Charge carrier transport in advanced DPP based polymer thin-film transistors

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Studies on charge carrier transports on thin-film transistors (TFTs) consisting of advanced polymeric semiconductor are provide considerable insight and help understand material properties and device physics. One such family of semiconductors are copolymers based on the diketopyrrolopyrrole (DPP) core- and include materials that can be used to fabricate high mobility p-channel and ambipolar TFTs. DPP based co-polymers are comprised of acceptor and donor blocks which can be designed to tune transport properties and mobilities of 2-10 cm2/V-s have been realized by a few groups with this materials system. TFTs formed from such donor-acceptor systems possess good device characteristics including high field-effect mobility due to good p-orbital overlap. We report on charge transport properties of DPP-based polymer TFTs under bottom gate, top gate, and dual gate operation. We have performed detailed non-quasistatic and steady-state characterization of TFTs at temperatures in the range 77-350 K. From such measurements we extract mobilities, activation energies (if applicable), electronic density of states, and information about transport mechanisms. We will also correlate key transport parameters with molecular structures and energy levels of several DPP-based materials that we have developed and studied.