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Impact of a dielectric layer at TiN/$HfZrO_2$ interface for ferroelectric tunnel junctions applications

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The discovery of memristor, theorized in 1971 by L. Chua, has led to the development of novel artificial neuromorphic concepts and devices, including ferroelectric-based ones. Ferroelectric Tunnel Junction (FTJ) type memristors based on zirconium-doped hafnium oxide, $\mathrm{Hf_{0.5}Zr_{0.5}O_2}$ (HZO), have recently displayed synaptic learning capabilities [1]. In addition, HZO processes are already fully compatible with silicon CMOS industry with oxide layers thinner than 10 nm. In the present work, the HZO layer is realized by room temperature magnetron sputtering of a $\mathrm{Hf_{0.5}Zr_{0.5}O_2}$ ceramic target and subsequently crystallized by rapid thermal annealing [2]. The titanium nitride (TiN) bottom (BE) and top (TE) electrodes are realized by reactive magnetron sputtering of a Ti target. We explored the impact of the insertion of an ultra-thin buffer layer at the HZO/TE interface on the stabilized crystalline phase and microstructure, band structure alignment and electrical properties of thin HZO films. We investigated two materials, Ti and Al. Behind the annealing process Ti and Al turned into $\mathrm{TiO_2}$ and $\mathrm{Al_2O_3}$ respectively, following the creation of oxygen vacancies inside the HZO barrier. We exploited X-ray photoemission spectroscopy to analyse the chemistry and the electronic state of the HZO/electrode interface. X-ray reflectometry and grazing incidence X-ray diffraction were used to probe the thickness and structural characteristics of the HZO layer, whose ferroelectricity is associated to the polar orthorhombic phase. We will discuss our results in the framework of structural, chemical and physical properties of the ferroelectric/TE interface and its effect on the electrical properties of thin HZO-based junctions.

References:

[1] L. Chen *et al.*, "Ultra-low power Hf0.5Zr0.5O2 based ferroelectric tunnel junction synapses for hardware neural network applications," *Nanoscale*, vol. 10, no. 33, pp. 15826–15833, 2018, doi: 10.1039/c8nr04734k.

[2] J. Bouaziz, P. R. Romeo, N. Baboux, and B. Vilquin, "Huge Reduction of the Wake-Up Effect in Ferroelectric HZO Thin Films," *ACS Appl. Electron. Mater.*, vol. 1, no. 9, pp. 1740–1745, 2019, doi: 10.1021/acsaelm.9b00367.