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Microstructure of self-assembled all-conjugated donor-acceptor block copolymers for organic solar cells MICHAEL BRADY, Materials Department, UC Santa Barbara, SUNG-YU KU, Materials Research Laboratory, UC Santa Barbara, JUSTIN COCHRAN, Department of Chemistry, UC Santa Barbara, CRAIG HAWKER, EDWARD KRAMER, MICHAEL CHABINYC, Materials Department, UC Santa Barbara — All-conjugated diblock copolymers (CBCPs), with donor and acceptor blocks, form intriguing alternatives to polymer/fullerene bulk heterojunction (BHJ) blends as low-cost photovoltaics. BHJs comprise a phase-separated thin film microstructure, in which chemically distinct domains of donor and acceptor enable exciton dissociation at their interface and transport of free charges through continuous n- and p-type paths to the electrodes. GIWAXS, AFM, soft X-ray spectroscopy (NEXAFS), and resonant scattering (RSoXS) are used to probe the structure of films of CBCPs that have an electron-donating P3HT block and an electron-accepting poly-(diketopyrrolopyrrole-terthiophene) (DPP) block. Thermal annealing after casting causes these CBCP films to form ordered domains on the scale of the exciton diffusion length, with ca. 50 nm in-plane lamellar spacings, with crystallites of each block present. GIWAXS diffraction peaks from the (100), (200), and (300) alkyl chain stacking planes for crystals of each block show (h00) orientation toward the out-of-plane direction, with the (010) pi-stacking vectors in the film plane. CBCP processing-structure studies have enabled the control of chain ordering and orientation at both length scales, and thus the formation of optimal BHJ morphologies.

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