

A Flexible Amorphous Bi₅Nb₃O₁₅ Film for the Gate Insulator of the Low-Voltage Operating Pentacene Thin-Film Transistor Fabricated at Room Temperature

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The amorphous Bi₅Nb₃O₁₅ film grown at room temperature under an oxygen-plasma sputtering ambient (BNRT-O₂ film) has a hydrophobic surface with a surface energy of 35.6 mJm⁻², which is close to that of the orthorhombic pentacene (38 mJm⁻²), resulting in the formation of a good pentacene layer without the introduction of an additional polymer layer. This film was very flexible, maintaining a high capacitance of 145 nFcm⁻² during and after 10⁵ bending cycles with a small curvature radius of 7.5 mm. This film was optically transparent. Furthermore, the flexible, pentacene-based, organic thin-film transistors (OTFTs) fabricated on the polyethersulphone substrate at room temperature using a BNRT-O₂ film as a gate insulator exhibited a promising device performance with a high field effect mobility of 0.5 cm²V⁻¹s⁻¹, an on/off current modulation of 10⁵, and a small subthreshold slope of 0.2 Vdecade⁻¹ under a low operating voltage of -5 V. This device also maintained a high carrier mobility of 0.45 cm²V⁻¹s⁻¹ during the bending with a small curvature radius of 9 mm. Therefore, the BNRT-O₂ film is considered a promising material for the gate insulator of the flexible, pentacene-based OTFT.