Improvement in mobility of indium zinc oxide transistor using the reactive metal contact method

Hyuk Ji,[1] Ah Young Hwang,[1] Sang Tae Kim,[1] Pil Sang Yun,[2] Jong Uk Bae,[2] and Jae Kyeong Jeong[1a)]

[1]Department of Materials Science and Engineering, Inha University, Incheon 402-751, Korea

[2]R&D Center, LG Display Company, Paju-Si, Kyonggi-Do 413-811, Korea

E-mail : jkjeong@inha.ac.kr

This study examined the improvement in mobility of In-Zn-O Thin Film Transistor(TFT) by Ti capping method and focused on the effects of post deposition annealing on the electrical properies Ti capped In-Zn-O(TC IZO)TFT. The TC IZO TFT oxidized at the temperature of 300℃ appeared a high field-effect mobility of 61.0 cm^2/Vs, low sub-threshold gate swing of 110mV/decade, V_{th} of -0.4V and high $I_{on/off}$ ratio of 2.3×10^8. This was attributed to the scavenging effect of loosely-bonded oxygen species in the IZO semiconductor by Ti thermal oxidation. It can be understandable that the Ti has a stronger oxidation power than In_2O_3 and ZnO.

It was confirmed from TEM analysis that the annealing process for the TC IZO stack caused the conversion of a Ti film to a partially crystalline TiO2 state. The loosely bonded oxygen species that in the IZO channel would be consumed during the thermal conversion of TiO2. Recently, it was calculated that some loosely bonded oxygen species can exist in a form of an OH impurity in metal oxide semiconductor. These oxygen interstitial defects can act as accptor-like trap states, they reduce the carrier mobility in the field-effect device.

Thereby, these results indicate that the high mobility for the TC IZO TFT indeed comes from the reduction of the tailing trap state in the Ti capped IZO region.

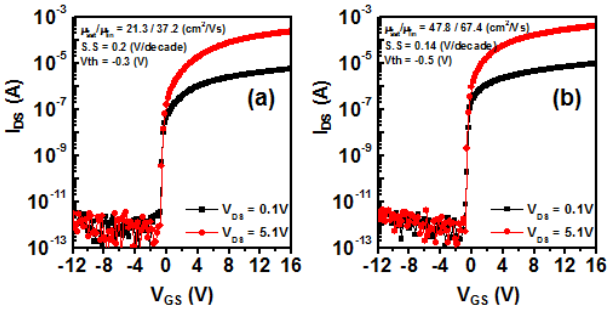

Fig. 1. Representative transfer characteristics of (a) controland TC IZO TFTs at the PDA temperatures of (b) 200, (c) 300 and (d) 400 °C.

References

1. P. S. Yun and J. Koike, *J. Electrochem. Soc.*, 150, H1023 (2011).

2. J. Robertson and Y. Guo, *Appl. Phys. Lett.*, 104, 162102 (2014).