Simple method for stable In-Ga-Zn-O thin-film transistors by vertically controlling the oxygen vacancy

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Amorphous oxide semiconductors (AOSs) have attracted much attention as an active layer of thin-film transistors (TFTs) because of its higher electrical properties compared with amorphous Si.[1] Oxygen vacancy plays an important role in oxide TFTs. Therefore, control of the oxygen vacancy in active layer is important to facilitate high performance and stable oxide TFTs.[2] In this study, we changed the oxygen partial pressure during sputtering to control the oxygen vacancy in active layer vertically.

We fabricated two types of TFTs: one was fabricated with only 0% oxygen partial pressure (P_O) (sample A) and the other was fabricated with 0% P_O for front channel and 5% P_O for back channel (sample B). For sample B, the thickness ratio of the film fabricated with 0% P_O to 5% P_O was 3:1.

Fig. 1 (a) shows the schematic diagram of In-Ga-Zn-O (IGZO) TFTs. The field-effect mobility of the sample A and sample B was 8.89 and 8.35 cm^2/Vs, respectively. Sample B had little degradation on electrical performance compared with sample A. To investigate the stability of these TFTs, we conducted 100 times consecutive transfer characteristic measurements. The transfer curves shifted to positive direction on both TFTs as the number of measurements was increased. This behavior was attributed to the trapping of charges at active layer and near the interface between active channel and gate dielectric layer.[2] V_{th} shift of the sample A and sample B after 100 times measurement were 2.97 and 1.34 V, respectively. The enhancement of consecutive measurement stability came from the low oxygen vacancy in back channel of sample B TFT.

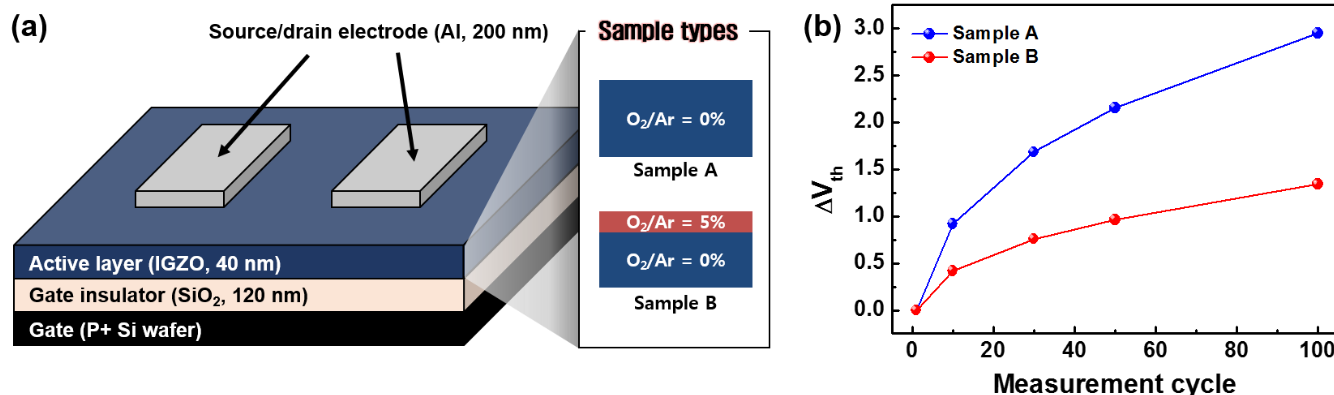

Fig. 1. (a) The schematic diagram of IGZO TFT and (b) V_{th} shift during 100 times consecutive transfer characteristic measurements.

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