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Improvement of Electrical Properties of InGaZnO Thin-Film Transistors by Fluorinated Silicon Nitride Passivation

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Recently, oxide-based thin-film transistors (TFTs) have attracted considerable attention for applications such as active-matrix flat panel displays (FPDs). Among oxide semiconductors, amorphous InGaZnO (a-IGZO) is widely accepted as a promising channel material for TFT application [1]. A silicon nitride contained hydrogen (SiN_X:H) is widely adapted for passivation layer (PL) of amorphous silicon TFTs; however, it is known that SiN_X:H passivation deteriorates electrical properties of oxide TFT due to hydrogen diffusion into an IGZO channel. In this presentation, fluorinated SiN_X (SiN_X:F) was employed as a PL of IGZO TFT. Difference of the electrical properties of IGZO TFTs between silicon oxide (SiO_X) and SiN_X:F passivation was investigated

Bottom-gate IGZO TFT with SiO_X etch-stopper, as shown in Fig. 1, was used for this experiment, and a SiO_X or SiN_X:F was deposited on the TFT as a PL. The experimental transfer characteristics (I_{DS}-V_{GS}) of the IGZO TFTs with SiO_X and SiN_X:F PL are shown in Fig. 2(a) and 2(b), respectively. Transfer characteristics were measured at a drain voltage (V_{DS}) of 0.1 V, the electrical properties are summarized in Table 1. It was found that the IGZO TFT with SiN_X:F PL showed steep subthrehold swing (S) and small hysteresis as compared with the SiO_X PL. To investigate the reason for improving S of the TFT with the SiN_X PL, channel length (L) dependence of the S value was studied. Fig. 3 shows the comparison of S value of the IGZO TFTs with SiO_X and SiN_X:F PL as a function of channel length (L). It was found that S value improved with decreasing L for TFT with SiN_X:F PL: however, S do not exhibited L dependence for the TFT with SiO_X PL. This result suggests that the Fluorine diffuses not only through ES-SiO_X layer but also from the contact hole of the TFT. Fluorine in SiN_X PL plays an important role for improving electrical properties. Influence of SiN_X:F PL on reliability of the IGZO TFT will be presented at a conference.

[1] K. Nomura, H. Ohta, A. Takagi, T. Kamiya, M. Hirano, and H. Hosono, Nature. 432, 488 (2004).
[2] K. Nomura, T. Kamiya, and H. Hosono, Appl. Phys. Let., 99 (2011).

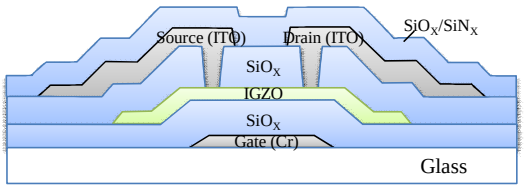

Fig. 1. Schematic cross-sectional view of the ITZO TFT

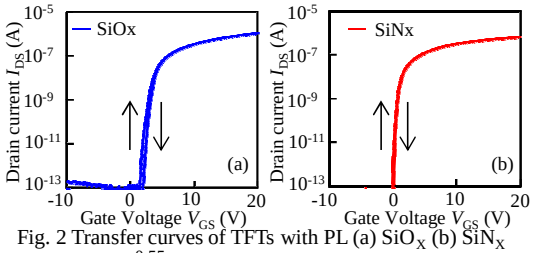

Fig. 2 Transfer curves of TFTs with PL (a) SiO_X (b) SiN_X

Table 1

Passivation layer	SiO_X	SiN_X
Mobility ($cm^2V^{-1}s^{-1}$)	12.53	12.9
Hysteresis (V)	0.30	0.07
Subthreshold swing (V/dec.)	0.40	0.21

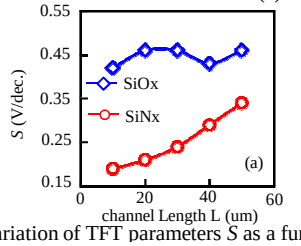

Fig. 3 Variation of TFT parameters S as a function of L.