N-Channel organic thin-film transistors based on naphthalene-bis(dicarboximide) polymer for organic transistor memory using hole-acceptor layer

Abstract

An investigation of threshold voltage shifts in organic thin-film transistors (OTFTs) based on poly{[N,N”-bis(2-octyldodecyl)-naphthalene-1, 4,5,8-bis(dicarboximide)-2,6-diyl]-alt-5,5”-(2,20-bithiophene)} [P(NDI2OD-T2)] with additional poly(3-hexylthiophene) (P3HT) films on a poly(methyl methacrylate) (PMMA) organic dielectric layer is reported. With a top source-drain contact structure, the device exhibited a unipolar property with n-channel characteristics similar to those of the P(NDI2OD-T2)-only device. Furthermore, the existence of P3HT films as hole acceptor-like storage layers resulted in reversible V th shift upon the application of external gate bias (V bias) for a certain bias time (T bias). Hence, the P(NDI2ODT2)/ P3HT-OTFTs exhibited a large memory window (δV th = 10.7 V) for write and erase electrically without major degradation in saturation mobility [μ sat = (1.8-2.8) × 10 $^{-4}$ cm 2 V $^{-1}$ s $^{-1}$]. These results clearly indicate the utility of the naphthalene-bis(dicarboximide) (NDI)-based polymer-hole acceptor layer in the development of n-channel organic transistor memories.