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Hierarchical Mixing of PCBM:P3HT Bulk Heterojunctions as Determined by Neutron Scattering: Implications for Organic Photovoltaics MARK DADMUN, NATHAN HENRY, WEN YIN, University of Tennessee, KAI XIAO, Oak Ridge National Laboratory — The current model for the ideal morphology of a conjugated polymer bulk heterojunction organic photovoltaic (OPV) is a phase-separated structure that consists of two pure phases, one an electron donor, the other an acceptor, that form an interpenetrating, bicontinuous, percolating network on the length scale of 10-20 nm. In this work, we use neutron scattering to demonstrate that the two phases in one of the most common conjugated polymer bulk heterojunctions, poly[3-hexylthiophene] (P3HT) and surface-functionalized fullerene 1-(3-methyloxycarbonyl)propyl(1-phenyl [6,6]) C₆₁ (PCBM), are far from pure. The implications of this finding on the ideal morphology of conjugated polymer bulk heterojunctions will be discussed. This hierarchical mixing picture provides a favorable amount of surface area for exciton dissociation, and if properly designed, sufficient pathways for charge transport, and presents a new paradigm in the definition of an ideal bulk heterojunction material.

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