

## The electrical characteristics of flexible organic field effect transistors with flexible multi-stacked hybrid encapsulation

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One of the critical issues for applications of flexible organic thin film transistors (OTFTs) for flexible electronic systems is the electrical stabilities of the OTFT devices, including variation of the current on/off ratio ( $I_{on}/I_{off}$ ), leakage current, threshold voltage, and hysteresis under repetitive mechanical deformation. In particular, repetitive mechanical deformation accelerates the degradation of device performance at the ambient environment.

In this work, electrical stability of the pentacene organic thin film transistors (OTFTs) employing multi-stack hybrid encapsulation layers was investigated under mechanical cyclic bending. Flexible bottom-gated pentacene-based OTFTs fabricated on flexible polyimide substrate with poly-4-vinyl phenol (PVP) dielectric as a gate dielectric were encapsulated by the plasma-deposited organic layer and atomic-layer-deposited inorganic layer. For cyclic bending experiment of flexible OTFTs, the devices were cyclically bent up to 105 times with 5mm bending radius. In the most of the devices after 105 times of bending cycles, the off-current of the OTFT with no encapsulation layers was quickly increased due to increases in the conductivity of the pentacene caused by doping effects from  $O_2$  and  $H_2O$  in the atmosphere, which leads to decrease in the  $I_{on}/I_{off}$  and increase in the hysteresis. With encapsulation layers, however, the electrical stabilities of the OTFTs were improved significantly. In particular, the OTFTs with multi-stack hybrid encapsulation layer showed the best electrical stabilities up to the bending cycles of  $10^5$  times compared to the devices with single organic encapsulation layer. Changes in electrical properties of cyclically bent OTFTs with encapsulation layers will be discussed in detail.<sub>2</sub>