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Imaging three dimensional bicontinuous networks in bulk heterojunction solar cells JAMES T. ROGERS, LOUIS A. PEREZ, ALAN J. HEEGER, UC Santa Barbara, HIROSHI JINNAI, Kyushu University, GUILLERMO C. BAZAN, EDWARD J. KRAMER, UC Santa Barbara — Highly efficient, solution processable, organic photovoltaics typically consist of a two component donor-acceptor type heterojunction structure comprised of a low bandgap conjugated polymer donor blended with a fullerene acceptor. Efficient charge extraction from these blends demands that donor and acceptor components form nanoscale phase separated percolating pathways to their respective electrodes. Although the existence of this bicontinuous interpenetrating network, termed a bulk heterojunction (BHJ), is hypothesized to be requisite for efficient device operation, attempts to characterize BHJ structures using conventional transmission electron tomography (TEMT) techniques have failed. Energy filtered TEMT (EF-TEMT) is demonstrated to overcome the inadequacies of conventional TEMT, enabling three-dimensional (3D) imaging of high efficiency BHJ structures with nanometer resolution. Considered in combination with x-ray scattering measurements, the 3D chemical maps derived from EF-TEMT are used to offer a plausible mechanism of BHJ formation in devices reaching 7.1% efficiency.

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