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Development of Test and Methodologies to Characterize the Electrical Performance of Resistive RAM Devices Using B1 500A Semiconductor Device Analyser.

ABSTRACT - Masterthesis

Semiconductor memory has always been a crucial component and backbone of modern electronic systems. The most currently used Flash memory is approaching its scaling limits. The demand for high-capacity, high-speed storage devices in the modern technologies accelerated the innovations in Non-Volatile Memories (NVM). The emerging technologies include the use of resistance, spin or polarization to store information and led to densely interconnected memory arrays.

Transition Metal Oxide (TMO) based Resistive Random-Access Memory (RRAM) is a promising candidate in the field of embedded circuits and in emerging applications like neuromorphic computing. The RRAM devices are particularly attractive due to its high switching speed, long retention time, good endurance, low operating voltage, high scalability and 3D stacking availability. Among the emerging RRAM devices, the Copper(Cu) based device with memory stack Cu/TiW/Al2O3/WOx/W has shown benefits like fast switching at very low operating current. The detailed endurance and retention reliability study is analyzed on the device, to outline the effect of Cu in the device.

To scope up with the emerging technologies, it is also very important to have fast, nondestructive, accurate and easy-to-use electrical characterization techniques. For testing the reliability, performance and dynamic behavior of memory devices, requires a software and hardware system that provides the complex arbitrary pulses as the input.

The hardware device B1500A Semiconductor Device Analyzer is implemented as it can satisfy all needs for today's memory technologies. An independent GUI is redesigned for SQL-based measurement database which presents the raw electrical measurements and its derived data as a waveform viewer.

This thesis focuses on the study of switching phenomenon of the Cu based RRAM device and also the software and hardware implementation of B1500 Semiconductor Device Analyzer.