Supplementary Information for:

Resistive Memory for Harsh Electronics: Immunity to Surface Effect and High Corrosion Resistance *via* Surface Modification

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Top-view and cross-sectional SEM images

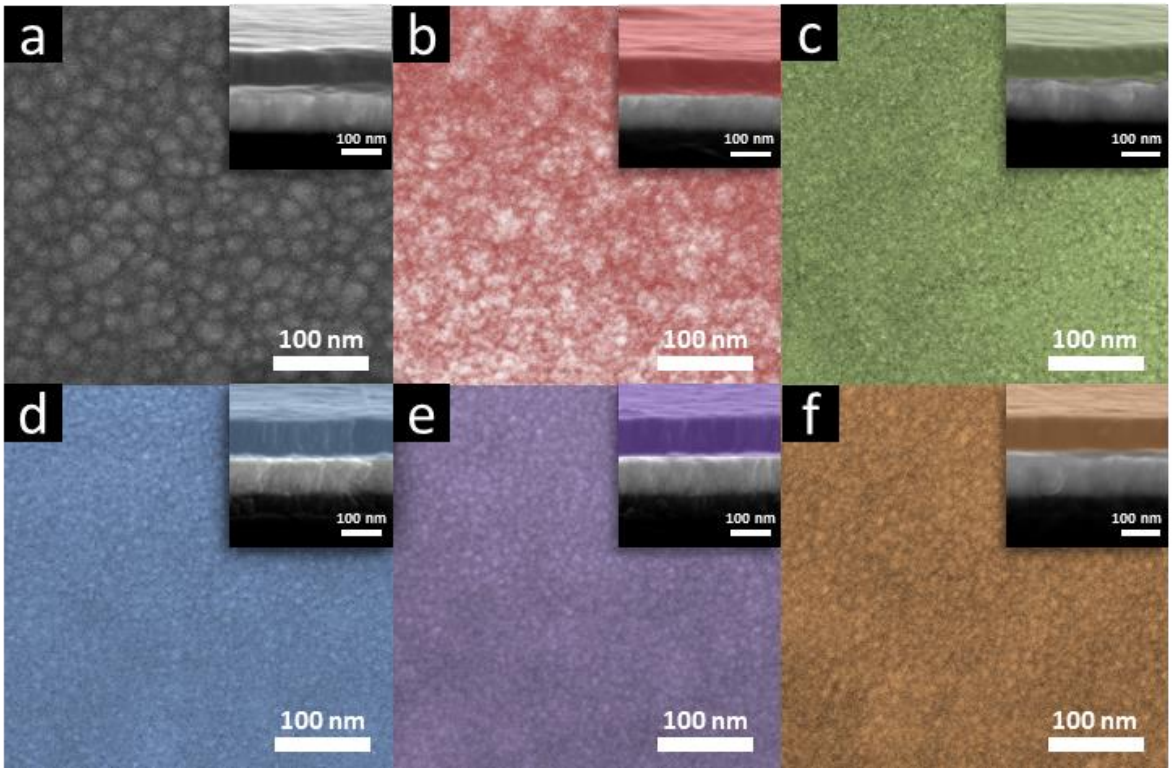

Figure S1. The surface morphologies of (a) pristine ZnO and ZnO with (b) 2-min, (c) 5-min, (d) 10-min, (e) 20-min, and (f) 30-min fluorination by CF_4 plasma. The insets show the cross-sectional SEM images. The thicknesses of ZnO thin films in the insets are (a) 100 nm, (b) 97 nm, (c) 95 nm, (d) 93 nm, (e) 90 nm, and (f) 85 nm.

Statistics of the thicknesses of ZnO thin films

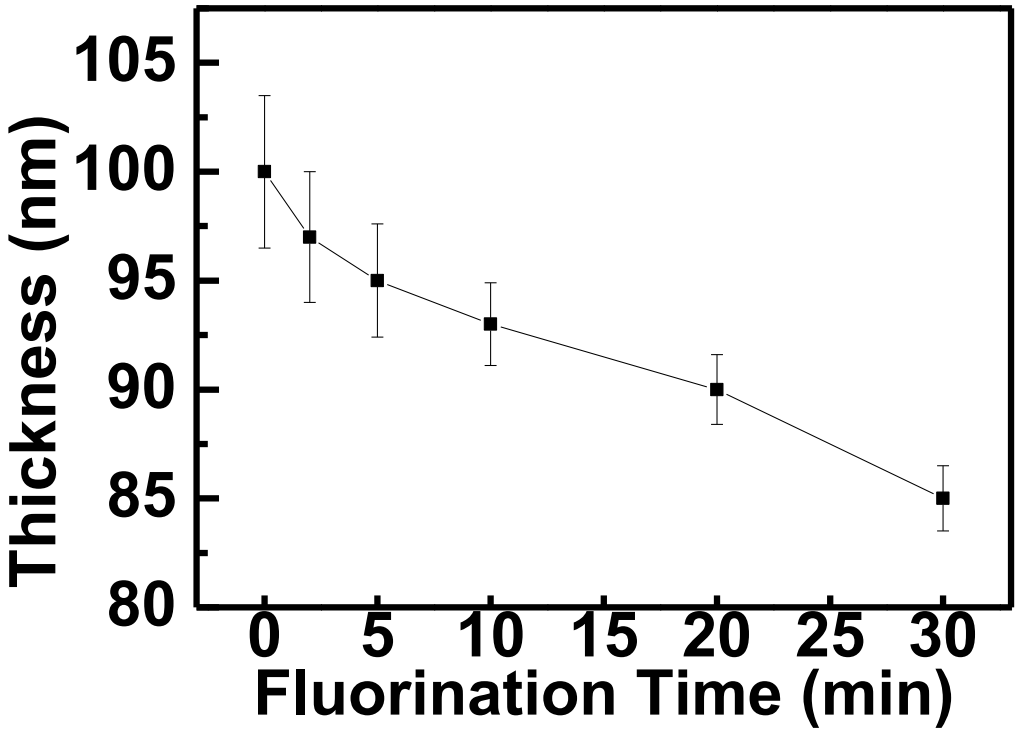

Figure S2. The dependence of the thicknesses of CF_4 plasma-treated ZnO thin films on the fluorination time measured from cross-sectional SEM images.

Chemical composition with depth of the F-modified ZnO thin films

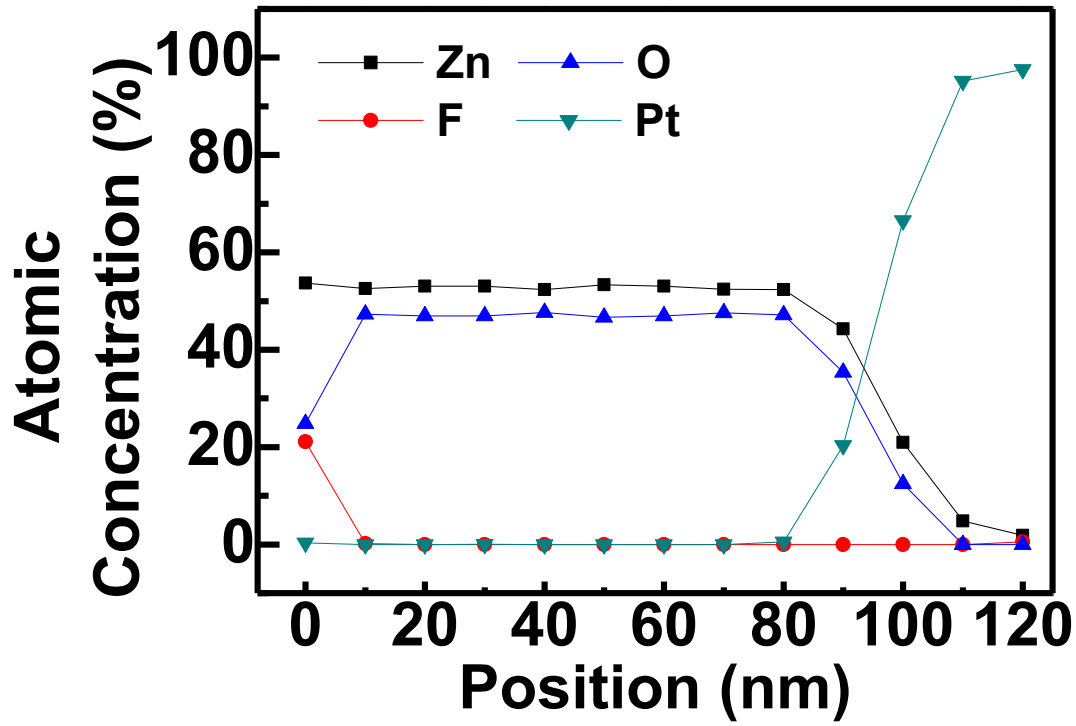

Figure S3. The depth profile of atomic concentration for four elements (Zn, O, F, and Pt) in the F-modified ZnO thin film by XPS characterization.

Forming process of the derived structure

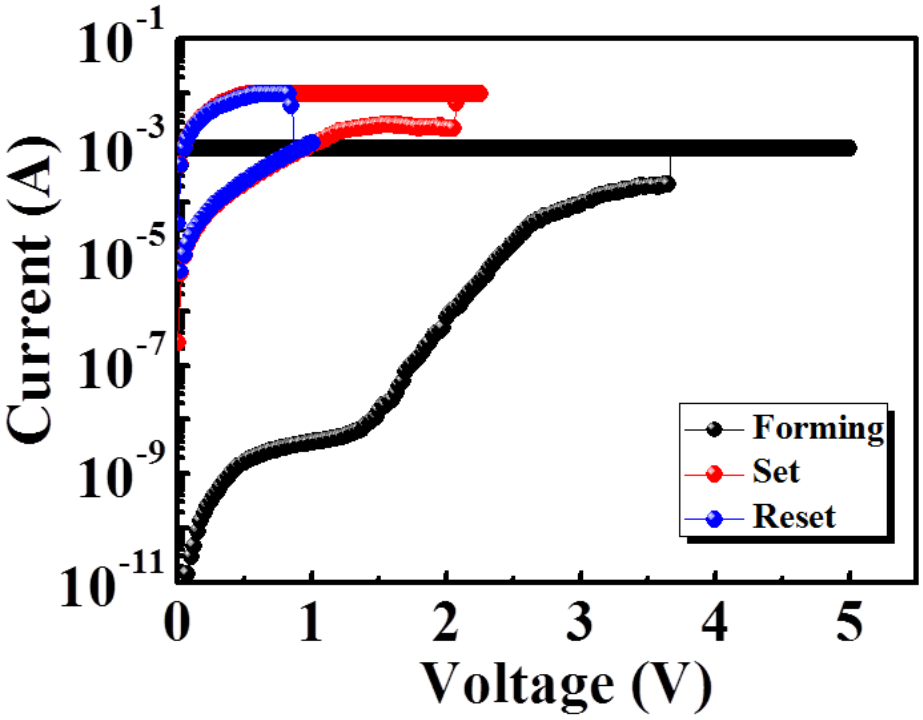

Figure S4. A complete switching cycle of the Pt/ZnO/Pt device.

Device yields under different operation modes

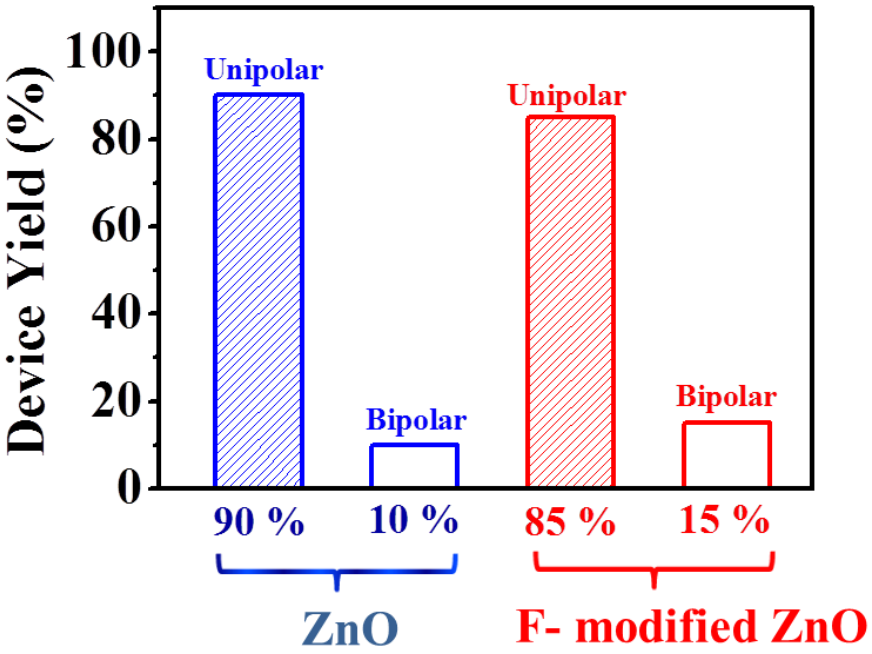

Figure S5. Device switching yield (left) ZnO RRAM (right) F-modified RRAM.

Dependence of the set (V_{set}) and reset voltages (V_{reset}) on the acid vapor treatment

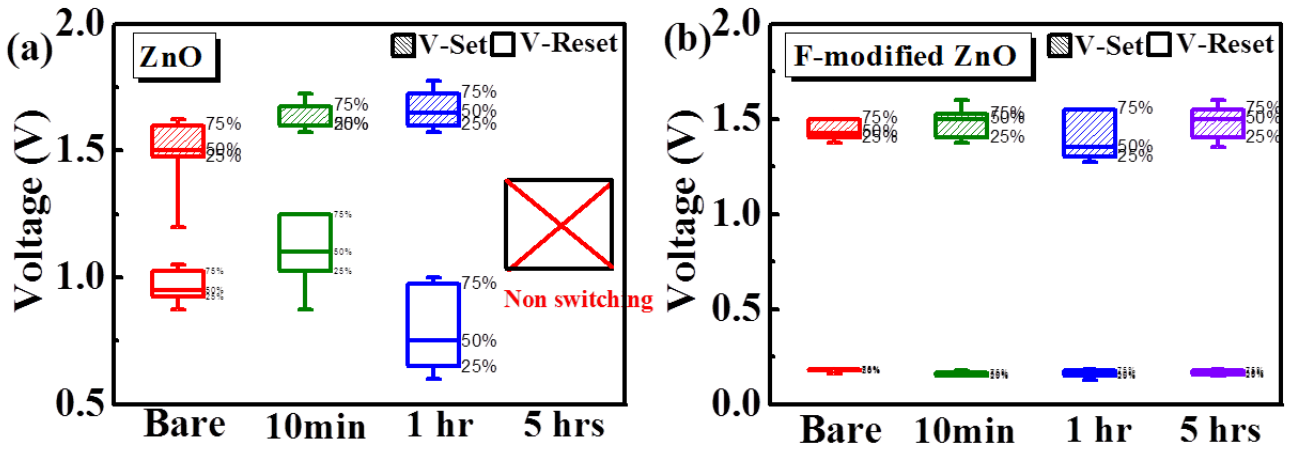

Figure S6. Distributions of operation voltages on ZnO (left) and F-modified RRAM devices (right) with acid vapor treatments.

Dependence of forming voltages on the acid vapor treatment

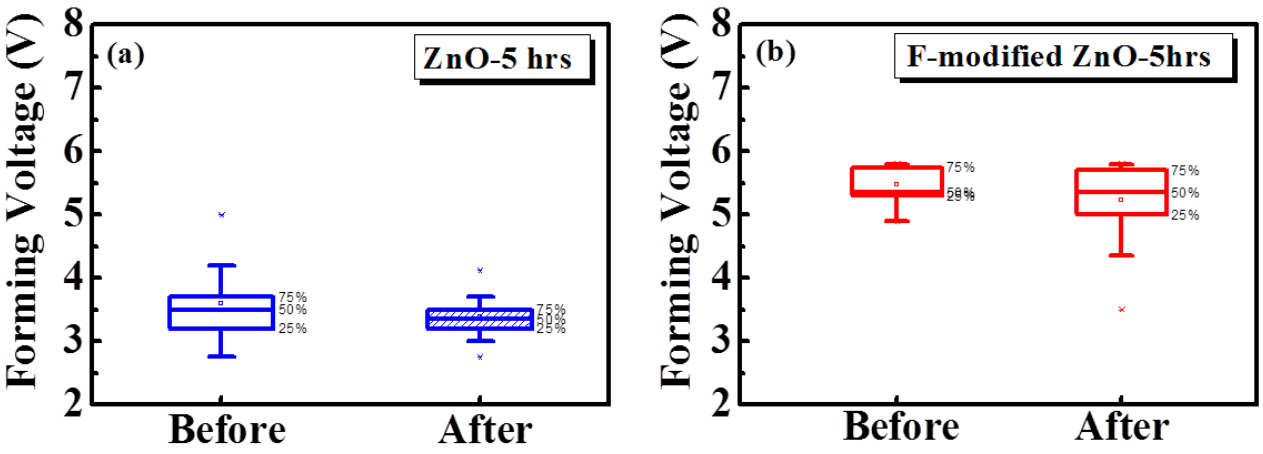

Figure S7. Distributions of forming voltages on pristine ZnO (left) and F-modified RRAM devices (right) before and after acid vapor treatment.

Evaluation of the limit on the F-modified ZnO device

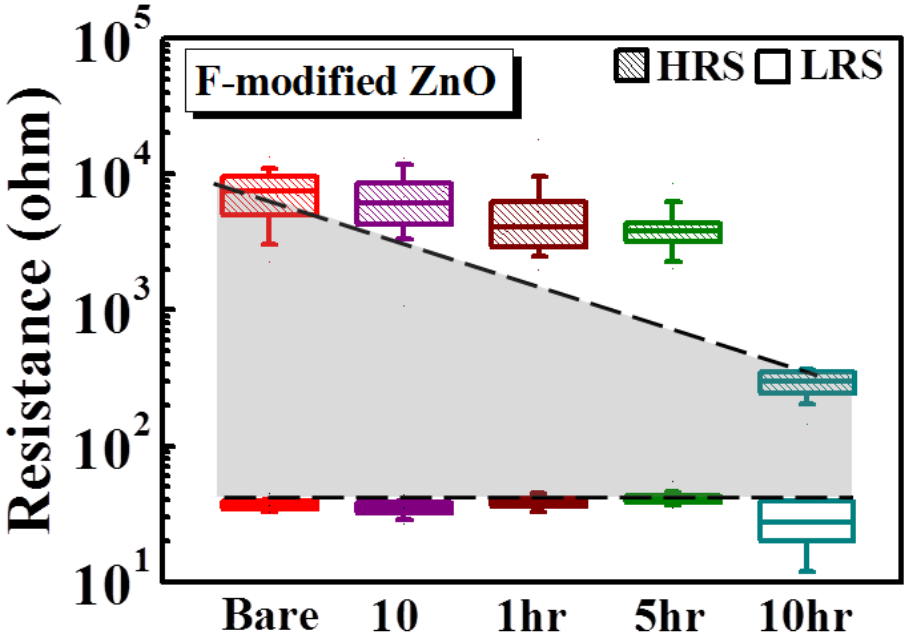

Figure S8. Durability limit of the F-modified RRAM device under acid vapor treatment.