

Abstract Submitted
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Real-time observation of optoelectronic properties during poly(3-alkylthiophene) crystallization VICTOR HO, BRYAN BOUDOURIS, University of California, Berkeley, LESLIE JIMISON, Stanford University, MICHAEL TONEY, Stanford Synchrotron Radiation Lightsource, ALBERTO SALLEO, Stanford University, RACHEL A. SEGALMAN, University of California, Berkeley — Poly(3-alkylthiophenes) (P3ATs) are commonly used semiconducting polymers in organic electronic applications where the nanoscale morphology of the active layer largely dictates device performance. However, during solution processing, a large driving force for crystallization results in thin film morphologies that are kinetically trapped and cannot be easily controlled. We show that rational side chain design, particularly the use of branched alkyl chains, can reduce the melting transition increasing thermal control relative to P3HT. Importantly, the lower crystallization transition temperature provides the opportunity to monitor crystallization in real-time using grazing-incidence x-ray diffraction and UV-vis absorption spectroscopy, and the relative degree of crystallinity is observed to increase gradually over the course of crystallization. In contrast to the gradual increase in crystallinity and optical properties, the field-effect mobility monitored during crystallization exhibits a sharp increase of approximately two orders of magnitude. We propose that the difference in time scales may be due to the formation of a percolated network between electrodes, and that increases in the degree of crystallinity beyond this point are not probed by the transistor geometry.

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