The Thermal Phase transitions of Regioregularity-Controlled Poly(3-dodecylthiophene)

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In this work, the temperature dependent LC phase transitions of regioregularity (RR) -controlled poly(3-dodecylthiophenes) (P3DDTs) are systematically investigated. Controlling RR of the P3DDT from 95% to 60% significantly modifies the strengths of the LC interactions of P3DDTs in a melt state while the chemical structures remain the same, providing an effective model system to systematically control the LC interactions of CPs. As the RR reduces, the P3DDT exhibits progressively decreased transition temperatures (i.e., nematic-to-isotropic transition temperature) under polarized optical microscopy (POM). In particular, in-situ X-ray scattering reveals that the P3DDT with high RR above 75% exclusively crystalizes into Form I structures while low RR P3DDT adopts Form II polymorph, which show much lower melting temperature due to larger entropic gain from the melting of alkyl chains. This study provides understanding of the influence of RR in crystalline structures and thermotropic LC behaviors.