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Low Voltage and High Field-Effect Mobility Thin Film Transistor Using Crystalline Polymer Nanocomposite as Gate Dielectric

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Abstract : The operation of organic thin film transistors (OFETs) with low voltage is currently a prevailing issue. We have fabricated anthracene thin-film transistor (TFT) with an ultrathin layer (~450nm) of Poly-vinylidene fluoride (PVDF)/CuO nanocomposites as a gate insulator. We obtained a device with excellent electrical characteristics at low operating voltages (<1V). Different layers of the film were also prepared to achieve the best optimization of ideal gate insulator with various static dielectric constant (εr). Capacitance density, leakage current at 1V gate voltage and electrical characteristics of OFETs with a single and multi layer films were investigated. This device was found to have highest field effect mobility of 2.27 cm2/Vs, a threshold voltage of 0.34V, an exceptionally low sub threshold slope of 380 mV/decade and an on/off ratio of 106. Such favorable combination of properties means that these OFETs can be utilized successfully as voltages below 1V. A very simple fabrication process has been used along with step wise poling process for enhancing the pyroelectric effects on the device performance. The output characteristic of OFET after poling were changed and exhibited linear current-voltage relationship showing the evidence of large polarization. The temperature dependent response of the device was also investigated. The stable performance of the OFET after poling operation makes it reliable in temperature sensor applications. Such High-ε CuO/PVDF gate dielectric appears to be highly promising candidates for organic non-volatile memory and sensor field-effect transistors (FETs).

Keywords : organic field effect transistors, thin film transistor, gate dielectric, organic semiconductor
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