Effect of Hydrogen in Gate Insulator on NBIS Performance of Oxide Thin Film Transistor

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Oxide semiconductor thin film transistor(TFT) should achieve high mobility and high stability for high resolution active matrix display. Most of high mobility oxide semiconductors, however, contain lots of oxygen vacancy. The oxygen vacancy is well known as the main source of negative bias illumination stress(NBIS) instability of oxide TFT. The increased oxygen vacancy (Vo) of high mobility oxide semiconudctors results in more negative Vth shift after NBIS. To minimize NBIS degradation, we should understand the origin of NBIS instability. It is reported that the H in SiO_2 gate insulator can trap Vo related states.* Therefore, it is very important to optimize the H amounts in the gate insulator of oxide TFT. In this study, we controlled H amounts in gate insulator by depositing alumina using thermal atomic layer deposition (ALD) and plasma enhanced atomic layer deposition (PEALD) in top gate structure to mimic self-aligned TFT which is used for high resolution display. We compared TFT performance in terms of NBIS, NBTS, PBTS and mobility to verify the effect of hydrogen in gate insulator on NBIS of oxide TFT. Each deposition method showed its own cons and pros in TFT performance. While TFT with ALD processed alumina gave high mobility of 21.9 cm^2/V.s with negative shifted Von of -1.32V, that with PEALD resulted in reduced mobility of 15.9 cm^2/V.s with positive shifted Vth of 0.06V. We will suggest the way to suppress NBIS instability with maintaining the high mobility characteristics.

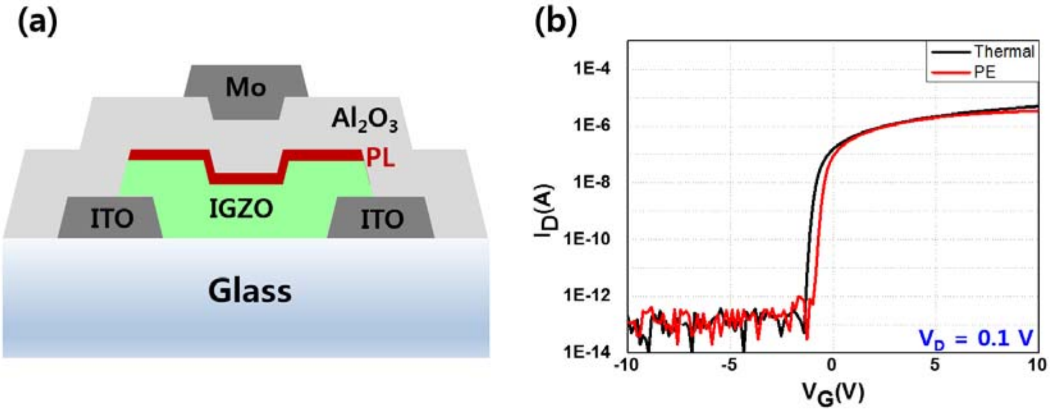

Fig. 1. (a) Schematic structure of top-gate TFT device, (b) Transfer curve of oxide semiconductor TFT device deposited by thermal ALD method PL and PEALD method PL.

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