Metal Oxides: Potential Candidates for Future Nonvolatile Memories

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Abstract

Resistive switching devices are promising alternative to existing memories which may offer a potential leap beyond the limits of Flash memories (with respect to write speed, write energies) and Dynamic random access memories DRAM (with respect to scalability, retention times). A conventional RRAM cell is composed of an insulating/dielectric layer sandwiched between two metallic layers. In this talk, an overview of physical and electrochemical processes which may be the origin of the switching phenomenon in various materials will be discussed. Furthermore, novel concepts (strategies) beyond classic doping will be discussed to control device properties like signal to noise ratios and power consumption.

In our work, as a first strategy, we realize the superior bipolar resistive switching characteristics of CeO_2:Gd-based resistive memory device by utilizing a unusual mean of UV radiation. This non-conventional tool provides us a new degree of freedom to manipulate the performance of a memory device. Our further investigations revealed that the prototype can deliver short term to long term memory transitions which is analogous to the forgetting process of human brain, which is a key biological synaptic function for information processing and data storage.

In another strategy, a non-conventional and unique “chronoamperometry” approach contrary to classic voltammetry measurements was implemented to examine the bipolar resistive switching characteristics of ceria based memory cell. Configurable device functionalities such as; categorization of minimum threshold potential to prompt switching behaviour, tuneable on/off ratios with accessible multi-level data storage states can be achieved which are hard to realize in conventional measurement setups.