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Morphology Control and Interfacial Activity Study of Semi-Crystalline Graft Copolymers HYEONG JUN KIM, JIN-SEONG KIM, YOUNGKWON KIM, KAIST, RYAN HAYWARD, UMASS AMHERST, BUMJOON KIM, KAIST — Self-assembly of copolymers containing conjugated segments has been considered a promising approach to achieve desirable nanostructures for efficient organic electronics. Most conjugated polymers, however, often exhibit a high degree of crystallinity, which significantly increases the complexity of their phase behaviors. Here, we explored graft-copolymer architectures with conjugated polymer backbones to regulate self-assembly. A series of poly(3-hexylthiophene) (P3HT) based graft copolymers were prepared, and the effectiveness of the graft architectures was demonstrated by comparing with the corresponding block copolymers. We found that: 1) crystallization of P3HT was suppressed in a tunable fashion due to steric hindrance from grafted chains, leading to production of thermally annealed well-ordered nanostructures; 2) graft architectures accumulate at the of P3HT/fullerene interface in bulk heterojunction solar cells, resulting in higher thermal and mechanical; and 3) grafting of hydrophilic side chains with high areal chain densities on P3HT crystals allowed for stable dispersion in aqueous solvent, enabling fabrication of green-solvent processable conjugated polymer devices.

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