Reliable High-Performance Amorphous In-Ga-Zn-O Schottky Diodes With Passivation Layer

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In this work, a-IGZO SBDs without PL were observed to show poorer performance even after the ambient storage, due to the water vapor adsorption through the exposed a-IGZO region. As shown in Fig1(a), the higher off-current in ambient storage after 5 days than that after 1 days, which means a-IGZO SBD without PL was extremely unstable in the atmosphere. And the lower off-current in 5days ambient storage with vaccum treatment means that the increased current was attribute to the vapor absorpted on the sidewall of IGZO. Conversely, the consistent current of 1 day ambient storage and 5 days ambient storage within SiO_2 PL demonstrates it has a highly stability in ambient storage (As shown in Fig, (b)). With the implementation of SiO_2 PL, high performance metrics were achieved, including an ideality factor of 1.35, a high Schottky barrier of 0.82ev, and a large current rectification ratio of 10^8(As shown in book1).

However, the high series resistance (R_{on}) of SBD with SiO_2 PL limits the on-current. So SiN_x was adopted as PL which not only protect SBD from vapor but also lower the series resistance of SBD because of the diffusion H^+ from SiN_x to IGZO. As reported in TFT, H^+ act not only as electron donor but also as accepter. In this work, we concluded that it acts as accepter first and then as donor as the increased of H^+. So it's essential to trade-off the off-current and on-current which depends greatly on the concentration of H^+. The different annealing time (Fig 2(a)) were perform to changes the H^+ escaped from SiN_x to IGZO, a longer annealing time means much more H^+ escaped from SiN_x to IGZO. As observed in Fig2(a), the lowest off-current and highest on-current were happened to 2 hours annealing. As shown in Fig2 (b), as the annealing time increasing, the high of Schottky barrier and R_{on} rise first and then fall down revealing the conclusion we made before. And the highest performance of n, Φ_B, R_{on}, I_{on}/I_{off} are 1.08, 0.76ev, 28Ω, $9.8*10^8$ respectively.

	This work		[1]	[2]	[3]
PL	w/o	w	w/o	w/o	w/o
n	1.84	1.35	1.36	1.07	1.13
Φ_B	0.79	0.82	0.92	1.17	0.86
I_{on}/I_{off}	$6.0*10^6$	$1.1*10^8$	$2.4*10^6$	$3.8*10^{10}$	$3.48*10^7$
Ron (Ω . cm^2)	0.04	0.02	0.15	0.07	0.06

TABAL 1:KEY PARAMETERS OF SBD IN THIS WORK AND PRIOR ARTS

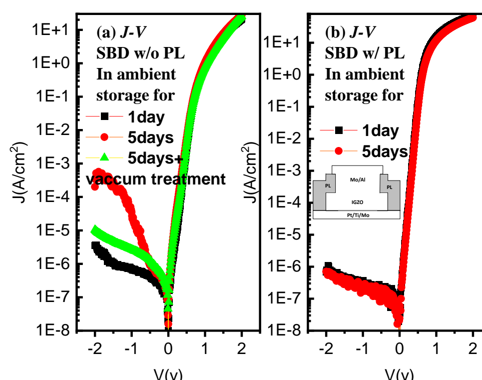

Fig. 1. The ambient influence on the *J-V* characteristics of a-IGZO SBD, respectively (a) without PL and (b) w ith PL. Insets show the schematic cross-sections SBD.

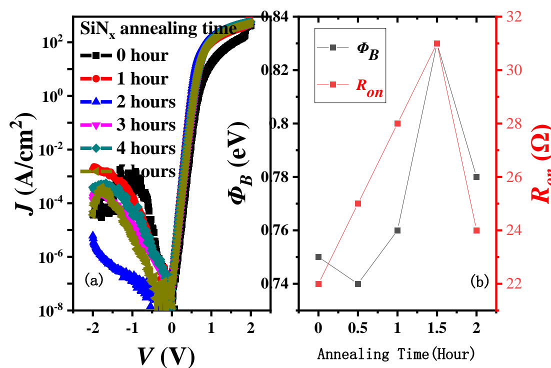

FIG. 2. The different performance (a) I-V; (b) R_{on} and Φ_B ;

References

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