Effect of Ambient Annealing on Electrical Characteristics of ZnO TFTs with AZO Interlayer

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Zinc oxide (ZnO) thin film transistors (TFTs) have attracted much attention as display drive device due to their high field-effect mobility, low fabrication temperature, transparent and large on/off current ration. But ZnO TFTs have some chronic problem, such as low on current and instability [1]. In order to solve these problems, we appied Al doped ZnO (AZO) interlayer, and confirm the improvement of electrical stability under the positive gate bias stress condition. But the field-effect mobility is observed to decrease sligthly, which indicates that the Al atoms in AZO layer can decrease oxygen vacancies but form Al clusters like Al-Al and Al-O affecting the mobility scattering mechanism [2].

In this study, we investigate the ambient annealing effect of ZnO TFTs with AZO interlayer comparing with the conventional ZnO TFTs. All TFTs were annealed in a furnace at 250°C for 1hour in the different ambient of N_2, air and O_2. Figure 1 shows the transfer curve of the ZnO and AZO TFTs according to the ambient. Here, the gate bias is shifted by the difference in threshold voltage between annealing ambient to emphasize the subthreshold properties. The electrical parameters are summarized in Table I. It is known that the native point defects in ZnO like oxygen vacancies, Zn interstitials contribute to the carrier concentration, but can act deep trap sites [3]. When the devices are annealed in the oxygen ambient, the oxygen vacancy can be cured lowering the deep trap density with the carrier concentration [4]. This theory explains well our experimental results like as the sub-threshold slope improvement and the positive threshold voltage shift in the case of Air and O_2 ambient. However, the amount of annealing effect on AZO interlayer TFTs is not the same with the conventional ZnO TFTs, which will be investigated focusing the mobility scattering mechanism.

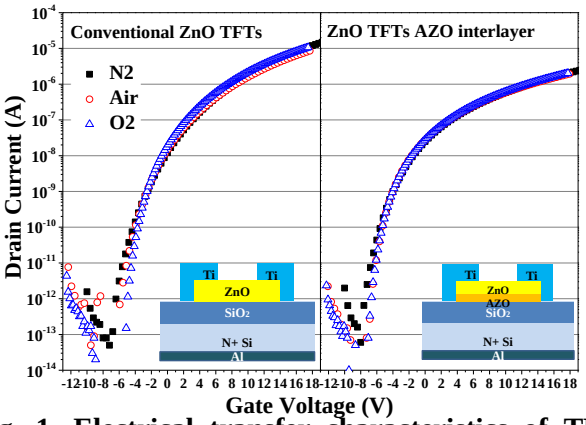

Fig. 1. Electrical transfer characteristics of TFTs with different annealing conditions normalized by threshold voltage.

	Annealing Gas	V_{th}(V)	SS (V/decade)	On current(A) (V_G-V_{th}=20V)
ZnO TFTs	N_2	-2.54	1.23	$1.03x10^{-5}$
	Air	-0.22	0.99	$8.55x10^{-6}$
	O_2	-0.01	0.74	$1.06x10^{-5}$
AZO/ ZnO TFTs	N_2	-4.02	1.10	$1.59x10^{-6}$
	Air	-1.95	0.84	$1.49x10^{-6}$
	O_2	-1.76	0.84	$1.60x10^{-6}$

Table I. Extraction results of electrical parameters in TFTs according to the annealing conditions.

Acknowledgment

References

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