

Improvement of organic photovoltaic microstructure through polymer sidechain modification

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In this work, we study the morphology of an OPV active layer with four different sidechain configurations. Substituting branched sidechains for linear sidechains of equal atomic composition is shown to increase the degree of face-on orientation in the film, increasing the device efficiency dramatically. In contrast, replacing the branched sidechains with longer linear sidechains increases the alkyl stacking distance, and this decreases the efficiency. The intermixing of polymer and fullerene, which increases with longer sidechains, is correlated with a decrease in VOC. Notably, the best performing polymer has the lowest degree of intermixing but the best fill factor, showing that intermixing is not necessary for efficient charge separation. The addition of fullerene encourages polymer crystallite formation compared to the neat film, and the best-performing film demonstrates the highest degree of crystallinity.