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N-Type and Ambipolar Charge Transport in Polymer Field-Effect Transistors JANA ZAUMSEIL, LAY-LAY CHUA, Univ. of Cambridge, PETER K.H. HO, National Univ. of Singapore, RICHARD H. FRIEND, HENNING SIRRINGHAUS, Univ. of Cambridge — Most organic field-effect transistors (FETs) readily show p- but not n-type conduction. So far electron conduction has only been found in a few high electron-affinity organic semiconductors. The origin of this difference in electron and hole transport is currently not well understood but the nature of the gate dielectric seems to play a major role. We have recently shown that with the appropriate hydroxyl-free gate dielectrics, such as a benzocyclobutene derivative (BCB) n-type field-effect conduction can be readily observed in a range of polymer semiconductors such as polyfluorenes (e.g. F8BT, F8) and polyphenylenevinylenes (e.g. MEH-PPV, OC_1C_{10}-PPV) which were previously believed to exhibit only p-type field-effect conduction. Here we show that even poly(3-hexylthiophene) (P3HT) which has been widely investigated as a p-channel semiconductor with high hole mobilities is equally able to conduct electrons and shows efficient n-type behaviour in field-effect transistors. Moreover we demonstrate ambipolar charge transport in transistors based on high purity P3HT with balanced electron and hole mobilities. We use these ambipolar transistors to investigate the origin of traps in the bulk and at the semiconductor-dielectric interface represented by hysteretic current-voltage characteristics. This observation of balanced ambipolar charge transport in a conjugated polymer opens the way to organic low power complementary circuits and even light-emitting field-effect transistors.

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