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Molecular Engineering of Polymer Semiconductors for Solar Cells SAMSON JENEKHE, Department of Chemical Engineering and Department of Chemistry, University of Washington, SELVAM SUBRAMANIYAN, EILAF AHMED, HAO XIN, FELIX KIM, University of Washington — We have developed a series of new donor-acceptor copolymers which allow us to tune the electronic structures, charge transport, and thus their photovoltaic properties. The new materials combined high field-effect hole mobilities (0.01-0.1 cm^2/Vs) with broad absorption spectra and optical band gaps as small as 1.7 eV. Bulk heterojunction solar cells using these copolymers as donor and fullerene derivative as acceptor were fabricated and their comparative performance will be discussed. A power conversion efficiency of 4.54% was achieved in ambient air from one of the polymers with a current density (J_{sc}) of 12.19 mA cm^{-2}, an open circuit voltage (V_{oc}) of 0.60 V, and a fill factor (FF) of 0.62. The variation in the photovoltaic properties in the series of copolymers is explained by the differences in optical properties and electronic structures of these polymers as well as the nanoscale morphology of the polymer-fullerene blend thin films. Our results provide new insights in the design of donor-acceptor copolymers for organic solar cell applications.

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