Nanocomposites and nanomaterials

Channel Length Modulation in Organic Field Effect Transistor with a Polystyrene Insulator using a PEDOT:PSS Composite Electrode

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Organic field-effect transistors (OFETs) have become of great interest due to their potentials for application to low-cost, flexible, and large-area thin-film devices [1-2]. The most significant and widely used π-conjugated material in OFETs is poly(3-hexylthiophene) polymer (P3HT). Early, it was investigated that for the production of high quality OFETs, the organic semiconductor is not the only critical component. It is also very significant to find an appropriate gate insulator. Polystyrene from these gate insulators has good dielectric properties [3]. Polystyrene (PS) is a versatile polymer in terms of chemical and structural properties and can be easily synthesized by various polymerization mechanisms with various tacticities and chain lengths [4]. As a viable alternative to inorganic contacts, a well-known conductive polymer mixture of PEDOT:PSS is already used in solid electrolyte in the organic devices.

The OFET with channel length modulation was fabricated by spin coating method using a P3HT and the PS insulator on a prepatterned OFET substrate. The poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) was used as an electrode. ITO/PS/PEDOT:PSS structure was prepared using same method for capacitance measurements of a polymer insulator. Electrical characterization of OFET devices were held in total darkness and in air ambient for the purpose of achieving output and transfer current-voltage (*I-V*) characteristics. the main parameters such as the threshold voltage (V_{Th}), field effect mobility (μ_{FET}) and current on/off ratio ($I_{on/off}$) of the devices were extracted from capacitance-frequency (*C-f*) plot of the ITO/PS/PEDOT:PSS structure. It was found that fabricated PS-OFETs exhibit good device performance such as low V_{Th}, remarkable mobility, and $I_{on/off}$ values.

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