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Influence of Morphological Disorder on In- and Out-of-Plane Charge Transport in Conjugated Polymer Films BAN DONG, ANTON LI, PETER GREEN, University of Michigan — We report the unequal impacts of morphological disorder on in- and out-of-plane charge transport in thin films of poly(3-hexylthiophene) (P3HT) fabricated by both conventional spin-casting and the novel technique Matrix-Assisted Pulsed Laser Evaporation (MAPLE). MAPLE produces films with inhomogeneous globular subfeatures with dimensions on the order of 100 nm. Optical absorbance spectroscopy corroborates that MAPLE-deposited films are more energetically disordered, but possesses average conjugation lengths comparable to spin-cast P3HT. Both in- and out-of-plane carrier transport measurements of MAPLE-deposited films show characteristics that reflect a higher degree of energetic disorder and broadened density of states. Whereas in-plane carrier mobilities of MAPLE-deposited thin-film transistors are comparable to spin-cast analogues (8.3 x 10^{-3} $cm^2V^{-1}s^{-1}$ versus 5.5 x 10^{-3} $cm^2V^{-1}s^{-1}$), the out-of-plane mobilities of MAPLE-deposited samples are nearly an order of magnitude lower (4.1 x 10^{-4} $cm^2V^{-1}s^{-1}$ versus 2.7 x 10^{-3} $cm^2V^{-1}s^{-1}$). The unusual ensemble of properties and behaviors arising from the unique morphologies produced by MAPLE provide important perspectives on the extent to which disorder impacts different mechanisms of charge transport in conjugated polymers.

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