High-mobility organic field-effect transistors with highly ductile and regio-regular indacenodithiophene-based semiconducting polymers

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We investigate the effect of regioregularity of four donor–acceptor polymers on their ductility and electrical properties. The polymers are comprised of cyclopentadithiophene (CDT) and/or indacenodithiophene (IDT) moieties as electron donors in conjunction with the asymmetric 5-fluoro-2,1,3-benzothiadiazole (FBT) as an electron acceptor that is precisely oriented in the regular pattern along the backbone. Morphological analyses of a series of polymers demonstrate that the exclusive CDT-containing polymer is semi-crystalline, whereas the others (IDT-containing counterparts) are near-amorphous. The IDT-containing polymers have superior hole mobilities exceeding 1 $cm^2/V-s$ which outperforms the CDT-based counterpart. More importantly, the IDT-based polymers exhibit remarkably improved ductility with a crack on-set strain value increased up to 100% which is unambiguously higher than that of the CDT-based counterpart ($\varepsilon < 30\%$). These results demonstrate that a near-amorphous IDT framework enables high mobility and ductility essential for realization of high-performance stretchable electronics.