Exploring the "resistance change per energy unit" as universal performance parameter for resistive switching devices

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Abstract

Resistive switching (RS) device (memristor) technology is continuously maturing towards industrial establishment. There are RS devices that demonstrate an “incremental” (analog) switching behavior, whereas others change their state in a binary form. The final achieved resistance is generally a function of the applied pulse characteristics, i.e. amplitude and duration. However, variability —both from device to device but also from cycle to cycle— and the stochastic nature of internal RS phenomena, still hold back any universal tuning approach based solely on these two magnitudes, making also difficult the qualitative comparison between devices with different material compounds owing to the required SET/RESET voltages being dependent on the biasing conditions. In this work we demonstrate experimentally using commercial RS devices from *Knowm Inc.* that the switching energy is very insensitive to the biasing conditions. We explored experimentally the SET-RESET behavior of bipolar RS devices from the energy point of view. We figured out the quantitative effect of the injected energy to the resistive state of the devices, and proposed an analytical model to explain our observations in the energy consumed by the device during the switching process. Our results lay the foundations for the definition of “resistance change per energy unit” as a performance parameter for this emerging device technology.