

Performance Investigation of Organic Thin Film Transistor on Varying Thickness of Semiconductor Material: An Experimentally Verified Simulation Study

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Physics-based two-dimensional numerical simulations are performed to analyze the device characteristics of tri-isopropylsilylethynyl (TIPS)-pentacene organic thin-film transistor (OTFT) fabricated using drop-casting technique. Further, using simulation technique enabling calibration this paper also presents the systematic study of the impact of active layer (TIPS-pentacene) thickness on device characteristics. The extracted parameters such as electric field intensity, current density, current On/Off ratio, and mobility exhibit variation with scaling down in active layer thickness from 500 to 100 nm. The study also revealed that Off current and On/Off current ratio (I_{On}/I_{Off}) is highly dependent on the thickness of the semiconductor layer. Furthermore, the highest value of I_{On}/I_{Off} is obtained at 100-nm thickness of TIPS-pentacene, which can be used for various fast-switching applications in digital circuits. Simulated results are not only reasonably matching with experimental results but also provide insight on charge transportation at the semiconductor–dielectric interface and in the bulk of TIPS-pentacene layer.

Keywords: semiconductor thickness, mobility, organic thin-film transistor.

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