Fabrication and Gamma Radiation Effects on Endurance of Ferroelectric Hafnium Zirconium Oxide Capacitors

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Ferroelectric hafnium zirconium oxide (HZO) is attracting significant interest in the semiconductor microelectronics industry with attributes including coercive voltages compatible with CMOS, retention of memory states after power down and reasonable polarizations achieved with films 8 to 15 nm thick. An immediate application of the HZO capacitors include non-volatile memory (NVM) with insertions in the back end of line (BEOL) fabrication. Although devices such as ferroelectric capacitors are most applicable for FeRAM integrations, subtle details in their fabrication including the electrodes used and thickness which can have impact in the device performance metrics.

This work investigates electrode configurations, ferroelectric thickness and anneals utilized in BEOL processes including W and TiN for effects on endurance and polarization. Insertion of thin linear dielectrics, 1 nm of alumina on the bottom electrode, is also investigated to determine properties impactful to FeRAM circuit design. To determine the stability of the film, device polarization and endurance was measured after 5 MRad of Co^{60} gamma cell irradiation over differing voltage rails and cycling frequencies. This work extends the knowledge base of ferroelectric HZO with radiation effects for non volatile memory applications in CMOS.

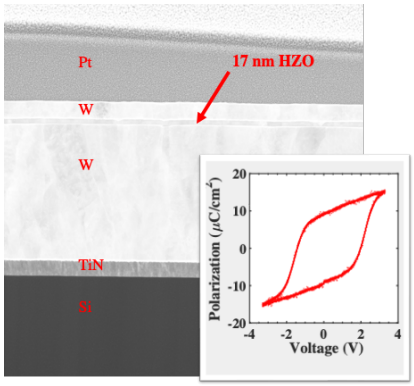

Figure 1. STEM of 17 nm HZO with W electrodes. Inset: Polarization loops of MFM capacitors.

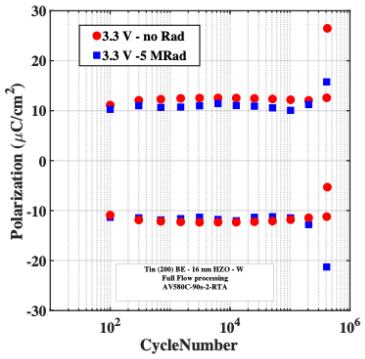

Figure 2. Endurance of 17 nm HZO with TiN and W electrodes before and after 5 MRad gamma radiation.

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