Supplemental Document

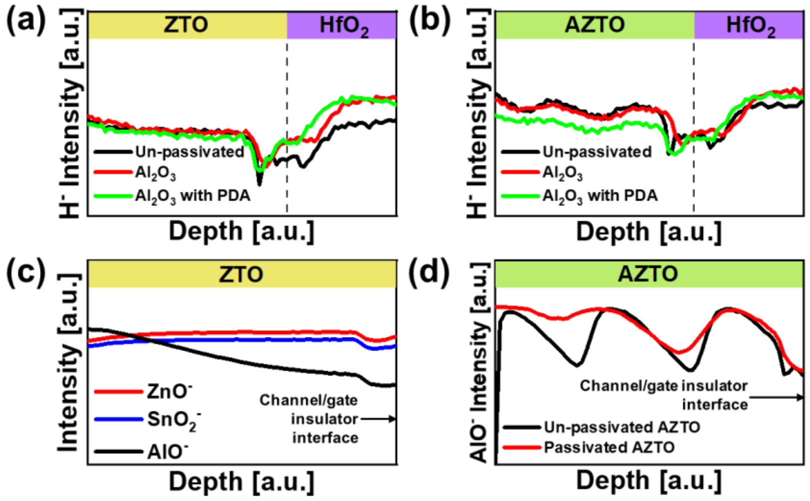

Figure 1. H-related ToF-SIMS depth profiles of 10-nm-thick Al_2O_3-passivated 20-nm-thick (a) *a*-ZTO and (b) *a*-AZTO films on 10-nm-thick HfO_2/30-nm-thick SiO_2/p^{++} Si substrates. Al-related ToF-SIMS depth profiles of 10-nm-thick Al_2O_3-passivated 20-nm-thick (c) *a*-ZTO and (d) *a*-AZTO films. The passivation layer was deposited at 300 ^{o}C, and PDA was performed at 400 ^{o}C for 1 hr.

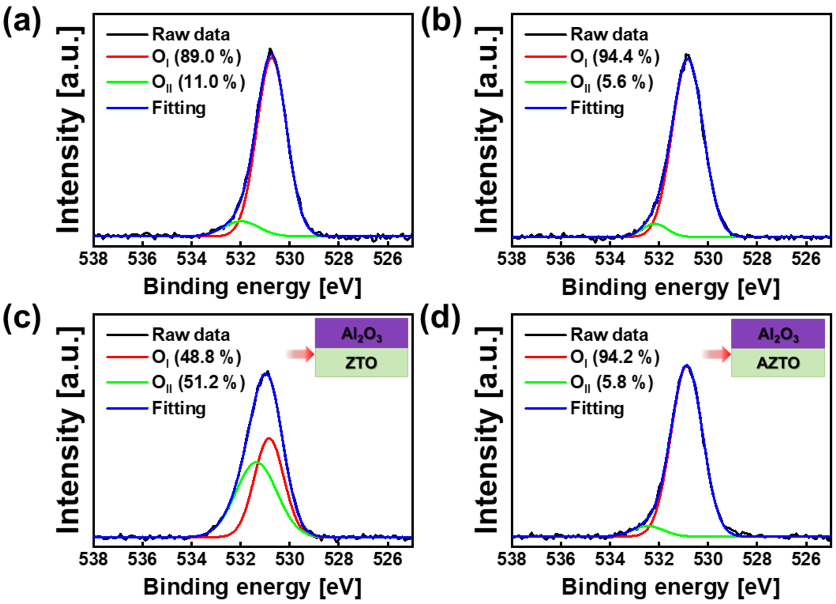

Figure 2. XPS O 1s spectra of unpassivated 20-nm-thick (a) *a*-ZTO, (b) *a*-AZTO films and passivated 20-nm-thick (c) *a*-ZTO and (d) *a*-AZTO films. The deconvolution of the peaks revealed two distinct components, corresponding to the oxygen bonded with metal ions (O_I) and the oxygen near V_O (O_{II}).

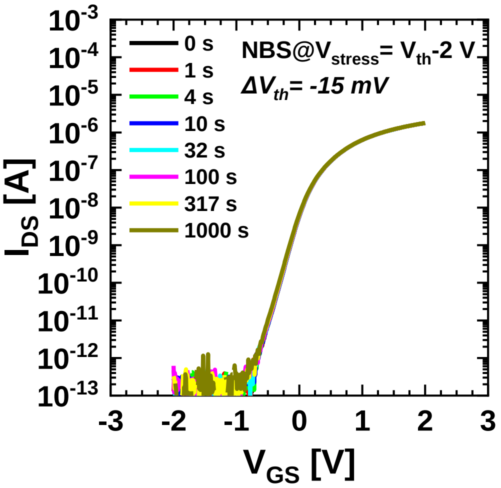

Figure 3. NBS I_{DS}-V_{GS} curve of optimized *a*-AZTO TFT with a passivation layer.

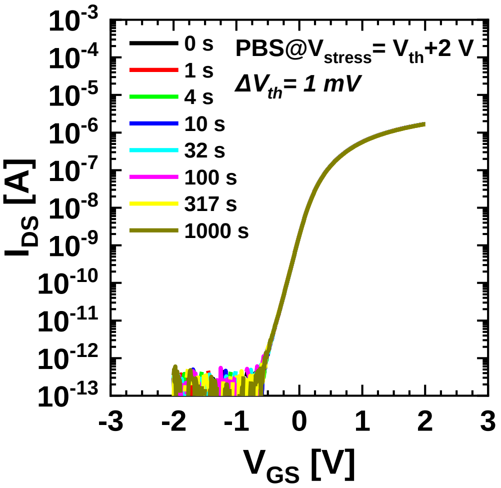

Figure 4. PBS I_{DS}-V_{GS} curve of optimized *a*-AZTO TFT with a passivation layer.