Structure-Property-Performance Relationships of *n*-Type Polymer Semiconductors for All-Polymer Solar Cells

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Fullerene-based electron acceptors, exemplified by $PC_{60}BM$ and $PC_{70}BM$, have enabled advances in organic photovoltaics (OPVs) in last 2 decades. The use of electron-conducting (*n*-type) polymer semiconductors as the electron acceptor in OPVs offers many potential advantages over fullerene acceptors. Among these is the facile tunability of the optical absorption band, electronic structure, crystallinity, solubility, and charge transport properties. Unfortunately, the performance of all-polymer solar cells is still inferior compared to fullerene-based solar cells. Low photocurrent and lack of approaches to optimize polymer/polymer blend morphology are some of the major factors that limit the performance of all-polymer photovoltaic devices. To overcome these challenges, we have developed a series of new naphthalene diimide-based acceptor copolymers and studied their structure-property-performance relationships. The resulting all-polymer solar cells gave power conversion efficiencies of up to 7.7 % while providing new insights into material design for high performance fullerene-free all-polymer blend photovoltaic cells.