Pentacene thin film transistors with an organic/high-k inorganic bilayer gate dielectric layer on flexible substrate

설영국[1], 이상설[2], 안진호[2], 이내응[1]
[1]성균관대학교 신소재공학과, [2]한양대학교 신소재공학과
* E-mail : nelee@skku.edu

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) bilayer gate dielectric layers were investigated in this work. Flexible organic thin film transistors were fabricated using pentacene as a semiconducting layer and electroplated nickel (Ni) as a gate electrode on polyimide substrate. Electroplated gate electrode formed on the plasma-treated polyimide substrate provides a good adhesion. First, poly(4-vinyl phenol) (PVP) as an organic gate dielectric layer was deposited by spin coating after Ni gate electrode formation. Ultra-thin (10 nm) HfO_2 as a high-k 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. The channel length varied from 10 to 110㎛, and the channel width was 800㎛. The measured I-V characteristics indicated the significant reduction in the leakage current for thinner PVP layer and improvement of current on-off ratio.