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Spectroscopic signatures of ambipolar injection in narrow gap donor-acceptor polymer transistors OMAR KHATIB, UCSD, JONATHAN D. YUEN, UCSB, JIM WILSON, UCSD, RAJEEV KUMAR, Nanoterra, FRED WUDL, UCSB, MASSIMILIANO DI VENTRA, UCSD, ALAN J. HEEGER, UCSB, DIMITRI N. BASOV, UCSD — Donor-Acceptor (D-A) copolymers have recently emerged as versatile materials for use in a large variety of device applications. Specifically, these systems possess extremely narrow bandgaps, enabling ambipolar charge transport when integrated in solution-processed field-effect transistors (OFETs). However, the fundamentals of electronic transport in this class of materials remain unexplored. We present a systematic investigation of ambipolar charge injection in D-A conjugated polymers polybenzobisthiadiazole-dithienopyrrole (PBBTPD) and polybenzobisthiadiazole-dithienocyclopentane (PBBTCD) using infrared spectroscopy. We observed a significant modification of the absorption edge in both PBBTPD- and PBBTCD-based OFETs under the applied electric field. The absorption edge reveals hardening under electron injection and softening under hole injection. The most straightforward interpretation of the observed band edge modification is in terms of the linear Stark effect, implying the existence of a built-in electrical dipole moment in these polymers. Additionally, we carried out microscopic IR measurements to characterize the ambipolar injection profile between electrodes.

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