RESISTIVE SWITCHING PROPERTIES OF HfO_2 - TiO_2 THIN FILMS GROWN VIA ATOMIC LAYER DEPOSITION

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Resistive switching has been previously studied in both titanium oxide [1] and hafnium oxide[2] metal-insulator-metal (MIM) structures. Devices utilizing TiO2/HfO2 bilayers have also been studied [3].

We investigated resistive switching properties of devices where TiO_2:HfO_2 mixed oxide dielectric layers were grown by ALD on RuO_2 bottom electrode with Pt top electrodes. The electrodes were deposited using magnetron sputtering. ALD was carried out at 350 °C. The precursors used were $HfCl_4$, $TiCl_4$, H_2O. Multiple samples with a varying ratio of TiO_2 to HfO_2 deposition cycles were prepared. For each ratio, both an as-deposited sample and a sample annealed for 30 minutes at 400 °C were evaluated.

Electrical measurements were carried out using a Cascade Microtech EPS-150 probe station and a Keithley 2636A source-meter. All studied samples showed resistive switching properties. As-deposited devices with the $HfTiO_4$ orthorhombic phase and a HfO_2:TiO_2 ratio of 1:3 demonstrated ratio between the low resistance state (LRS) and high resistance state (HRS) about 10, with an endurance measurable up to thousands of cycles. Retention measurements were carried out at variable temperatures, up to 140 °C, for 6 hours and showed good stability for both LRS and HRS. Preliminary device-to-device repeatability tests were also carried out and showed that annealed devices demonstrated better repeatability when compared with non-annealed devices.

References:

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