Origin of Negative Transfer Shift under NBIS of a-InGaZnO Thin Film Transistor using TCAD Simulation

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We investigate the effect of negative bias illumination stress (NBIS) of a-InGaZnO thin film transistor using technology computer aided design (TCAD). NBIS with negative gate bias of -20V under blue light shows a prolonged negative transfer shift. The origin of negative shift are commonly assumed as the formation of ionized oxygen vacancy and/or hole trapping at the interface of gate insulator with a-IGZO. Using TCAD simulation, we clarified that the NBIS is due to the increment of Gaussian donor bump density of states (DOS) at 2.9eV as well as acceptor like DOS at 2.5eV to 2.3eV from valance band edge. It also increases the interface charge density at a-IGZO/SiO_2 interface, which makes the negative threshold voltage shift with stress time.

In Fig. 1. we plotted threshold voltage shift and Interface charge densities with respect to stress time from 0 to 3600 sec. NBIS makes negative transfer shift with stress time, while the interface charge density also builds up with increasing stress time. Density of states of a-IGZO under NBIS is shown in Fig. 2, indicating the generation of both donor-like states and acceptor-like defect states.

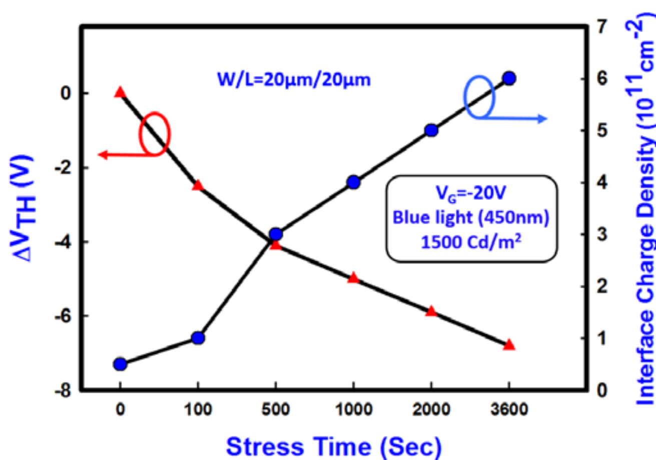

Fig. 1. ΔV_{TH} and interface charge plotted as a NBIS time

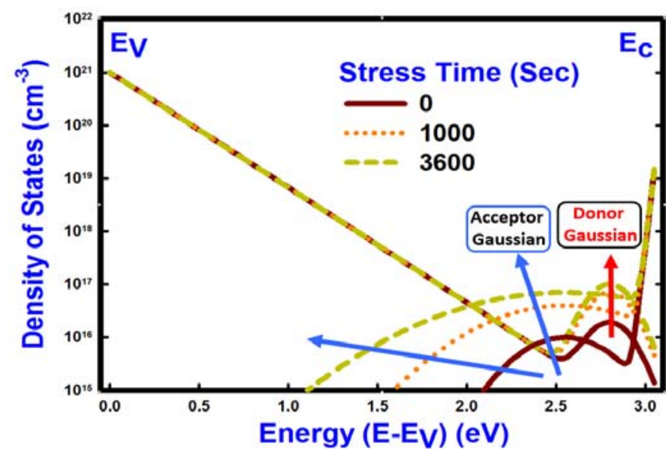

Fig. 2. Model density of states for NBIS in a-IGZO TFT

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References

1. M. D. H. Chowdhury, P. Migliorato, et al., Appl. Phys. Lett., vol. 97, no. 17, pp. 173506-1–173506-3, Oct. 2010.
2. J G Um, M Mativenga, P Migliorato, et al., Appl. Phys. Lett. 101, 113504 (2012).
3. B. Ryu, H.-K. Noh, E.-A. Choi and K. J. Chang, Appl. Phys. Lett. 97, 022108 (2010).
4. Y. Kim, S. Kim, W. Kim, M. Bae , H.K. Jeong , D. Kong , S. Choi , D.M. Kim , and D.H. Kim, IEEE TED 59, (10), 2012, PP : 2699 – 2706.