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All Electronic Charge Carrier Transit Time Mobility Measurements and Data Analysis in Pentacene Organic Field Effect Transistors

LAWRENCE DUNN, University of Texas at Austin and IMRE, Singapore, DEBARSHI BASU, LIANG WANG, ANANTH DODABALAPUR, University of Texas at Austin — In organic field-effect transistors (OFETs), the most common method of estimating mobility is to extract it from the transfer characteristics (*e.g.*, I_d - V_{ds} and I_d - V_{dg} curves). Time-of-flight measurements via optical excitation of charge carriers in the organic material are also used, but this technique measures the mobility of carriers perpendicular to their motion in the OFET geometry. Additionally, in some polycrystalline organic semiconductors, the optically excited time-of-flight measurements are rendered difficult due to charge trapping. We present an all-electronic time of flight method for measuring the in-plane mobility of charge carriers using an applied voltage pulse to the source of the OFET with a rise time of < 60 ns. The gate of the OFET was grounded and the drain was connected to ground across a small load resistor. The transit time of the charge carriers from the source to the drain was measured by recording the voltage drop across the load resistor using a high-speed oscilloscope. The fabrication of the OFET, extraction of the charge carrier transit time from recorded data and effect of the displacement current over varying temperature and voltage step magnitudes will be discussed.

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