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Resistance Switching of Organic Devices Based on P3HT-PCBM Heterojunction

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We prepared organic memory devices using poly(3-hexyl thiophene) (P3HT) and [6,6]-phenyl C_{61}-butyric acid methyl ester (PCBM) system as active layer. The active layer of 50nm thickness was formed by spin-coating 1:0.8 mixture solutions of 2.0 wt% P3HT and PCBM in 1,2-dichlorobenzene. Al/P3HT-PCBM/ITO devices showed an asymmetric bipolar resistance switching in current-voltage characteristics. The initial high resistance state (OFF state) changed into a low resistance state (ON state) when we applied a voltage of 2.5 V (V_{SET}) and the low resistance state could also change into the high resistance state when we applied a voltage of -2V(V_{RESET}). The high resistance state and the low resistance state were switched reversible by applied pulsed bias and the device remained its own state even after the removal of bias. To understand the conduction and switching mechanism we analyzed the I-V characteristics with respect to several conduction models. The conduction mechanism could be well described by the trap- controlled space-charge-limited-current model. From the conduction measurement with lateral electrodes configuration it was found that the electrical bistability is related to the charges stored in traps near the interface of the top metal electrode and organic layer, and the space-charge-limit-current of the interface traps explains the conduction and switching of the P3HT-PCBM memory devices.

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