devices, thereby increasing efficiencies. We found the extent of phase separation to be influenced by the hydrophobicity of the ligands on the transition metal complex, with the most hydrophobic ligands increasing χ, the interaction energy between the electron donor and acceptor phases, the most. This result shows that proper control of phase separation within the photoactive layer is crucial for optimal device performance.

[1] Barry C. Thompson and Jean M. J. Frechet, *Angew. Chem. Int. Ed.* 47, 58 (2008).
[2] Gang Li, Vishal Shrotriya, Yan Yao, Jinsong Huang and Yang Yang, *Journal of Materials Chemistry* 17, 3126 (2007).