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Nanoparticle distribution in polymer solar cells B.J. KIRBY, NIST, J.W. KIEL, U. Delaware, B.B. MARANVILLE, C.F. MAJKRZAK, NIST, M.E. MACKAY, U. Delaware — Polymer based solar cells (PSC) hold the promise of cheap, versatile devices for harnessing solar energy. A widely studied PSC is poly-3-hexylthiophene (P3HT) blended with [6,6] - phenyl-C61 - butyric acid methyl ester (PCBM) nanoparticles. The acceptor PCBM is needed to inhibit exciton recombination, thus, proper PCBM distribution is critical for photovoltaic performance. However, determining this distribution is challenging, as PCBM is extremely difficult to distinguish from P3HT via standard techniques like microscopy or x-ray diffraction. Neutron scattering presents a solution, as the scattering potential for PCBM is ∼5 x that of P3HT. Thus, we have studied PCBM:P3HT thin film samples using neutron reflectometry, which is sensitive to the compositional depth profile.[1] Measurements were conducted both with a weak scatterer (air) and then with a strong scatterer (D2O) backing the sample, such that the depth profile could be calculated from the reflectometry data with no fitting parameters, and/or model fitted with virtually no ambiguity. We find that PCBM aggregates near the substrate and surface interfaces of the P3HT film, implying that the PCBM is not optimally distributed for best photovoltaic performance. In general, this work demonstrates the extreme utility of neutron reflectometry for studying this class of materials. [1] Kiel, et al. Soft Matter, DOI:10.1039/B920979D (2009).

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