Resistive Non Volatile Memories Characterization by Conductive Atomic Force Microscopy in Ultra High Vacuum

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Abstract:

Resistive switching in transition metal oxides (OXRAM) and Phase change materials (PCM) have attracted great attention for the application of eNVM. By applying electrical bias, the conductivity of the device can be drastically increased or decreased. Here those phenomena are studied with the help of Ultra High Vacuum Conductive-AFM at nanoscale for OxRAM. Concerning the OXRAM the UHV-CAFM will be used to fully characterize the forming step and its dynamics as well as its reversibility which has recently been evidenced. This phenomenon will also be theoretically studied and modelled.

We are doing all the experiments in Ultra High Vacuum environment by using Atomic force Microscopy with a conductive tip. Conductive AFM tips are used as a top electrode for OxRAM as we do not have any layer deposited on oxide for top electrode in the sample. We started studying the forming and set process in OxRAMs based on HfO_2 with TiN as the bottom electrode. We identified a suitable tip for the characterization that has low resistance and can withstand high current. We investigated the effect of pressure (force applied on the AFM tip) and its impact on the current-voltage characteristics. We studied the SET, RESET and forming process in these samples.

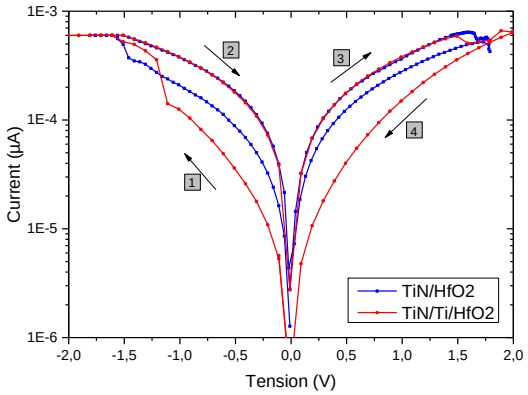

Fig1: Resistive switching I-V curves of HfO_2 based OxRAM samples TiN/Ti/HfO_2 (red color) & TiN/HfO_2 (blue) showing SET and RESET. The direction from 1 → 2 is SET process and from 3 →4 is RESET process. The current compliance is set to 600µA in order to avoid permanent dielectric breakdown.