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Enhanced Photovoltaic Performance of All-Conjugated Poly(3-alkylthiophene) Diblock Copolymers MING HE, WEI HAN, JING GE, YU-LIANG YANG, FENG QIU, ZHIQUN LIN — Control of the ratio of blocks in the all-conjugated poly(3-butylthiophene)-b-poly(3-hexylthiophene) (P3BHT) diblock copolymer provides a simple route to precisely tune the molecular organization and nanoscale morphology in the resulting bulk heterojunction (BHJ) solar cells made of P3BHT/ $PC_{71}BM$. An attractive high PCE of 4.02 % was found in P3BHT21 (i.e., P3BT/P3HT block ratio of 2:1 mol/mol)/$PC_{71}BM$, compared to that of 1.08 % in P3BT and 3.54 % in P3HT homopolymer-based devices. The enhanced performance is attributed to improved phase separation, interpenetrating pathway and the formation of crystalline domain size of 10.4 nm in the active layer; the latter also elucidated the importance of alkyl side-chain lengths in the molecular organization and final film morphology. In the P3BHT21/$PC_{71}BM$ blend films, P3BT block facilitated the self-assembly of P3BHT chains into interpenetrating crystalline pathway for efficient charge transport, while P3HT block provided P3BHT chains with necessary flexibility to form improved phase separation at the nanoscale with maximum interfacial areas for charge generation.

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