Effect of the RF power in sputter system on performance and photoelectric degradation of amorphous indium-gallium-zinc-oxide thin-film transistors

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Although the radio frequency (RF) power is a critical process-controlled parameter which determines not only the performance but also the photoelectric degradation, its effect on electrical performance and reliability of the RF-sputtered amorphous indium-gallium-zinc-oxide (a-IGZO) thin-film transistors (TFTs) has been seldom systematically investigated [1– 2].

Here we analyzed the effects of RF power on the dc performance and the negative bias illumination stress (NBIS)-induced degradation which has been pointed out to be a main hurdle to real commercialization of a-IGZO TFT-driven active-matrix liquid crystal displays (AMLCDs). It was found that the RF power controlled very sensitively the trade-off between the dc performances such as ON current, mobility and subthreshold swing [Fig. 1(a), (b)], and the long-term NBIS instability [Fig. 1(c)]. The RF power-dependent density of subgap states in a-IGZO TFTs also suggested that higher power made the states near the conduction band edge [$g_A(E)$] less and those near the valence band edge [$g_D(E)$] more, and vice versa, explaining very well the RF power dependencies of the performance and instability. Finally, related physical mechanisms, details on parameter-extraction and analysis, and the recovery after NBIS will be discussed.

Our results are expected to give useful physical insight on optimizing the sputtering power for high-performance highly reliable oxide TFT technology.

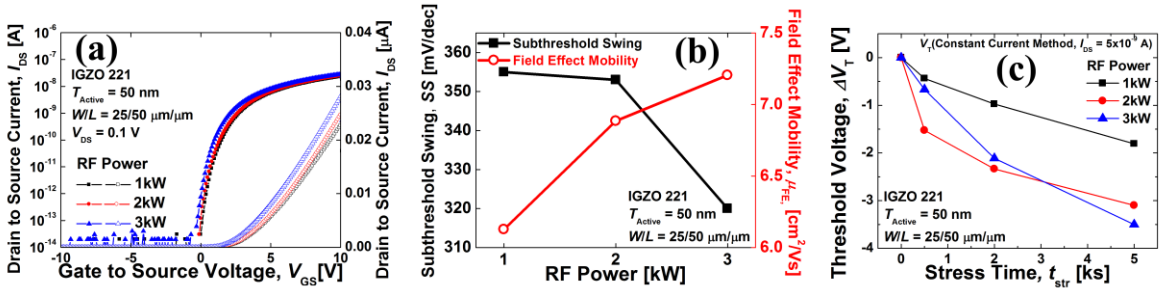

Figure 1 (a) Initial transfer characteristics, (b) SS and field effect mobility, (c) Stress time-evolution ΔV_T of RF power split in a-IGZO TFTs.

[1] H. Q. Chiang, *et al*, *J. Non-Cryst. Solids*, vol. 354, pp. 2826 – 2830 (2008)

[2] S. Junfei, *et al*, *J. Semiconductors*, vol. 34, no. 8, pp. 084003-1 – 084003-5 (2013)