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Unpinning the Open-Circuit Voltage in Organic Solar Cells through Tuning Ternary Blend Active Layer Morphology PETR KHLYABICH, Princeton University, Department of Chemical and Biological Engineering, BARRY THOMPSON, University of Southern California, Department of Chemistry and Loker Hydrocarbon Research Institute, YUEH-LIN LOO, Princeton University, Department of Chemical and Biological Engineering — The use of ternary, as opposed to binary, blends having complementary absorption in active layers of organic bulk heterojunction solar cells is a simple approach to increase overall light absorption. While the open-circuit voltage (V_{oc}) of such solar cells have generally been shown to be pinned by the smallest energy level difference between the donor and acceptor constituents, there have been materials systems, that when incorporated into active layers of solar cells, exhibit composition dependent and tunable V_{oc}. Herein, we demonstrate that this V_{oc} tunability in ternary blend solar cells is correlated with the morphology of the active layer. Chemical compatibility between the constituents in the blend, as probed by grazing-incidence X-ray diffraction (GIXD) measurements, affords V_{oc} tuning. The constituents need not "co-crystallize"; limited miscibility between the constituents in the active layers of solar cells affords V_{oc} tunability. Poor physical interactions between the constituent domains within the active layers, on the other hand, result in devices that exhibit an invariant V_{oc} that is pinned by the smallest energy level difference between the donor(s) and the acceptor(s). Our morphological studies thus support the proposed alloying model that was put forth originally.

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