Low Temperature Processed Non-volatile Memory Oxide TFT with Mobile Proton Generation in SiO2 Gate Dielectric by Hydrogen Neutral Beam

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We will present the non-volatile memory (NVM) functionality of indium gallium zinc oxide (IGZO) thin film transistors (TFTs) using mobile protons generated silicon oxide (SiO2) gate dielectric that are produced by very short time (within 5 minutes) hydrogen neutral beam (H-NB) treatment at room temperature (25 °C). The typical hydrogen insertion processes have been carried out by long time (more than 40 minutes) & high-pressure hydrogen annealing (HPHA) at high temperature (up to 400 °C) that also need several steps such as poly silicon deposition, HPHA process, and poly silicon etching process. However, the H-NB based hydrogen insertion process does not need any additional annealing process but only H-NB irradiation on the SiO2 insulator surface during gate dielectric formation process. Also, whole fabrication processes for the NVM-TFT have kept under 150 °C including the IGZO thin film formation and the post annealing processes; the randomly generated Ar neutral beam (A-NB) during plasma sputtering process achieves excellent performances of metal oxide thin films even without post annealing process, combining with our novel physical deposition technology named as Magnetic Field Shielded Sputtering (MFSS) to prevent the negative oxygen ions (NOIs) bombardment damages. The low temperature processed NVM-TFT devices have exhibited reproducible hysteresis, reversible switching, and non-volatile memory behaviors in comparison with those of the conventional TFT devices.

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