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Neutron Scattering Provides a New Model for Optimal Morphologies in Organic Photovoltaics: Rivers and Streams MARK DADMUN, NATHAN HENRY, WEN YIN, University of Tennessee, KAI XIAO, JOHN ANKNER, 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, network on the length scale of 10-20 nm. In this talk, neutron scattering experiments that demonstrate that this model is incorrect for the archetypal conjugated polymer bulk heterojunction, poly[3-hexylthiophene] (P3HT) and the fullerene 1-(3-methyloxycarbonyl)propy(1-phenyl [6,6]) C_{61} (PCBM) will be presented. These studies show that the miscibility of PCBM in P3HT approaches 20 wt%, a result that is counter to the standard model of efficient organic photovoltaics. The implications of this finding on the ideal morphology of conjugated polymer bulk heterojunctions will be discussed, where these results are interpreted to present a model that agrees with this data, and conforms to structural and functional information in the literature. Furthermore, the thermodynamics of conjugated polymer:fullerene mixtures dominate the formation of this hierarchical morphology and must be more thoroughly understood to rationally design and fabricate optimum morphologies for OPV activity.

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