Recovery characteristics of solution-processed indium-gallium-zinc-oxide and indium-strontium-zinc-oxide TFTs from an intense light illumination

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Solution-processed metal-oxide semiconductors are now considered as one of the promising candidates for transparent and flexible displays due to their high electrical performance even in amorphous state. Despite their good electrical performance, light-induced instability such as negative-bias illumination stress (NBIS) give rise to negative V_{TH} shift, and persistent photoconductivity (PPC) are the known drawbacks of the metal-oxide semiconductors [1,2]. Particularly, the NBIS-induced V_{TH} shift and PPC behavior are closely related with the oxygen vacancies in the channel layer [3]. Also, the recovery characteristics of the oxide TFTs after severe stress conditions or illumination by an intense light are important to trace the physical properties of the channel layer. In addition, it is desired to have a channel layer having rapid recovery characteristics after illumination [4].

Here, we investigated the recovery characteristics of solution-processed indium-gallium-zinc-oxide (IGZO) and indium-strontium-zinc-oxide (ISZO) TFTs from an intense light illumination. Particularly, we utilized conventional thermal annealing (at 350°C) and deep-ultraviolet-induced photochemical activation routes to fabricate the IGZO and ISZO channel layers. Figure 1 shows the time-variant recovery characteristics (I_D, drain current) for thermally annealed IGZO and ISZO, and photo-annealed IGZO TFTs. As indicated, the photo-annealed IGZO channel shows more rapid recovery after illumination compared to thermally annealed IGZO channel, which can be attributed to a variation in oxygen vacancy concentrations in both channel layers. In addition, the thermally annealed ISZO TFTs showed enhanced recovery characteristics compared to thermally annealed IGZO TFTs. We analyzed the PPC behaviors in various metal-oxide channel layers and correlate with vacancy concentration of the channel layer to describe their recovery characteristics.

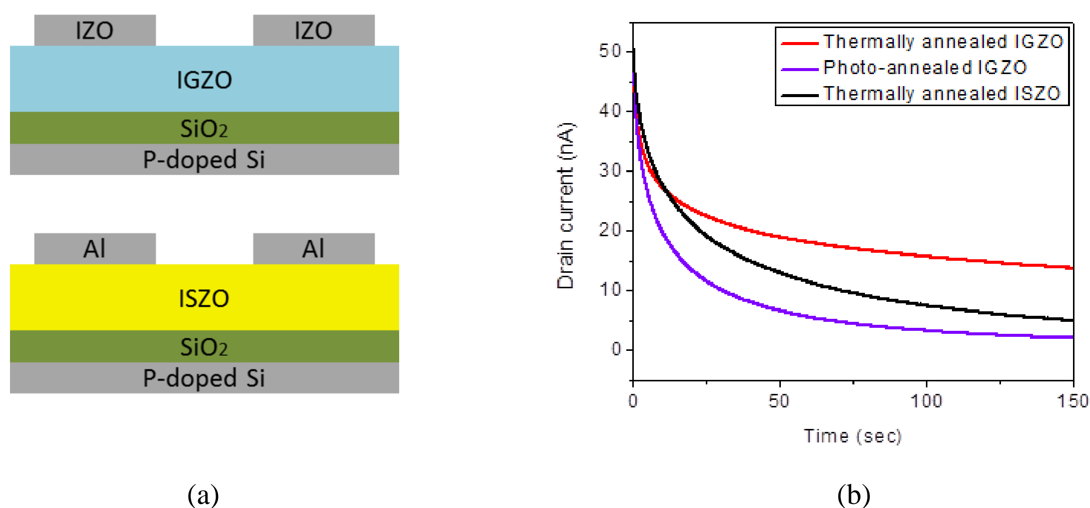

Fig. 1. (a) Schematics showing fabricated IGZO and ISZO TFTs, and (b) recovery behaviors (trace of I_D, drain current) after an intense white light illumination.

References

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