Characterization and Optimization of Plasma-Enhanced Chemical Vapor Deposited SiO_2 Film as a Hydrogen Diffusion Barrier in Metal Oxide Thin-Film Transistors

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(2 line spacing)

It is well-known that the hydrogen is acting as a shallow donor in metal oxide semiconductors such as ZnO[1] or InGaZnO and actually hydrogen plasma treatment[2], hydrogen diffusion[3] from PECVD SiN_x film or hydrogen ion implantation[4] into the metal oxide are sometimes utilized to lower the active resistance in the junction area for the source-drain metallization, especially in the self-align process. SiN_x film is a good barrier against alkali ion migration or water permeation so that it can be used as a passivation film to avoid environmental effects and increase the shelf life of the products. But, PECVD SiNx film using SiH_4 and NH_3 gas precursor usually contain about 20 at. % of hydrogen[5]. Therefore we should use good hydrogen diffusion barrier in order to use SiNx film as a passivation layer of metal oxide TFT. In this study, we optimized the process parameters of PECVD SiO_2 film to use it as a diffusion barrier of hydrogen coming from upper SiNx 200 nm. As shown in Fig. 1, we find that the SiO_2 50 nm deposited at high pressure exhibits good barrier performance even at 350 °C annealing for 2hrs without making IGZO TFT conductive, while SiO_2 50 film deposited at low pressure permits some hydrogen to enter into the IGZO from SiNx so that the V_{th} of IGZO TFT becomes negative or the switching behavior disappears at the current gate bias range.

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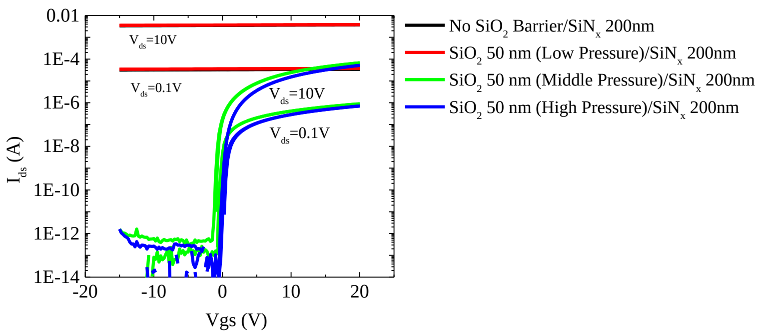

Fig. 1. Transfer curves of a-IGZO Etch Stopper TFTs with SiO_2/SiNx double passivation layer structures.
(1line spacing)

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