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Varying the apparent conduction mechanism in polymer semiconductors EMILY G. BITTLE, HYUN WOOK RO, JAMES I. BASHAM, DEAN DELONGCHAMP, DAVID GUNDLACH, Natl Inst of Stds Tech, OANA JURCHESCU, Wake Forest University — The weak van der Waals inter-molecular interactions in organic semiconductors (OSCs) result in large variations in transport behavior ranging from hopping to band-like. Accurately measuring and modelling charge transport is a prerequisite to establishing robust transport-microstructure correlations and developing predictive structure-function relationships for optimized materials design and processing. Field-effect transistors have become a favored test structure for parameterizing and benchmarking the electronic properties of OSCs due to their ease of fabrication, measurement, and possible use in commercial applications. However, correctly analyzing transistor current-voltage measurements to extract material properties has proven difficult, as parasitic effects influence the device electrical properties and mask intrinsic material properties. Here, we use impedance spectroscopy to evaluate the effects of contacts on device operation and extract the properties of the channel which we compare with conventional DC measurements. We apply this approach to model systems of the widely studied polymer regioregular poly(3-hexylthiophene-2,5-diyl) which we engineer through different solidification kinetics to achieve distinct, well characterized degrees of molecular order. When increasing the order we find that the transport changes from field enhanced to field independent. This study addresses the origins of transport behavior seen in OSCs while discerning non-linear contact effects from field dependent transport.

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