

Low voltage flexible organic thin film transistor with an organic/high- k inorganic multilayer gate dielectric layer

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To develop the high performance OTFT devices, low threshold voltage (V_T), low-leakage current, high current on-off ratio, and channel mobility are needed. To achieve low V_T and low-leakage current level, use of thin high- k gate dielectrics is required. For this purpose, the organic/inorganic (high- k) multilayer gate dielectric was employed. First, poly(4-vinyl phenol) (PVP) as an organic gate dielectric layer was spin-coated after Ni gate electrode formation by electroplating. Ultra-thin (10 nm) HfO_2 as a inorganic dielectric deposited by ALD (atomic layer deposition) on the spin-coated PVP layer. ALD of HfO_2 layer was carried out at the substrate temperature 220~240°C. Pentacene as a semiconductor layer was thermally evaporated on the gate dielectric layer using a shadow mask in vacuum chamber at the substrate temperature of 80°C and then the thermal evaporation of gold source and drain electrodes was followed. The OTFT devices with no ALD HfO_2 layer were also fabricated for comparison. In order to investigation of flexible device, OTFT was bended as function of cyclic bending at tension mode with 5 mm bending radius. The electrical measurements indicated the significant reduction in the leakage current for thinner PVP layer and improvement of current on-off ratio when the ALD HfO_2 layer is inserted. And the OTFTs operating at low voltage range with reduced V_T could be obtained.