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Supplementary Information

Water adsorption effects of nitrate ion coordinated Al_2O_3 dielectric for high performance metal-oxide thin-film transistor

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Figure S1.

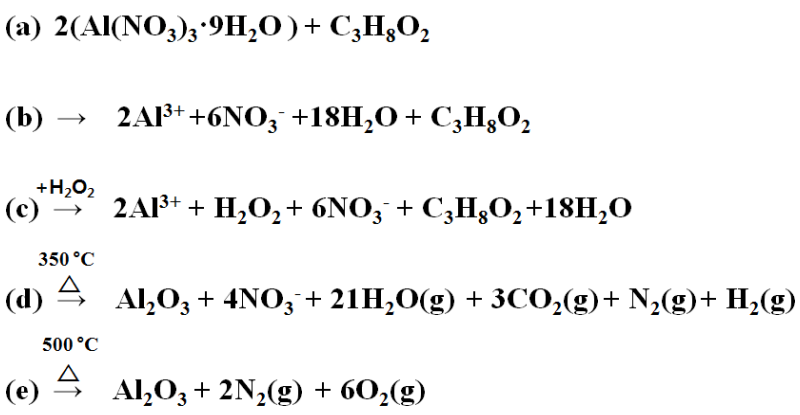

Figure S1. Schematic descriptions and the analyses of the formation of ionic Al_2O_3 dielectric. (a) The Aluminum nitrate hexahydrate ($Al(NO_3)_3 \cdot 9H_2O$) was resolved in methoxyethanol ($C_3H_8O_2$). (b) The hydrogen peroxide (H_2O_2) was added to Al_2O_3 precursor solution for suppression of oxygen vacancy. (c) When the Al_2O_3 precursor solution was annealed at 350 °C, the Al_2O_3 was formed with a small amount of nitrate ions (NO_3^-). (d) When the ion embedded Al_2O_3 was annealed over 500 °C, the embedded ions were completely decomposed.

Figure S2.

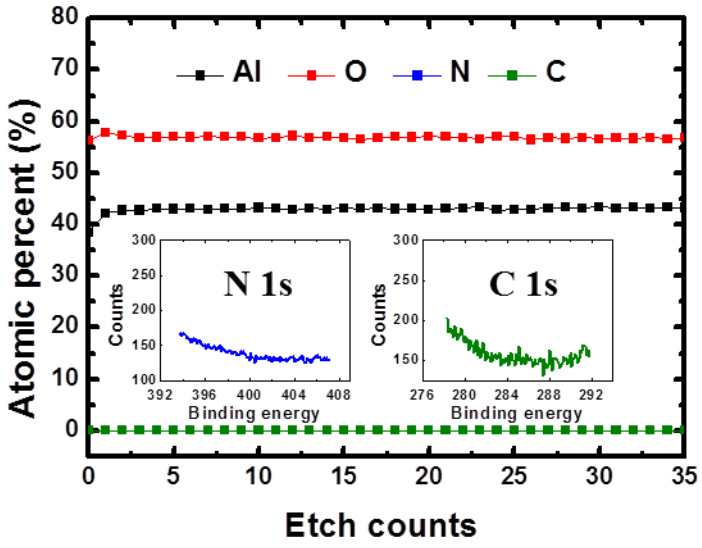

Figure S2. The XPS depth profile of 500 °C annealed Al_2O_3 film. The insets indicate N 1s and C 1s peaks.

Figure S3.

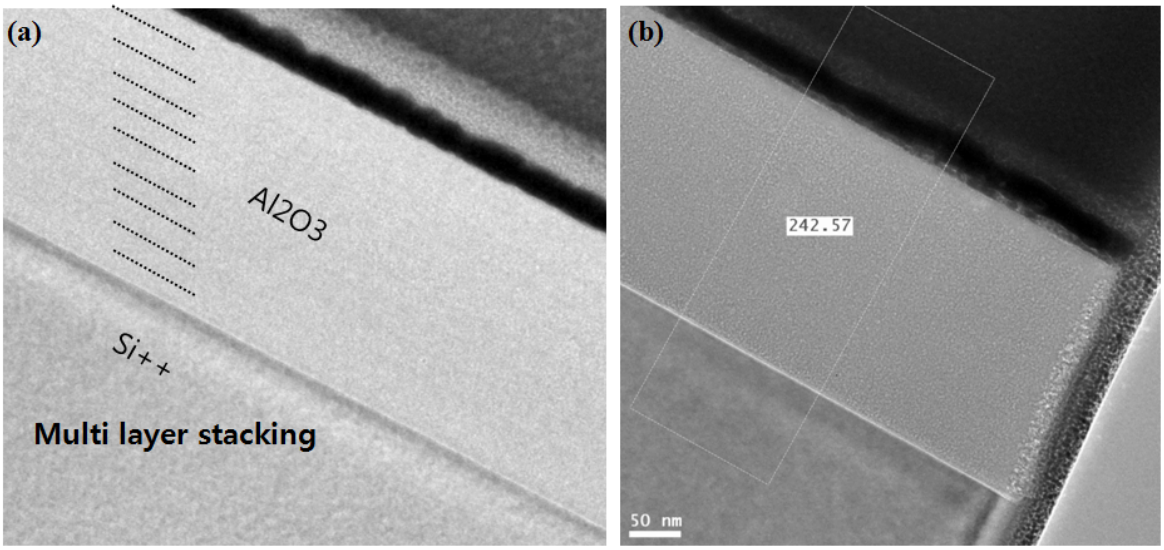

Figure S3. The HR-TEM images of solution processed ionic amorphous Al_2O_3 dielectric layer were shown. (a) The 10 times coated ionic amorphous Al_2O_3 layer was fabricated on the heavily boron doped Si wafer and (b) the thickness of amorphous ionic Al_2O_3 layer was 242.57 nm.

Figure S4.

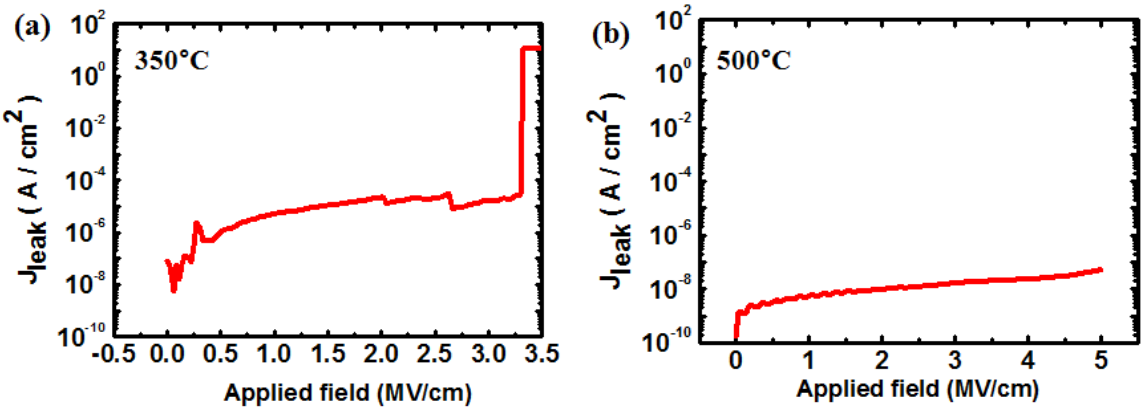

Figure S4. Leakage current density of (a) 350 ºC and (b) 500 ºC annealed amorphous Al_2O_3 dielectric with thickness of 242nm and 200nm, respectively. Their values are 4.1×10^{-6}A/cm^2 and 4.6×10^{-9}A/cm^2 at 1MV/cm, respectively.

Figure S5.

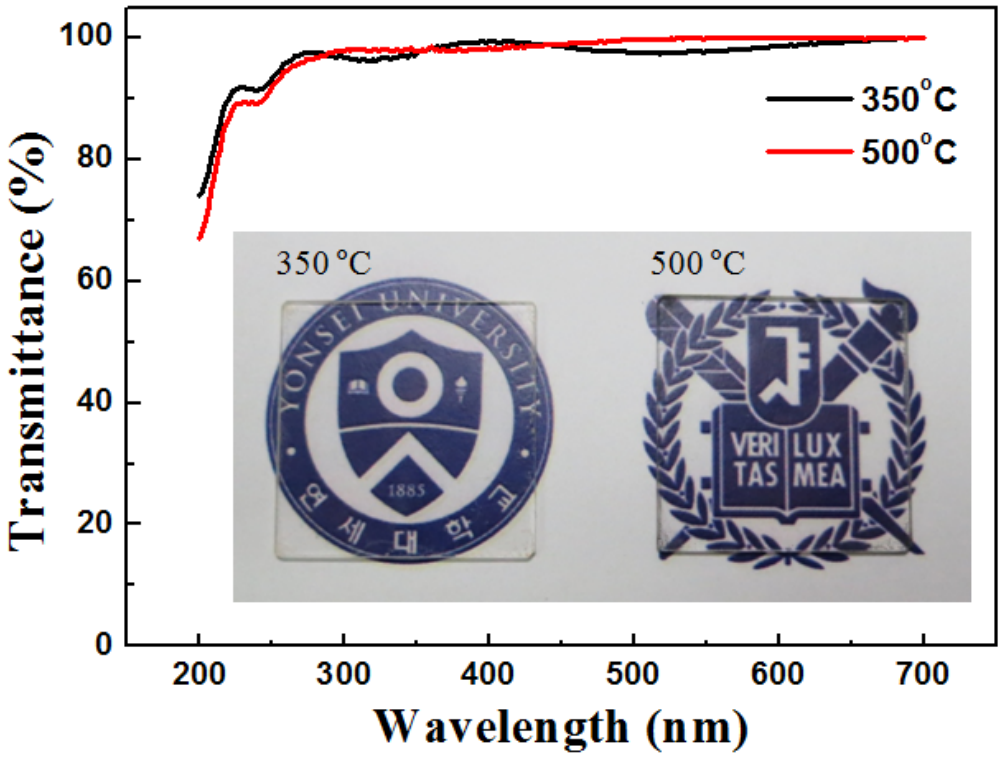

Figure S5. The transmittance of ionic amorphous Al_2O_3 dielectric layers on quartz glass under UV-visible range photons. (200 nm ~ 700 nm)

Figure S6.

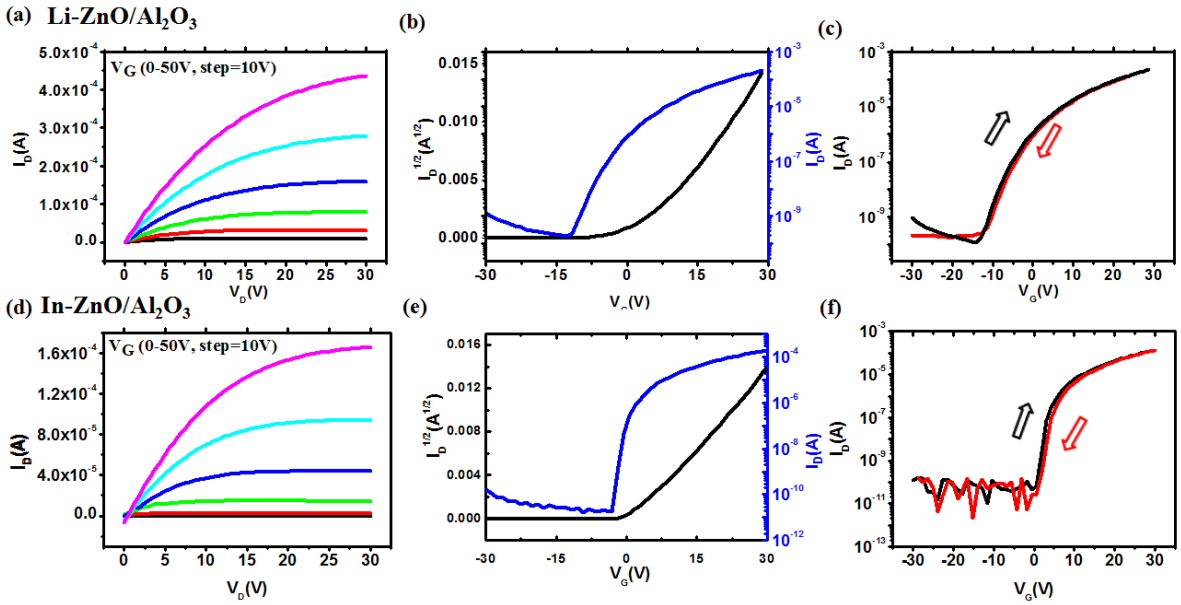

Figure S6. (a) Output curve of TFTs consisted of 350 ºC annealed Li-ZnO semiconductor film on 500 ºC annealed Al_2O_3 dielectric layer with the sweep of 10 V steps on gate voltage from 0 V to 50 V. (b) Transfer curve of Li-ZnO/Al_2O_3 TFT with drain current of 30V. (c) Clockwise hysteresis of Li-ZnO/Al_2O_3 TFT. (d) Output curve of 350 ºC annealed In-ZnO on 500 ºC annealed Al_2O_3 dielectric layer with sweep of 10 V steps on gate voltage from 0 V to 50 V. (e) Transfer curve of In-ZnO/Al_2O_3 TFT with drain current of 30 V. (f) Clockwise hysteresis of In-ZnO/Al_2O_3 TFT.

Figure S7

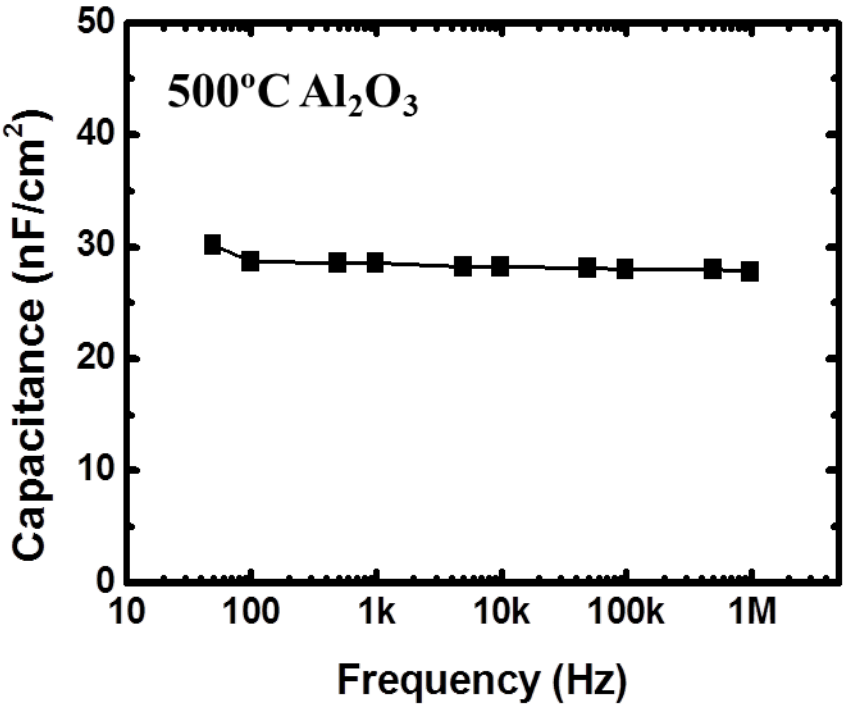

Figure S7. Frequency vs capacitance of 500 ºC annealed Al_2O_3 dielectric layer with thickness of 215 nm.