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Structural andElectrical Response of Emerging non-volatile Memories Exposed to Heavy Ion Radiation

Hafnium oxide- and GeSbTe-based functional layers represent promising material platforms for next-generation memory technologies. In addition to their potential for conventional computing applications, these materials are increasingly being investigated for use in radiation-harsh environments. Evaluating their resilience against ion irradiation is therefore essential to assess their suitability for future applications in emerging memory technologies, such as oxide-based, ferroelectric, and phase-change random-access memories. Radiation-induced modifications to the crystalline structure and microstructure must be carefully examined, as these changes are directly correlated with the memory states and potential failure mechanisms of these technologies

In this context, we present a comprehensive study on the effects of heavy ion irradiation in emerging memory devices based on various functional materials, specifically focusing on thin films of HfO_2, $HfZrO_2$ and GeSbTe. Our results highlight the crucial role of initial crystallinity, chemical composition, and microstructural characteristics in determining the materials' response to swift heavy ion irradiation. This integrates structural analysis via X-ray diffraction at the macroscopic scale, scanning transmission electron microscopy at the nanoscale, and electrical characterization of fully processed devices to understand how these materials interact with the radiation.

Our results demonstrate the radiation hardness of these emerging memories making them very interesting for future applications in high-dose environments.

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