Study on Physical Mechanism on the Positive Bias Stress-Induced Degradation of Amorphous InGaZnO Thin-Film Transistors with Density-of-States Based Characterization

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In active matrix organic light emitting diode displays (AMOLEDs), amorphous oxide semiconductor-based thin film transistors (TFTs) operate as current drivers at the turn-on state (gate-voltage $V_{GS}>V_T$ and drain-voltage $V_{DS}>0$) for a long frame time, and the electrical stability of the driving TFT is very important to guarantee the image quality of the AMOLED. Most previous publications draw attention to the charge trapping as a dominant mechanism, although some observations favoring a defect creation under high positive bias [1]. However, the charge trapping and the creation of defect states near the channel/dielectric interface do not offer a sufficient physical explanation on the instability mechanism. In this work, the instability mechanism of amorphous InGaZnO (a-IGZO) TFTs under a positive bias stress (PBS) was systematically investigated. In particular, we pointed out a variation of the subgap density-of-states (DOS) as the most probable physical mechanism on the degradation of the carrier transport characteristics [2]. Moreover, the PBS effect was examined by both capacitance-voltage (C-V) and current-voltage (I-V) measurement in order to systematically characterize the degradation mechanisms quantitatively.

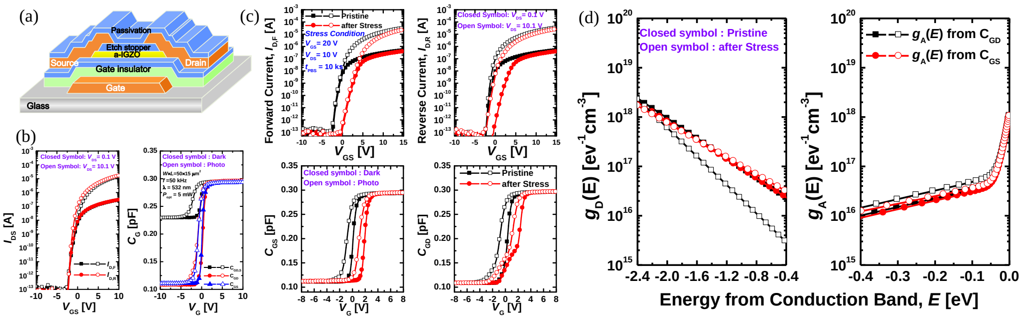

Fig 1. (a) Schematic of the a-IGZO TFTs, (b) *I-V* curve at V_{DS}=0.1, 10.1 V ($I_{D,F}$, $I_{D,R}$) and C-V curve under dark and photonic states ($C_{GD,S}$, C_{GD}, C_{GS}), (c) PBS time evolution (t_{PBS}) of *I-V* and *C-V* curve characteristics, (d) t_{PBS} of subgap DOS.

[1] R. B. M. Cross and M. M. De Souza, IEEE International Reliability Physics Symposium, pp. 467-471 (2007).
[2] H. Bae et al., IEEE Electron Device Letters, Accepted (2013).