
Heterostructured semiconductor single-walled carbon nanotube films for solution-processed high-performance thin film transistors

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In this paper, we report a simple and effective method to achieve a high charge-carrier mobility and low off current in polymer-wrapped semiconducting single-walled carbon nanotube (s-SWNT) transistors by applying a SWNT bilayers. To achieve the high mobility and low off current, highly purified and less purified s-SWNTs are successively coated to form the semiconducting layer consisting of poly (3-dodecylthiophene-2,5-diyl) (P3DDT)-wrapped high-pressure carbon mono oxide (HiPCO) SWNT (P3DDT-HiPCO) and poly (9,9-di-n-dodecylfluorene) (PFDD)-wrapped plasma discharge (PD) SWNT (PFDD-PD). The SWNT transistors with bilayers SWNT networked film showed highly improved hole field-effect mobility ($6.18 \pm 0.85 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ average), on/off current ratio (10^7), and off current ($\sim 1 \text{ pA}$). Thus, the combination of less purified PFDD-PD (98%–99%) charge-injection layer and highly purified s-P3DDT-HiPCO (>99%) charge-transport layer as the bi-layered semiconducting film achieved high mobility and low off current simultaneously.

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