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Electronic Supplementary Information (ESI) for Subgap States in Aluminum- and Hydrogen- Doped Zinc-Oxide Thin-Film Transistors

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KEYWORDS: subgap states, atomic layer deposition, zinc oxide transistors, doping, field-effect transistor

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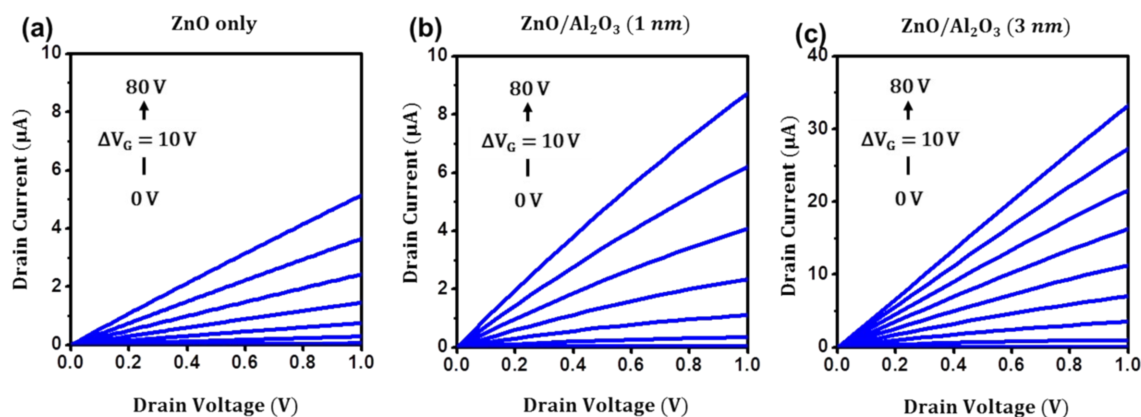

Figure. S1. (a-c) Output characteristics of ZnO TFTs with and without the top Al_2O_3 layer..

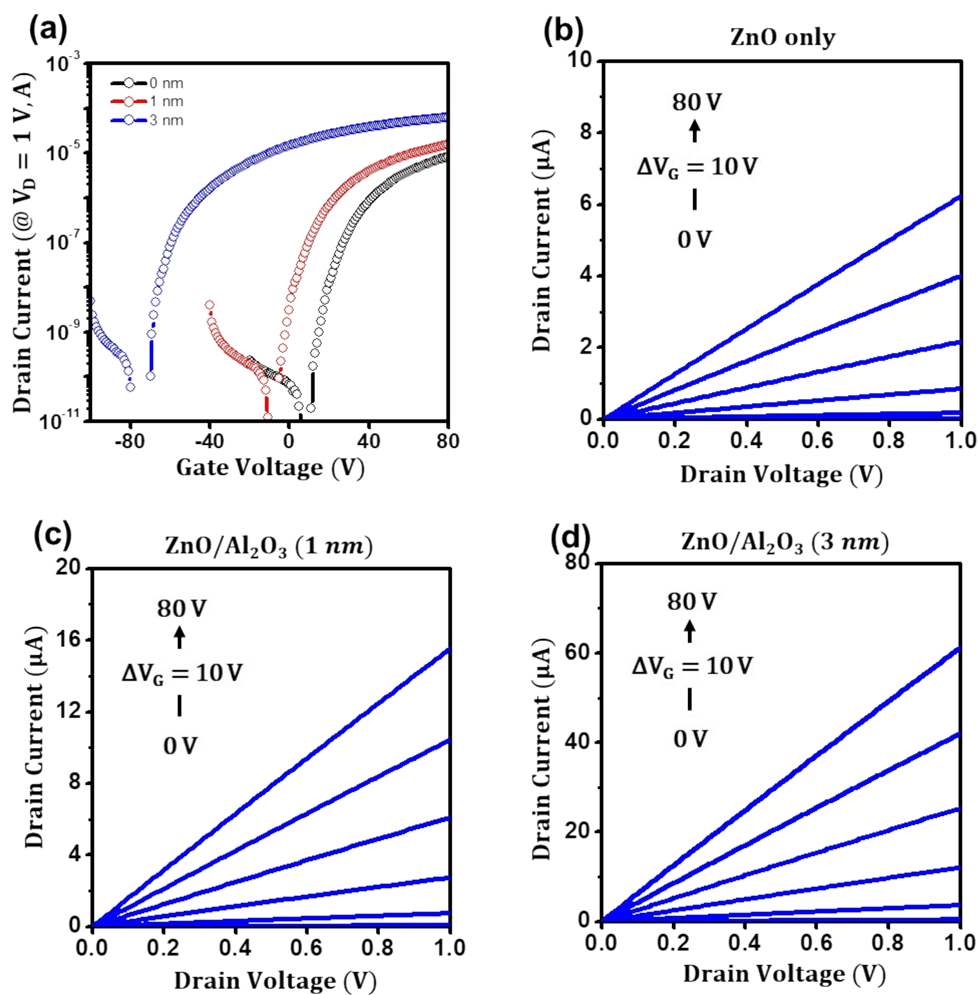

Figure. S2. (a) Transfer characteristic of the pure and doped ZnO TFTs. (b,c,d) Output characteristics of ZnO TFTs with and without the top Al_2O_3 layer.

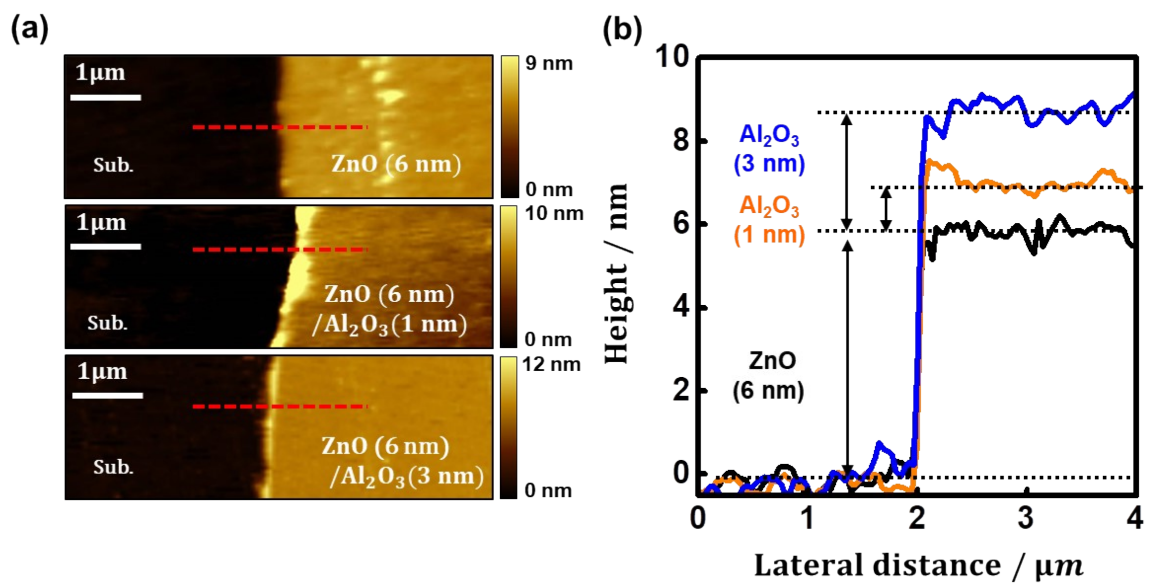

Figure. S3. Thickness measurements for characterization of the top Al_2O_3 layer with an atomic force microscope. (a) AFM images (scan size : 6×2 μm), (b) Thickness profiles of the films.

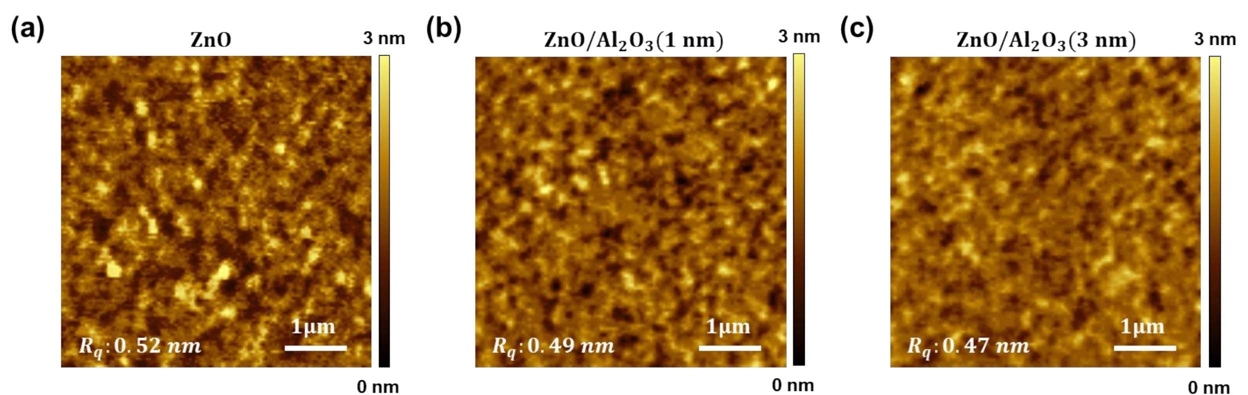

Figure. S4. Surface morphology of (a) pure ZnO, (b) 1nm-thin Al_2O_3-coated ZnO, and (c) 3 nm-thin Al_2O_3-coated ZnO film, respectively.

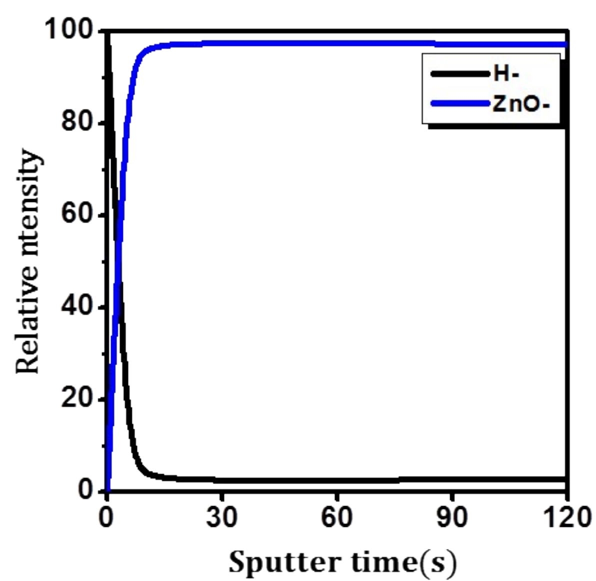

Figure S5. The SIMS depth profiling of the pure ZnO film.

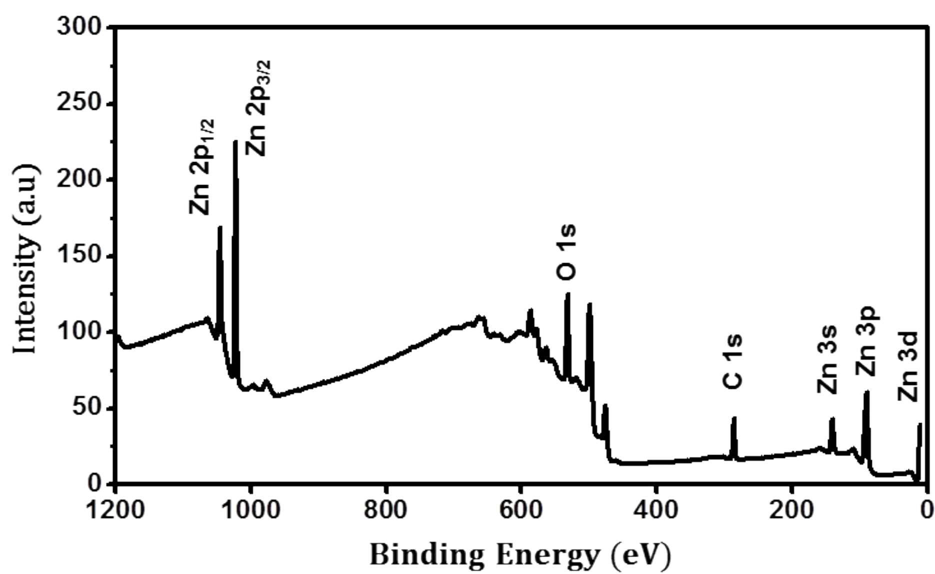

Figure S6. XPS survey spectrum of the ZnO film.

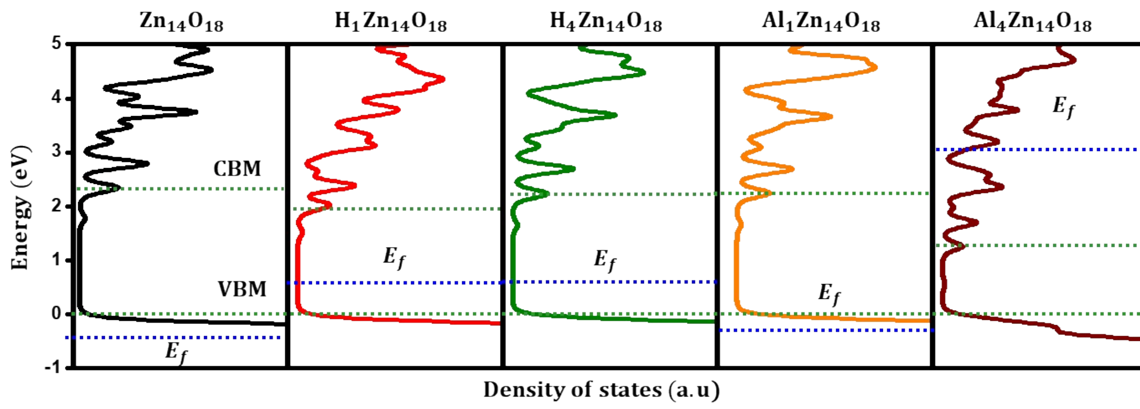

Figure. S7. DFT calculations of the ZnO films doped with either aluminum or hydrogen ions only