Effect of Dimethylaluminum Hydride as Al_2O_3 Precursor on the Characteristics of *a*-InGaZnO Thin-Film Transistors

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Passivation layers are elements added to improve the stability as well as the photoresponse of amorphous InGaZnO (*a*-IGZO) thin-film transistors (TFTs) [1]. One promising technique used to deposit these layers is through atomic layer deposition (ALD) owing to its excellent conformity and simple yet accurate thickness control mechanism through layer-by-layer deposition [2]. In this study, we explored dimethylaluminum hydride (DMAH) as a new Al_2O_3 precursor utilizing its higher deposition rate and fewer methyl groups compared to a well-used precursor trimethylaluminum (TMA). Specifically, the effect of DMAH on the characteristics of Al_2O_3-passivated a-IGZO TFTs was investigated.

Bottom gate top contact *a*-IGZO TFTs were fabricated by sputtering the *a*-IGZO channel material and Mo/Pt electrodes. After atmospheric (N_2:O_2 = 4:1) (AT) annealing, Al_2O_3 passivation layers were deposited through thermal- or plasma-ALD using trimethylaluminum (TMA) or DMAH as precursor. Finally, the passivated *a*-IGZO TFTs were annealed at different post-annealing environments, namely AT, N_2, and O_2.

After testing, only the TFTs passivated using plasma-ALD exhibited switching behavior as shown in Fig. 1. From the TFT characteristics obtained, it was observed that *a*-IGZO TFTs passivated using DMAH as precursor resulted to higher carrier mobilities (μ), V_{on} (V_{gs} at 1 nA) closer to 0 V and lower subthreshold swing (S) compared to TFTs passivated using TMA. Furthermore, the O_2-annealed *a*-IGZO TFT passivated using DMAH exhibited the best set of transfer characteristics as shown in Table 1 as well as the highest stability against positive and negative bias stresses. These results show that DMAH is a promising precursor for Al_2O_3 passivation.

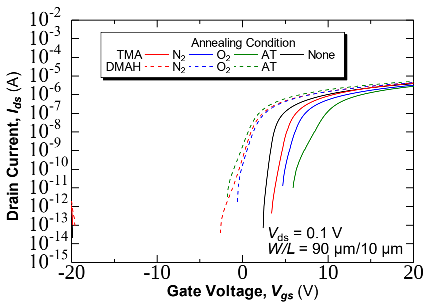

Figure 1. Transfer curves at V_{ds} = 0.1 V of TFT samples passivated using plasma-ALD in different post-annealing environments.

Table 1. Comparison of transfer characteristics of O_2-annealed *a*-IGZO TFTs passivated using plasma-ALD with DMAH and TMA as precursor.

TFT Characteristics	TMA	DMAH
μ (cm^2/Vs)	10.98 ± 1.17	11.00 ± 0.29
V_{on} (V)	5.80 ± 0.43	1.20 ± 0.42
S (V/dec)	0.18 ± 0.06	0.12 ± 0.06

[1] T. Kamiya *et al.*, Sci. Technol. Adv. Mater. **11** 044305 (2010).

[2] M. Xu *et al.*, Journal of the Korean Physical Society **51** 1063 (2007).