Effect of HCN treatment on positive gate bias instability a-IGZO thin-film transistor

*Myeong-ho Kim[1], Hikaru Kobayashi[2], and Duck-Kyun Choi[1]**
[1]Department of Materials Science and Engineering, Hanyang University, Seoul 133-791, Korea
Tel.:82-2-2220-0506, E-mail: ho0815@hanyang.ac.kr
[2]Institute of Scientific and Industrial Research, Osaka University, CREST, Japan Science and Technology Corporation, 8-1, Mihogaoka, Ibaraki, Osaka 567-0047, Japan

For secure bias stability of amorphous indium-gallium-zinc-oxide (a-IGZO) thin film transistors (TFTs), many researches have been conducted with various ideas. In silicon based TFTs, the hydrogen cyanide (HCN) treatment was known to be effective in the bias stability by eliminating metal contaminants on the silicon surface or passivating Si dangling bonds. In this study, we examined the effect of the HCN treatment on bias stability of bottom gate a-IGZO TFTs under positive gate bias stress (PBS) expecting the passivation of electron trapping sites in the IGZO active layer. The HCN treatment was performed using a 0.1 M HCN solution with pH of 10 at room temperature. Before applying bias stress, difference of the major electrical properties such as saturation mobility (μ_sat), threshold voltage (Vth) and subthreshold swing (S/S) between HCN treated and non-HCN treated devices was not noticeable. However, under the PBS, the HCN treated device demonstrated superior bias stability compared to the non-HCN treated device. The better bias stability of HCN treated a-IGZO TFTs is associated with the passivation of the defect states and the surface of the back-channel layer of the device by cyanide ions.

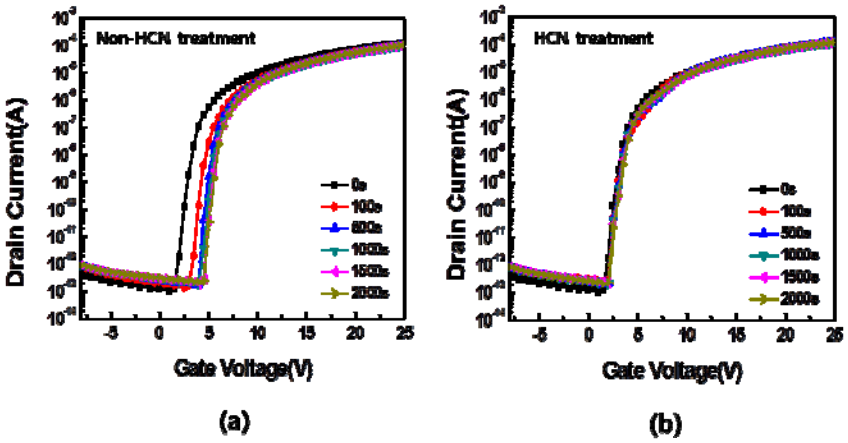

Fig.1. Evolution of the transfer characteristics for (a) non-HCN treatment a-IGZO TFTs (device A) and (b) HCN treatment a-IGZO TFT (device B) as a function of applied PBS time (W/L=50/80μm). The gate bias stress was applied +20 V PBS conditions. The HCN treated a-IGZO TFT shows good bias stability compared to the non-HCN treated device under PBS conditions.

References

[1]J.S. Park, J Electroceram. 28 (2012) 74-9.
[2]E. Fortunato, P. Barquinha, R. Martins, Adv Mater. 24 (2012) 2945-86.
[3]T. Kamiya, K. Nomura, H. Hosono, Sci Technol Adv Mat. 11 (2010) 4.
[4]J.S. Park, W.J. Maeng, H.S Kim, J.S. Park, Thin Solid Films. 520 (2012) 1679-93.
[5]Y.C. Chen, T.C Chang, H.W. Li, S.C. Chen, J. Lu, W.F. Chung, Y.S Tai, T.Y. Tseng, Appl Phys Lett. 96 (2010) 26.