

Morphological Analysis of ALD HZO Thin Films Using Cp-Based Hf/Zr Precursors

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In recent years, extensive research has been conducted on application of doped-HfO₂ as high-k dielectric materials in advanced electronic devices such as dynamic random-access memory (DRAM), ferroelectric field-effect transistors (Fe-FETs), and ferroelectric junction transistors (FJTs). Among these materials, ZrO₂-doped HfO₂, specifically Hf_{0.5}Zr_{0.5}O₂ (HZO), has attracted significant attention as a promising alternative dielectric for DRAM capacitor applications. HZO exhibits various crystalline phases depending on dopant concentration and thermal conditions, including the tetragonal phase with a high dielectric constant and the non-centrosymmetric orthorhombic phase, which is associated with ferroelectric behavior. In this study, HZO thin films were deposited using an atomic layer deposition (ALD) process with Cp-based Hf and Zr precursors at low temperatures ranging from 250 to 350 °C. The morphological characteristics and thickness uniformity of the deposited HZO films were evaluated using atomic force microscopy (AFM) and X-ray reflectivity (XRR). The crystalline structure and phase distribution were analyzed by X-ray diffraction (XRD), while the microstructural features and interfacial properties were further investigated using transmission electron microscopy (TEM). This systematic analysis provides insight into the effects of deposition temperature on the morphological and structural properties of low-temperature ALD-grown HZO thin films, offering a fundamental understanding for process optimization in high-k dielectric applications.

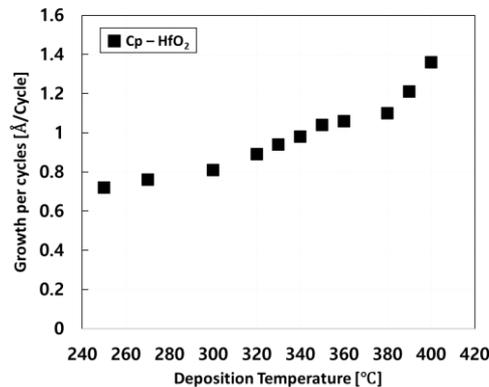


Fig 1. Cp-HfO₂ ALD Window

Acknowledgments

References [1] Journal of Materiomics,101101 (2025). [2] Nanoscale,13,8524-8530 (2021).