Supporting Information

Highly controllable and stable quantized conductance and resistive switching mechanism in single-crystal TiO_2 resistive memory on silicon

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XPS characterization of the epitaxial single-crystal TiO_2 films

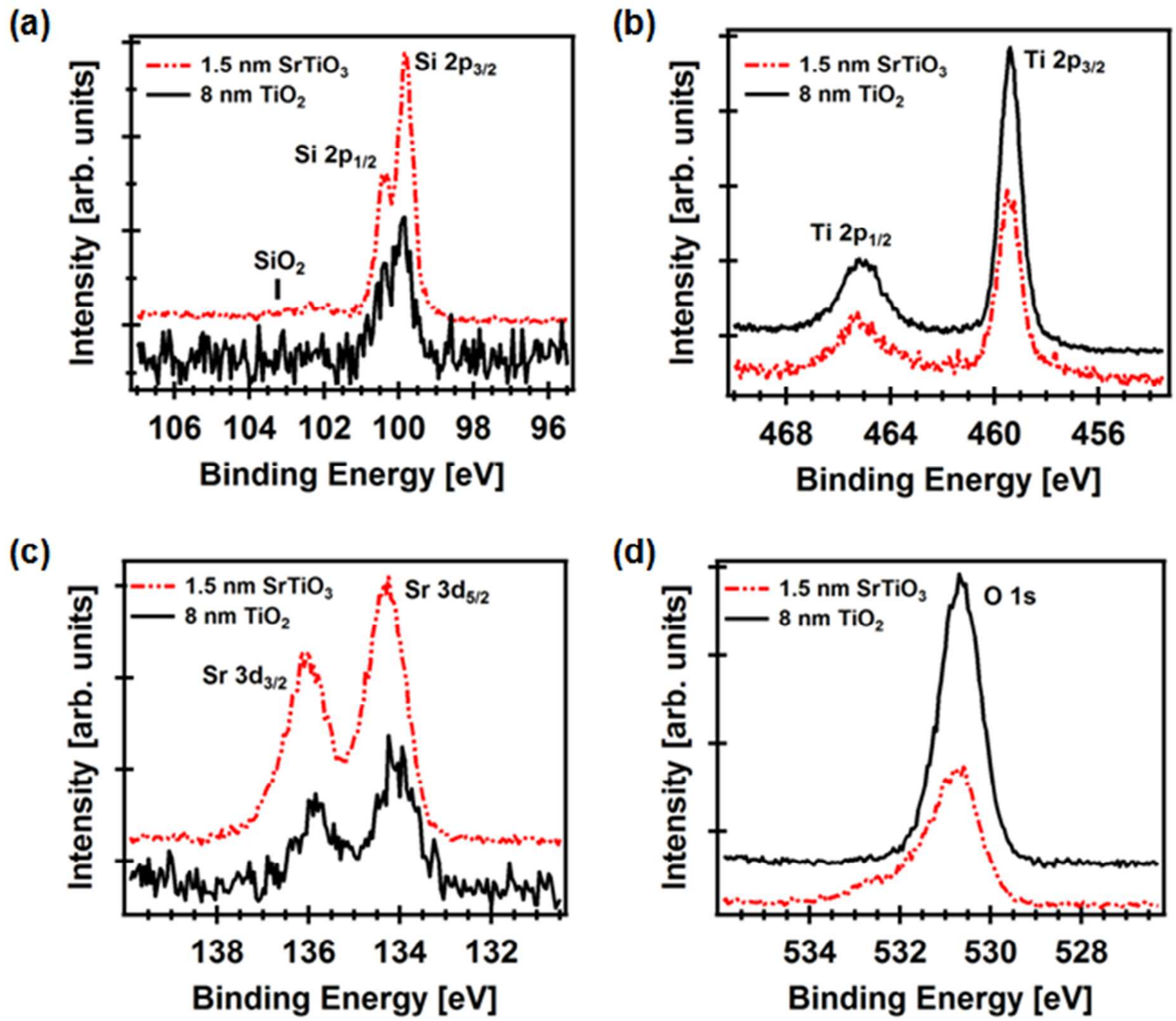

Figure S1. X-ray photoelectron spectra taken of a four-unit-cell (1.5 nm) $SrTiO_3$ buffer layer on Si (001) (dashed red line) and after 8-nm-thick epitaxial TiO_2 grown by ALD (solid black line). The high resolution core-level scans are shown for (a) Si 2*p*, (b) Ti 2*p*, (c) Sr 3*d*, and (d) O 1*s*.

The chemical composition of the crystalline TiO_2 films was characterized by *in situ* XPS. High resolution core-level spectra were collected for Si 2*p*, Ti 2*p*, Sr 3*d*, and O 1*s*, as shown in Fig. S1(a)-(d). The Ti $2p_{3/2}$ peak is located at 459.4 eV for the 8 nm TiO_2 film, indicating that the Ti is fully oxidized.

The Si 2*p* spectrum verifies that there is negligible SiO_2 formation after MBE growth of the single-crystal STO buffer layer, with only a small presence of silicon suboxide (SiO_x) is observed at ~102.2 eV. The Sr 3*d* signal is greatly suppressed after growth of the TiO_2 layer, but still visible. The O 1*s* peak can be fit with a single Voigt function after TiO_2 growth, which strongly indicates that no secondary phases are present in the epitaxial TiO_2 film. For the 8 nm TiO_2 film, the ALD growth was continuous and no post-deposition vacuum annealing was performed. The resulting heterostructure for the 8 nm TiO_2 film is composed of TiO_2 (8 nm) / $SrTiO_3$ (1.5 nm) / SiO_x (~0.5 nm) / Si (001).