**Multilevel characteristics of TiOx transparent non-volatile resistive switching device by embedding SiO2 nanoparticles**

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Figure S1. Survey spectra and compositions of (a) TiOx and (b) TiOx@SiO2 NPs films.



Figure S2. Electro-forming process of (a) TiOx and (b) TiOx@SiO2 NPs switching devices.



**Figure S3**. The resistive switching characteristics as a function of the composition of SiO2 NPs with (a) 0 %, (b) 4 %, and (c) 11 %.



**Figure S4**. Raman spectra of TiOx and TiOx@SiO2 NPs films. Dotted lines indicate anatase TiOx.