

Organic thin film transistor with BaTiO₃-PVP nanocomposite gate dielectric for thermal sensing applications

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In this study, organic thin film transistor (OTFT) with BaTiO₃-PVP nanocomposite gate dielectric layer has been fabricated and characterized before and after poling process for temperature-dependent electrical measurements. Because of good piezoelectric and pyroelectric properties, barium titanate (BT) ceramic particles were used as the filler in the polymer matrix of poly 4-vinyl phenol (PVP). A coupling agent was applied onto BaTiO₃ particles before dispersing in the polymer to form PVP-BaTiO₃ nanocomposite. Treatment of BT nanoparticles by the coupling agent helped to achieve a coupling effect between the nanoparticles and polymer matrix. The AFM images showed that the surface roughness of the nanocomposite layer increases with the increase of BaTiO₃ content. The surface roughness was controlled within 2.8nm for the 400-nm-thick nanocomposite layer with 25 wt% of BaTiO₃. Nanocomposite gate dielectric layer was shown to have higher capacitance and lower leakage current compared to those of pure PVP gate dielectric layer. The drain currents of the OTFT device with 25 wt% of BaTiO₃ nanocomposite increased after poling. Temperature-dependent I-V measurements of the OTFT device with poled 25 wt% of BaTiO₃ nanocomposite showed that the drain currents decreased when the temperature was increased.