

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(NDI2OD-T2)/P3HT-OTFTs exhibited a large memory window ($\delta V_{th} = 10.7$ V) for write and erase electrically without major degradation in saturation mobility [$\mu_{sat} = (1.8-2.8) \times 10^{-4}$ cm² 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.