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**Role of Domain Size and Phase Purity on Charge Carrier Density, Mobility and Recombination in P3HT:$PC_{61}BM$ Devices** BINGYUAN HUANG, JOJO AMONOO, ANTON LI, CHELSEA CHEN, PETER GREEN, Univ of Michigan - Ann Arbor — From an experimental perspective, understanding the interrelationships between the morphological structure, transport properties and device performance remains an important question. We designed and fabricated active material morphologies that possess dissimilar domain sizes/phase purities using different processing strategies: organic solvent casting, supercritical carbon dioxide ($scCO_2$) processing and thermal annealing. The short circuit currents of the as-cast samples, $J_{as-cast}$, were appreciably lower than those in the $scCO_2$ processed samples, $J_{scCO2}$, and the thermally annealed samples, $J_{thermal}$. While $J_{scCO2} \sim J_{thermal}$, the initial carrier densities in the $scCO_2$ processed samples, $n(0)_{scCO2}$, and the carrier recombination coefficients, $\alpha_{scCO2}$, were significantly higher than those in the thermally annealed samples ($n(0)_{scCO2} \sim 5n(0)_{thermal}$; $\alpha_{scCO2} \sim 2\alpha_{thermal}$). It is also shown that while $J_{scCO2} \sim 3J_{as-cast}$, the $n(0)_{scCO2} \sim n(0)_{as-cast}$, yet $\alpha_{scCO2} > \alpha_{as-cast}$. These observations are reconciled on the basis of details of the morphologies of these systems.

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