Quantitative Analysis of Coplanar a-IGZO TFTs for High Reliability Device

Jiyong Noh, Ju-heoyuck Baeck, Jong Uk Bae, Kwon-Shik Park, Soo Yong Yoon, and In Byeong Kang (LG Display Co., Ltd., Korea)

We has been investigating on high reliability (specially PBTS characteristics) oxide device for a few years, and we currently expand more application of large sized OLED display based on the high reliability oxide TFT backplane. In this paper, we report that the PBTS instability of coplanar InGaZnO TFTs can be improved by the minimization of Non-Bridging Oxygen Hole Centers (NBOHC) and optimization of hydrogen passivation in the GI/ACT interface region. Furthermore, we define and propose the diffusion behavior of light elements by the quantitative analysis of hydrogen and oxygen in each region. For interpretation of physical properties of light elements we perform a diversity of analysis such as XRR, RBS, and ERDA measurements. Finally, trap density in GI/ACT interface layer is obtained by photonic capacitance-voltage measurements which are correlated with PBTS characteristics. A decrease of under coordinated bonding states lessens electron trap density, which brings improvement in PBTS from $V_{th} = 2.61$V to $0.21$V by process optimization.

Stability Investigation on Amorphous InSnZnO Thin Film Transistors with a Top Nitrogen Doped Active Layer

Gongtan Li, Chuan Liu, and Bo-Ru Yang (Sun Yat-Sen Univ., China)

The top nitrogen doped active layer takes the advantage of the high mobility in the pristine a-IZTO films as well as the good stability in the a-IZTO:N films. As shown in Fig. 2 (a), the front channel dominates the conduction, thus the high conduction underlying layer acts as a “high-way” for electron transport, while the nitrogen doping layer is for stability improvement. The field-effect mobility as a function of $V_g$ and the $V_{th}$ shift under NBLS are shown in Figs. 2b and c to compare the top-doped device (red curves) and the single layer device with or without N-doping (blue and black curves, respectively). The top doped TFTs exhibited a high mobility ($\sim 31.75$ cm$^2$/Vs) and good NBLS instability ($\Delta V_{th} = 1.24$ V for 3600 s), simultaneously. Importantly, fabrication of such top doping TFTs only requires adjustment in gas flow rate and does not break vacuum, and thus it is rather simple and highly compatible with traditional fabrication methods.
Oxide TFTs: High Performance

Date: Aug. 31, 2017 (Thursday)
Time: 09:00~10:30
Session Chair: Prof. Yukiharu Uraoka (NAIST, Japan)

E53-3 09:50~10:15
Invited Short Channel Oxide TFTs for Digital Holography
Chi-Sun Hwang, Jong-Heon Yang, JiHun Choi, Jae-Eun Pi, Kyunghee Choi, Chi-Young Hwang, Yong-Hae Kim, Gi Heon Kim (ETRI, Korea), Sang-Hee Ko Park (KAIST, Korea), and Jinwoong Kim (ETRI, Korea)

Holography, which has been known as final goal of realistic display, will be a crucial form of next generation media. But, for the fulfillment of wide viewing angle for holography, the SLM, which modulate light wave, demands ultra high resolution display panel with pixel pitch less than 1 \( \mu m \). For the example of applying oxide TFTs for holography will be presented. Oxide TFTs with BCE structure can be a good candidate as switching device for such a high resolution display. Another method for achieving ultra high resolution is that adapting 3D channel structure, such as vertical channel for oxide TFTs. Until now MOSFETs based on crystalline Si wafer substrate have been thought as a solution for such small pixel pitch. The impact of applying oxide TFT for such small pixel pitch is that realistic digital hologram which will show large images with wide viewing angle will be realized in near future.

E53-4 10:15~10:30
Development of a 55-in 4K UHD OLED TV with High Reliability and Short Channel IGZO TFTs
Mijeong Park, Hyunmin Cho, Woocheol Jeong, Jaeyong Park, and Jongwoo Kim (LG Display Co., Ltd., Korea)

We investigated the phenomenon of degradation of short channel length TFTs such as negative threshold voltage and increasing deviation. We have two optimization processes to alleviate the short channel effect of 4.5um channel length device. First, the condition A is carrier reduction process of IGZO layer during sputter deposition. Condition B is the optimized process of thermal annealing for minimized \( \Delta L \) diffusion length. Applying both conditions A and B, we can attain Vth deviation of only \( \Delta 0.4V \) at short channel devices. In addition, we improved long-term PBTS stability by controlling NBO site in gate insulator of a-IGZO TFTs with H-passivation process. Finally, we developed the short channel device (L=4.5um) with high reliability characteristics for narrow bezel size (5.5mm) OLED TV.