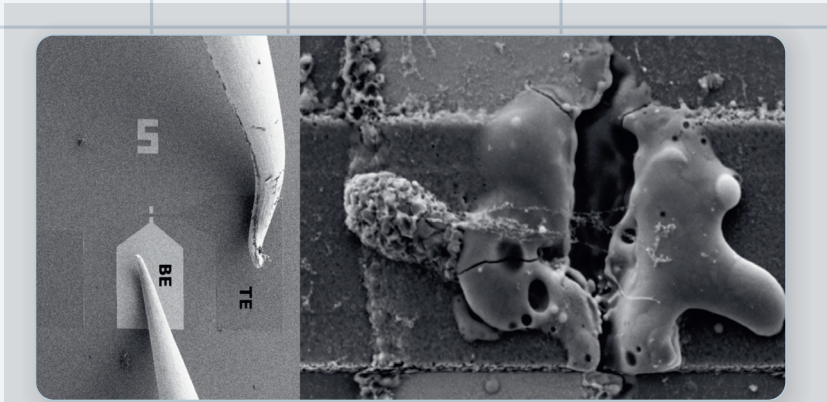


Abstract

This thesis investigates HfO₂-based resistive switching devices through combined electrical and physical characterization, statistical analysis, and physics-based compact modeling. Devices with different layer thicknesses, dimensions, and fabrication routes were evaluated under different electrical and environmental conditions, showing how material properties, process-induced defects, device geometry, and environment shape switching behavior, variability, leakage, and degradation. The combined analysis of electrical characteristics, physical damage signatures, and statistical data, including Weibull analysis and clustering, provides insight into the physical origins of device dispersion and the competing degradation pathways that limit reliability and scalability.

To interpret and reproduce these behaviors, the Quasi-static Memdiode Model (QMM) and the Dynamic Memdiode Model (DMM) were progressively adapted and extended, incorporating asymmetric field terms, stochastic effects, and multi-filament interactions. These frameworks reproduce direction-dependent switching, long cycling sequences, and statistical spread, and were further applied to Complementary Resistive Switching (CRS) structures for logic-in-memory simulations.

Overall, the work provides an integrated understanding of how material properties, fabrication processes, electrical behavior, physical degradation, and compact modeling converge to determine the performance, reliability, and scalability of HfO₂ based memristive devices.



M. Saludes Tapia

From Dielectric Breakdown to Memristive Switching in HfO₂

2026

From Dielectric Breakdown to Memristive Switching in HfO₂ Devices:

Physical Characterization and Compact Modeling

M^a Mercedes Saludes Tapia
Ph.D. Thesis

Bellaterra (Cerdanyola del Vallès)
2026

