Docket #: S21-225

CeO2-doped HZO for unparalleled ferroelectric performance

We present a revolutionary advancement in ferroelectric materials that is set to redefine the landscape of embedded memories and semiconductor technologies. Current ferroelectric materials are hampered by issues of scalability, low-voltage operation, and limited cyclic endurance, thereby impeding their seamless integration into commercial products. Stanford researchers are addressing these challenges head-on with this cutting-edge invention—CeO2-doped HZO—heralding a new era of reliability and performance for ferroelectric fabrication processes.
The prevailing state-of-the-art relies on HfO2-ZrO2 alloys (HZO), however, their incorporation into commercial applications is stifled by their intrinsic limitations. By leveraging CeO2 doping, we have unlocked a reliable fabrication process that boasts unparalleled endurance performance, as showcased by our tests on MFM capacitors which endured a remarkable 1010 cycles, which is three orders of magnitude higher than identically processed undoped HZO. The resulting higher conductivity of the films not only enhances endurance properties but also mitigates the risk of local Joule heating-induced breakdown, thanks to the conduction via in-gap electronic states. This unique mechanism curtails the possibility of hard breakdown and paves the way for consistently reliable operation over extended periods. This breakthrough technology not only enhances endurance but also enables precise control for optimal performance, ushering in a new era of ferroelectric excellence.

Applications

- Embedded memories
- Semiconductor devices
- Integrated circuitry
- IoT devices
- Sensor technologies

Advantages

- Enhanced endurance
- Voltage modulation precision
- Reliable Fabrication process

Patents

- Published Application: 20230163190
- Issued: 12,166,098 (USA)

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