

Supplementary Information

Lithium Ion Assisted Hydration of Metal Ions in Non-Aqueous Sol-Gel Ink for High Performance Metal Oxide Thin-Film Transistors

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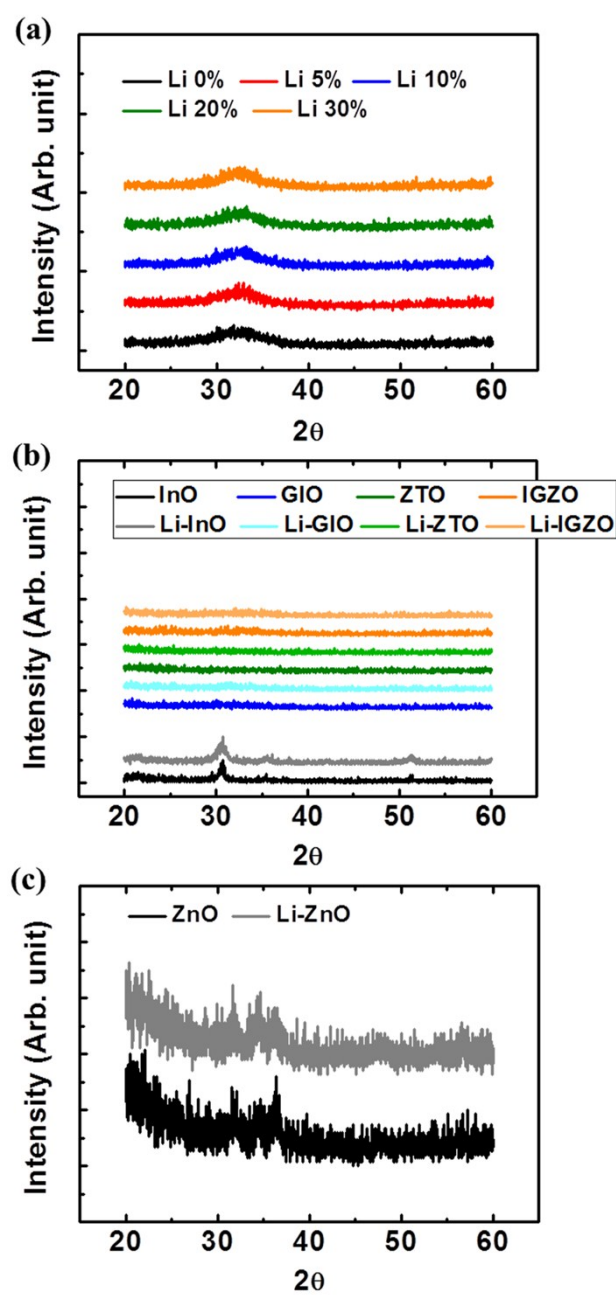


Figure S1. XRD patterns of films annealed at 300 °C. (a) IZO film with various Li contents, (b) various Li-doped and undoped metal oxide thin films, and (c) the ZnO thin film. The pattern of the ZnO thin film exhibited weak peaks which are associated with the crystalline phase.

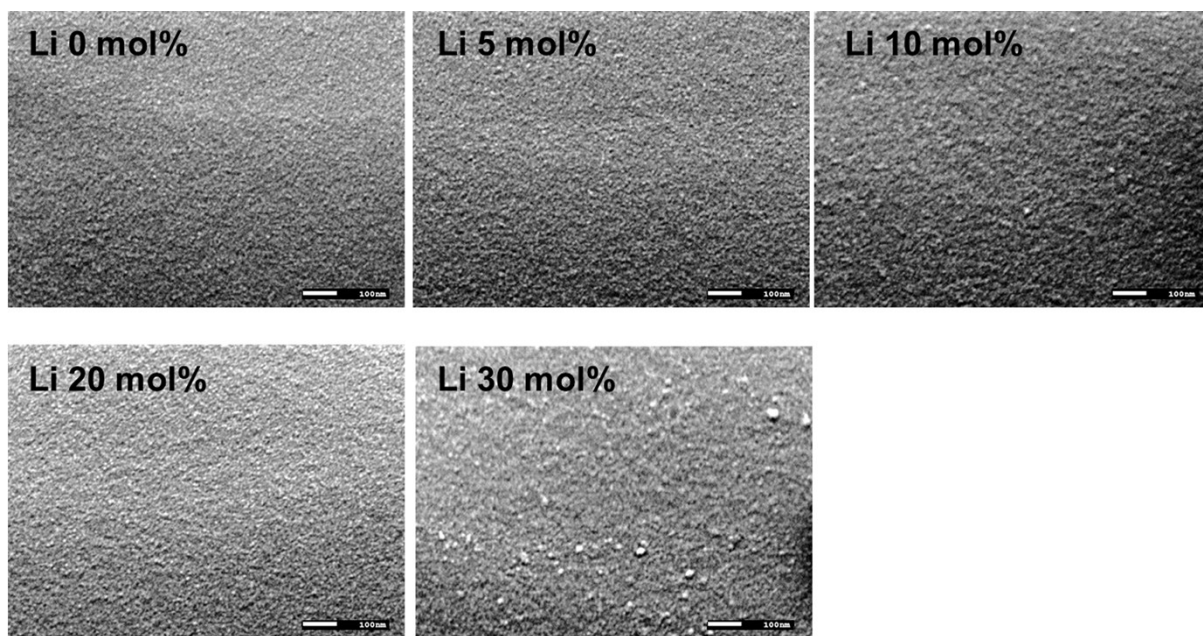


Figure S2. SEM images of 45 degree tilted LIZO thin film as a function of Li concentrations.

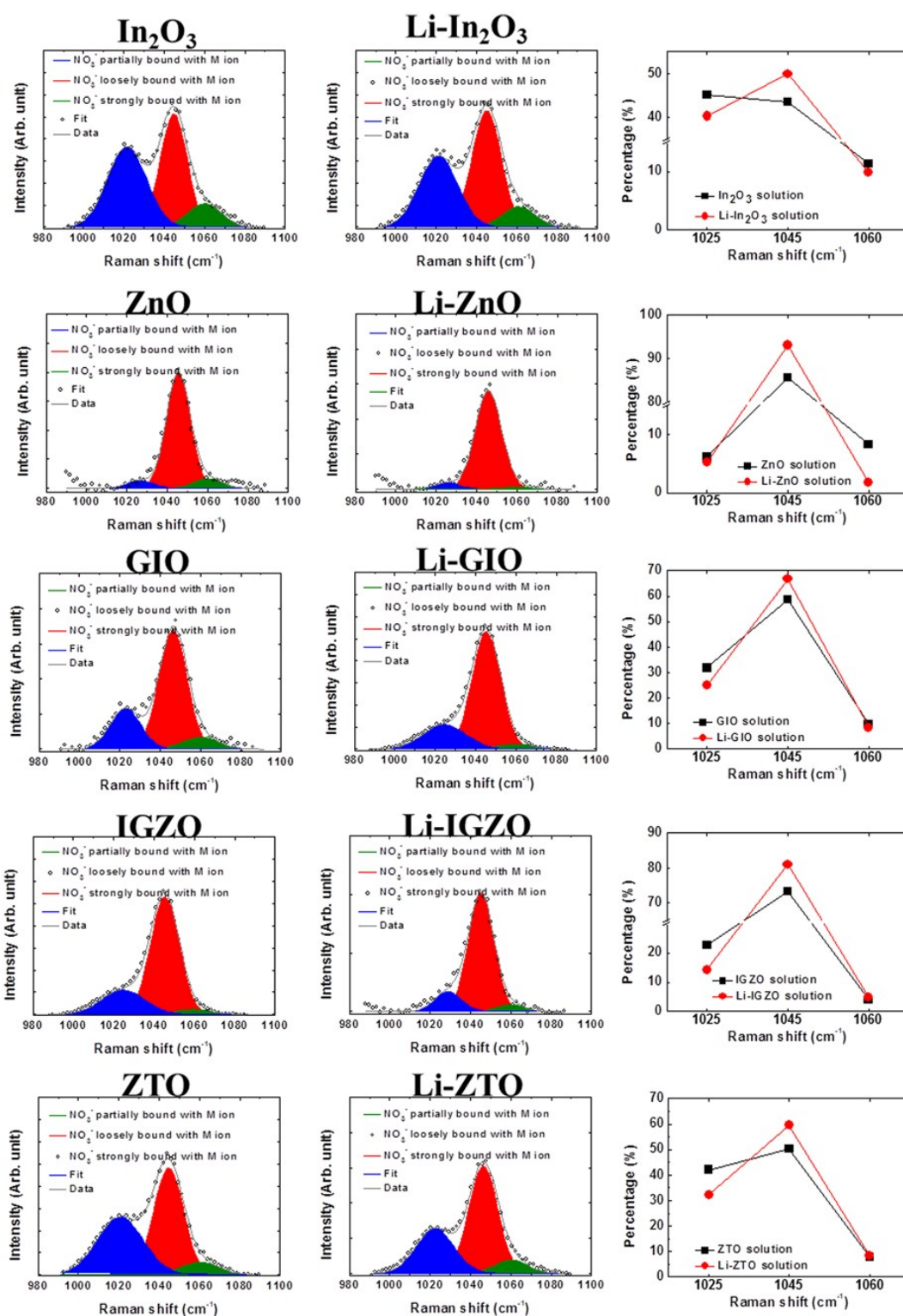


Figure S3. Raman spectra of various precursor solutions. The peaks at 1025, 1045, and 1060 cm⁻¹ correspond to NO₃⁻ partially, loosely, and strongly bound to M ions, respectively. The

summarized percentage of each peak is shown in the right-hand side of the Raman spectra. In all cases, the peak at 1045 cm^{-1} occurs with a higher percentage in the Li-doped metal oxide precursor solutions than in their undoped counterparts.

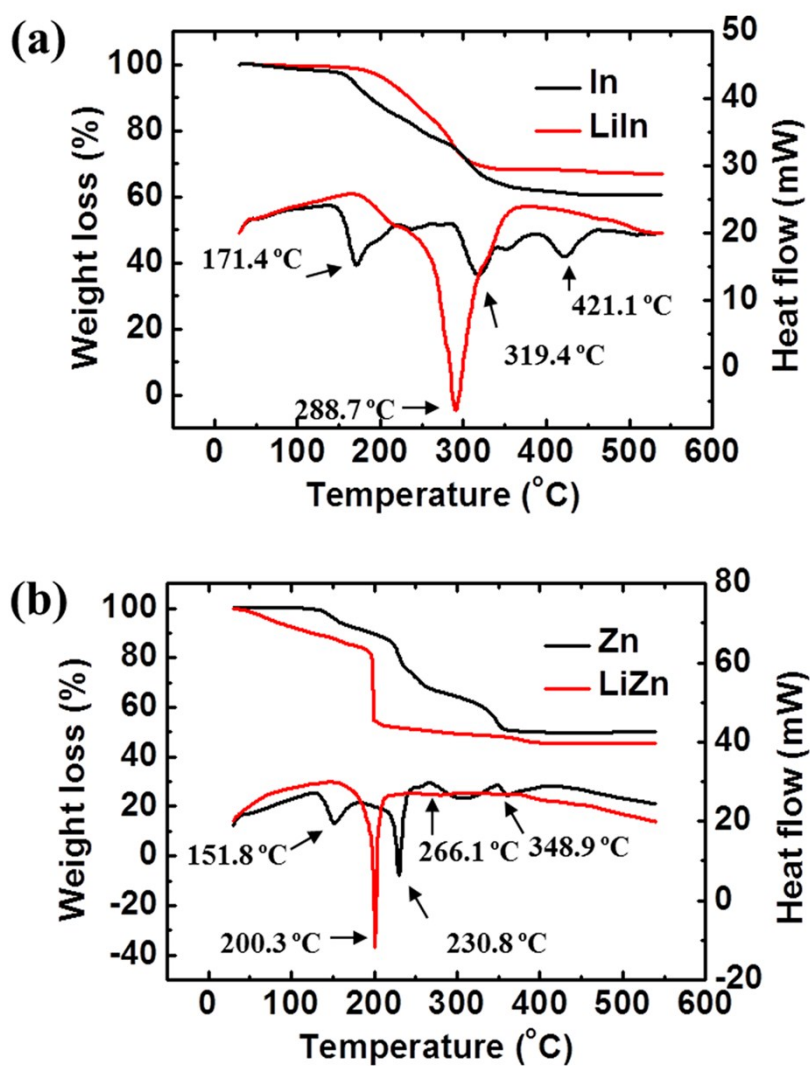


Figure S4. TGA-DSC curves of Li-free/Li-incorporated (a) In_2O_3 and (b) ZnO .

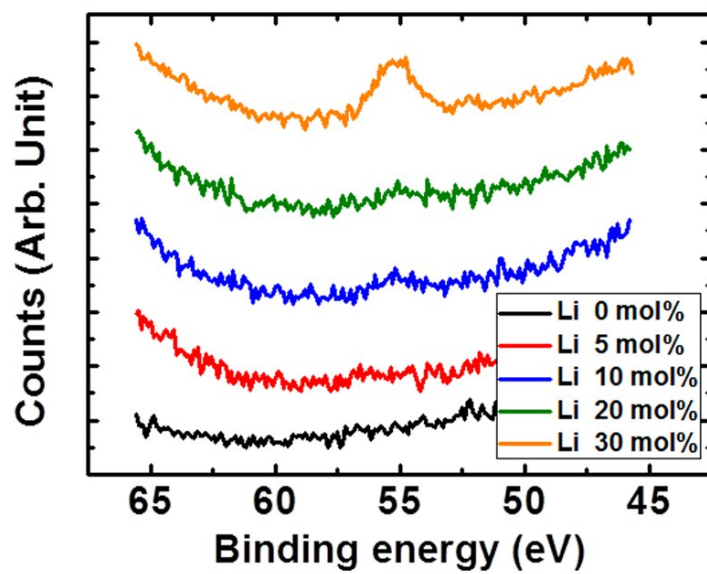


Figure S5. XPS Li 1s peaks of LIZO thin film.

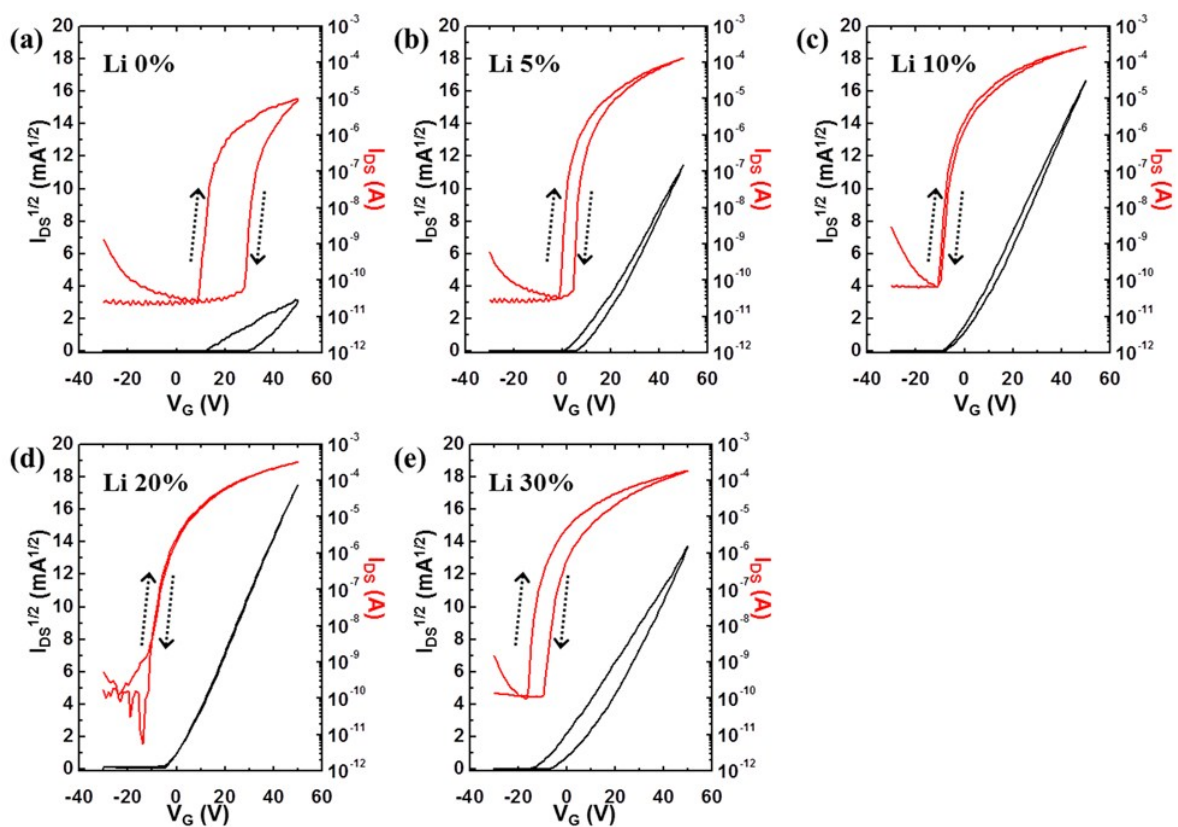


Figure S6. (a)-(e) Current-voltage characteristics of the LIZO TFTs for a drain current of 30 V. All of the transfer curves exhibit clockwise hysteresis; Li 20 mol%-doped IZO TFTs exhibit the smallest hysteresis of 0.36 V.

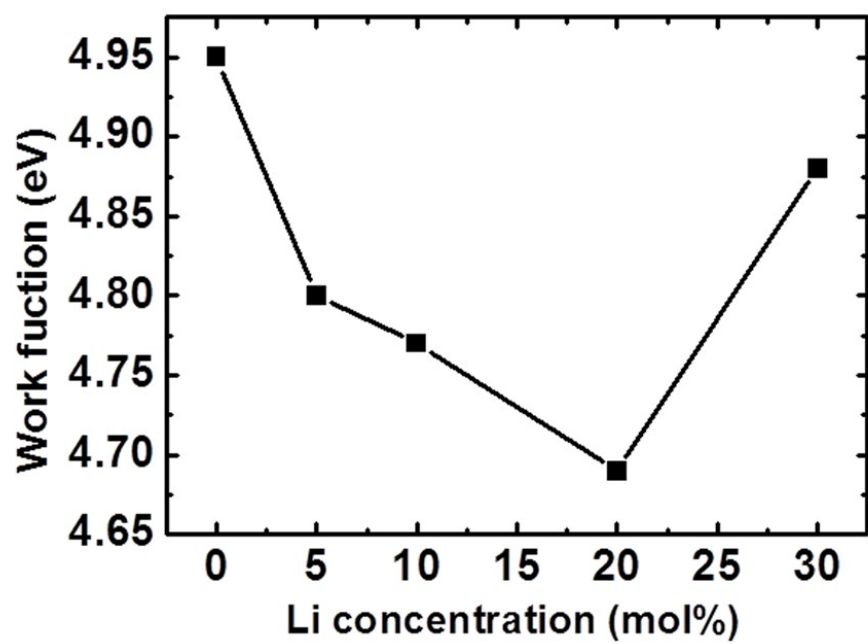


Figure S7. Work functions of IZO thin films with various concentrations of Li. The 20 mol% Li-doped IZO thin film exhibits the lowest work function of 4.7eV.

LIZO work function

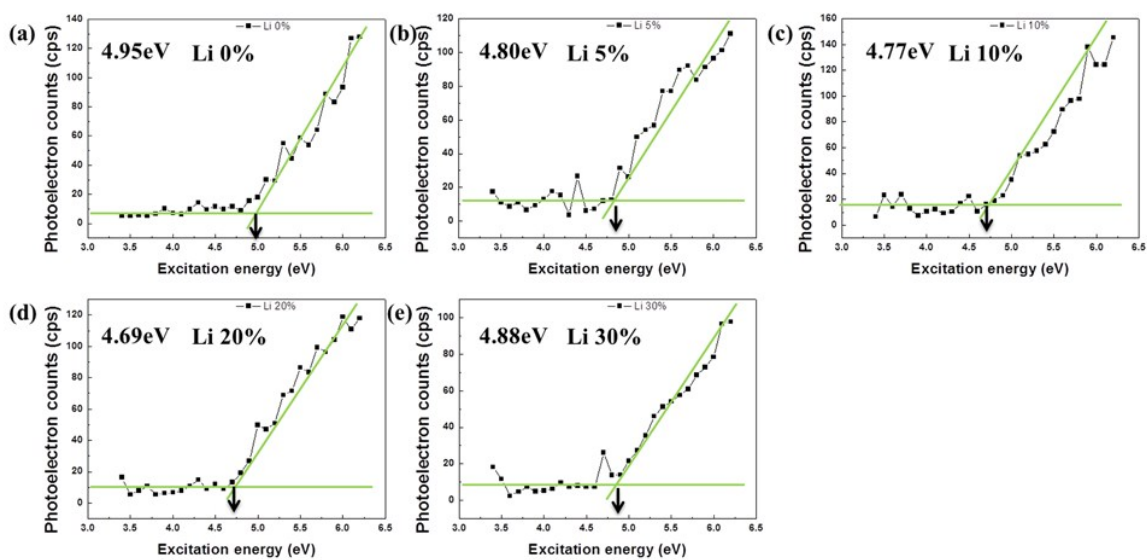


Figure S8. Photoelectron counts-excitation energy curves of the IZO thin film with various Li contents. The values of the work function are written in each graph.

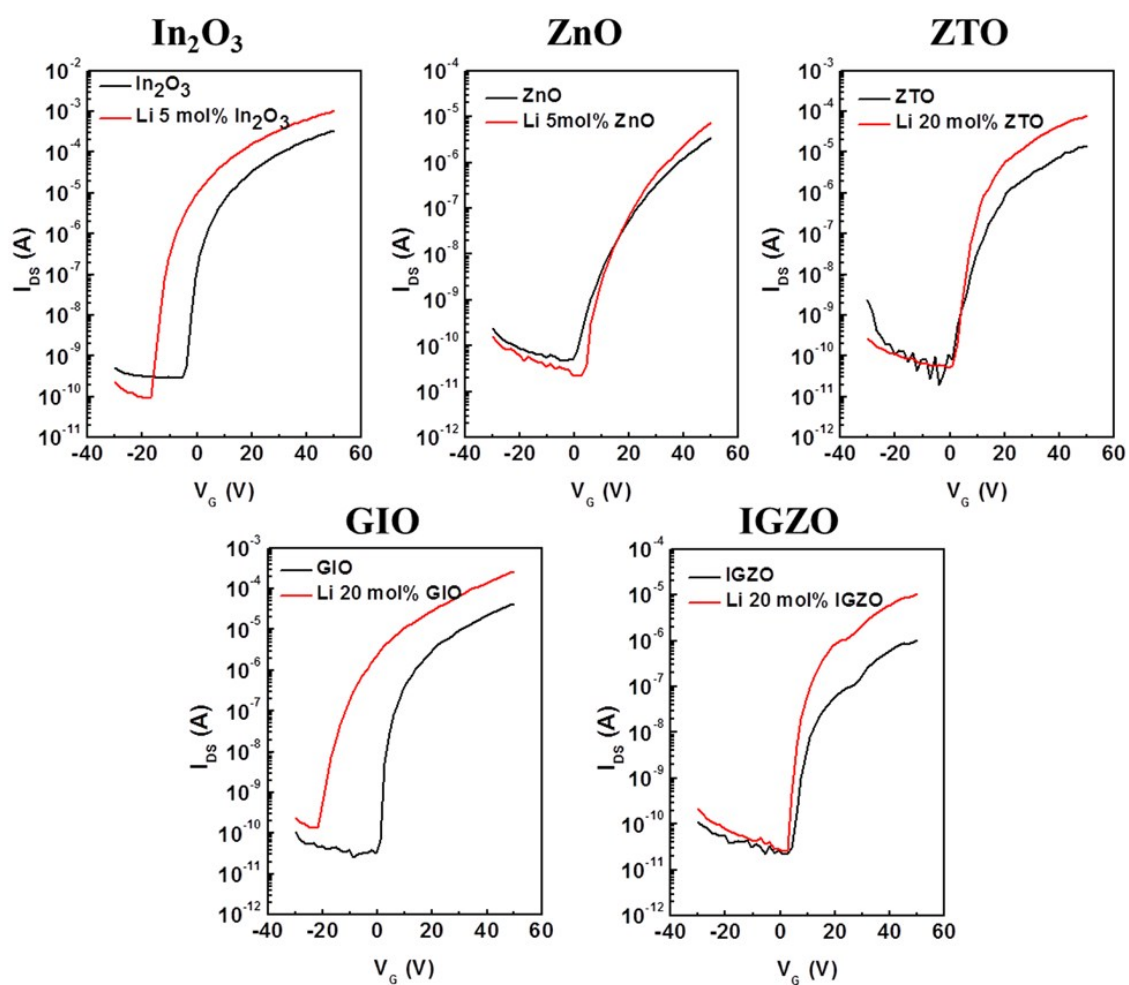


Figure S9. Transfer curves of various metal oxide TFTs annealed at 300 °C with an I_D of 40 V. The black and red lines represent undoped and Li-doped metal oxide TFTs, respectively.

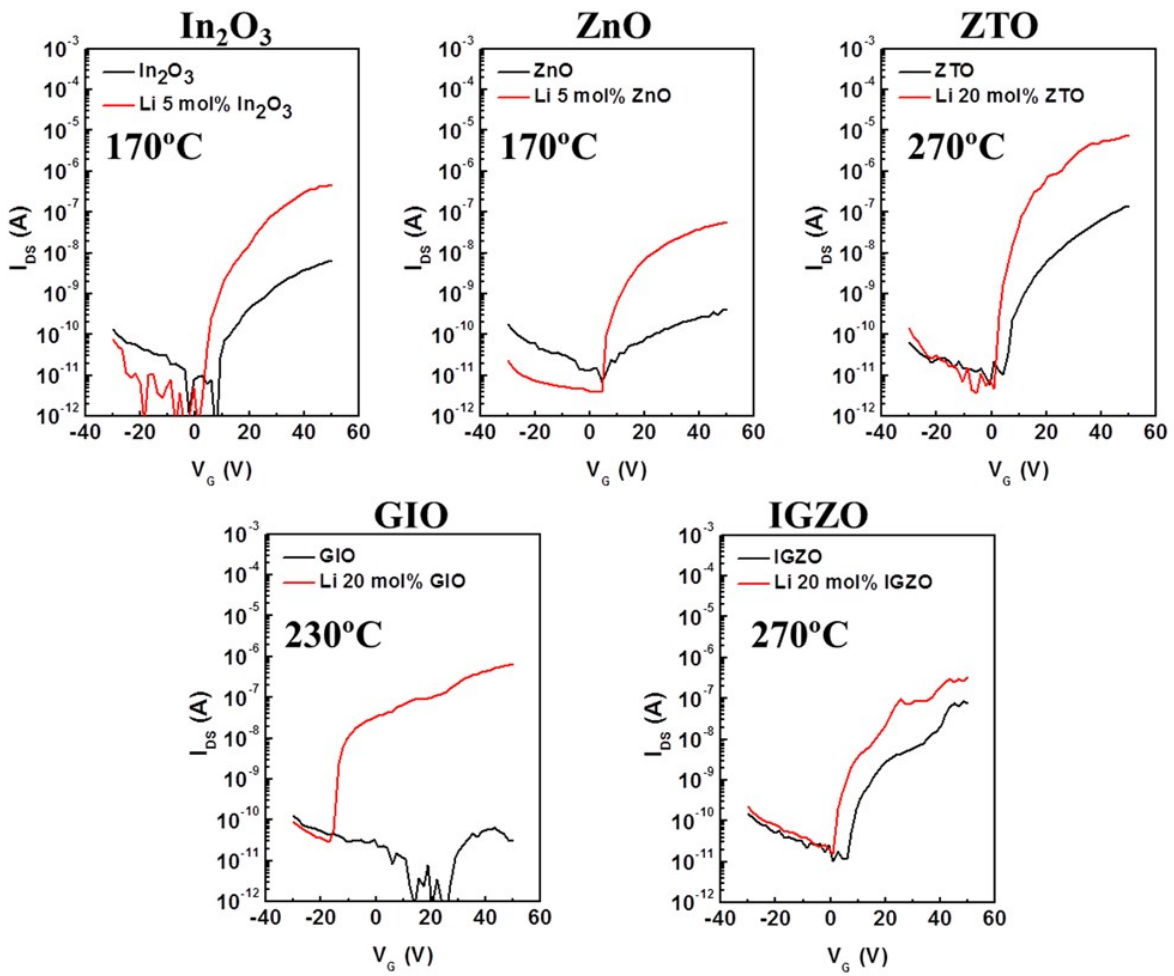


Figure S10. Transfer curves of various metal oxide TFTs with an I_D of 40 V. The black and red lines represent undoped and Li-doped metal oxide TFTs, respectively. The thermal treatment temperature, which is indicative of the activation temperature, is written in the figures.

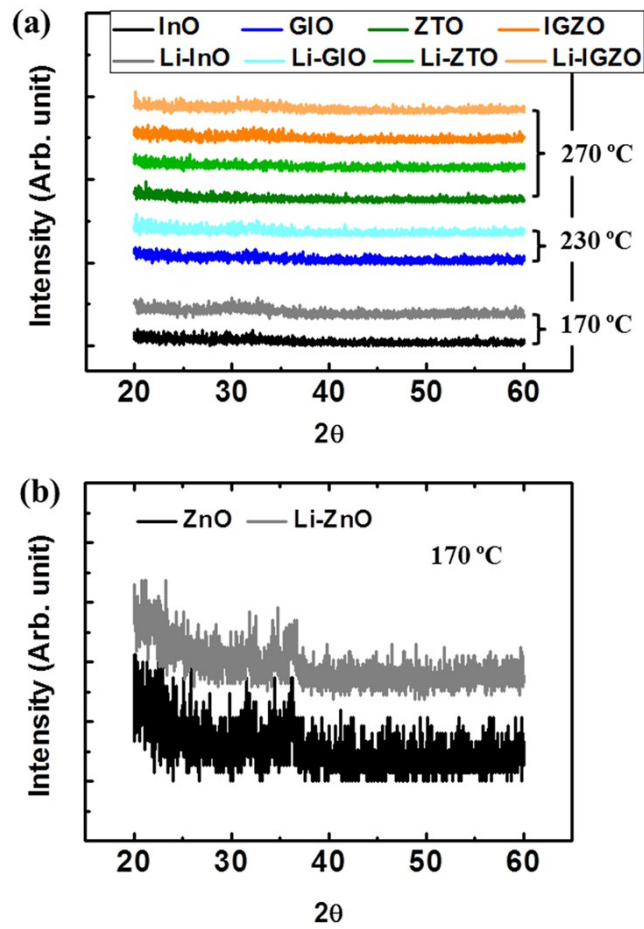


Figure S11. XRD patterns of various metal oxide thin films. (a) The annealing temperature is written in the figure. Each oxide consists of only amorphous phases. (b) The ZnO thin film annealed at 170 °C exhibited weak peaks associated with the crystalline phase.

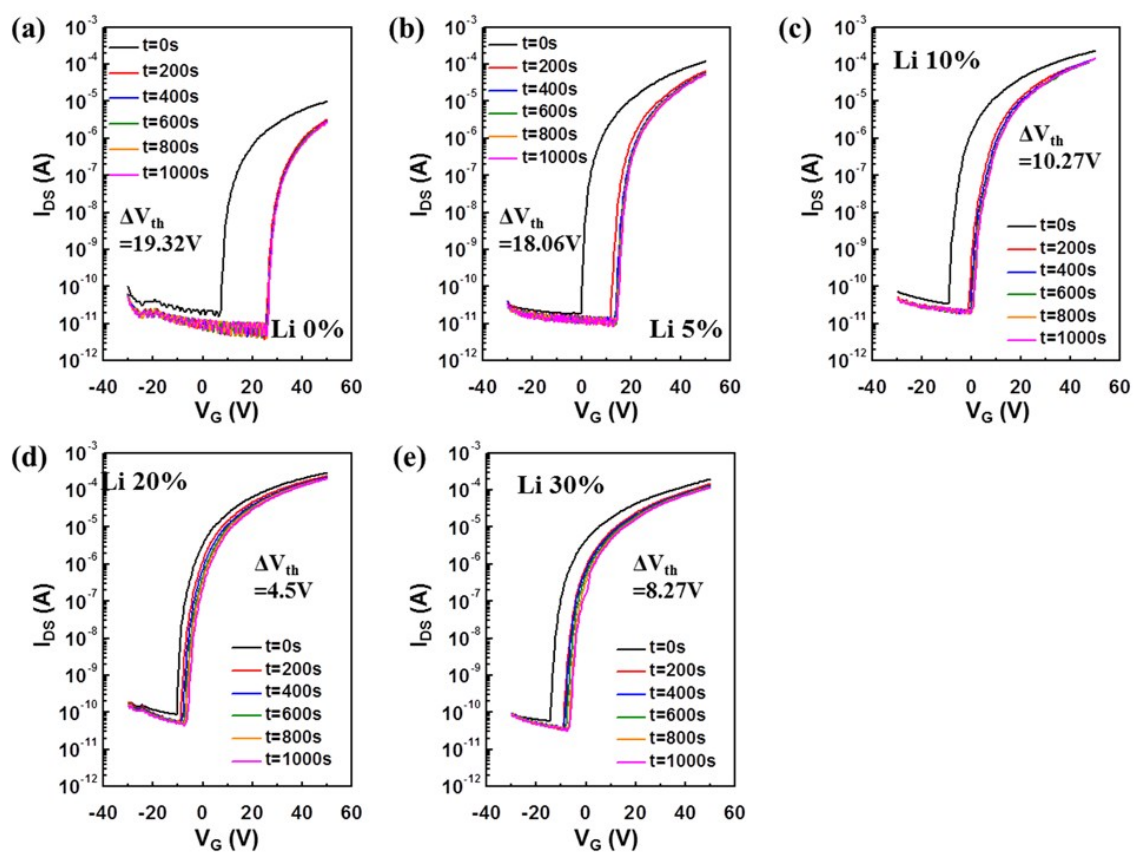


Figure S12. (a)-(e) LIZO TFT under positive gate bias stress conditions. These plots were obtained for a gate voltage of 20 V and a stress time of 1000 s.

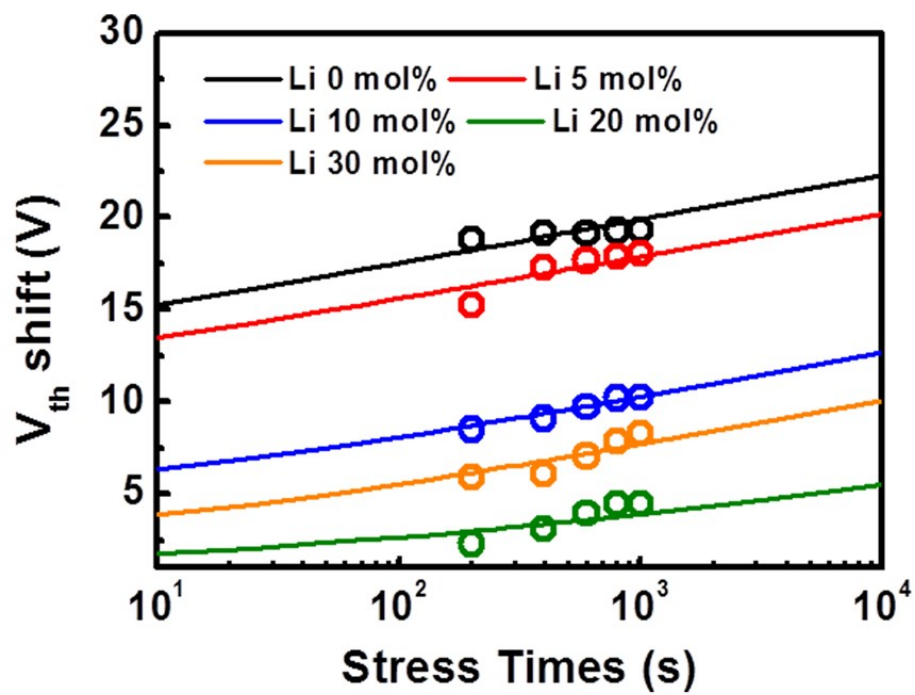


Figure S13. The circle indicates V_{th} shift value and the solid curves were fit to a stretched exponential equation.