A Novel Type of Nonvolatile Memory Device - RS Study on ZnO Materials

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With the current demand of fast speed computers and related digital memory devices, alternatives to silicon-based materials are highly sought after for the building of the next generation of super computers. Cu-doped zinc oxide ZnO:Cu, grown by the method pulsed laser deposition, exhibits potential in its resistive switching capabilities and is explored in this innovative research. The electrical and optical properties of the metal/ZnO:Cu/GZO device was characterized by current-voltage (I-V) measurement and photoluminescence (PL), where the GZO is the highly Ga-doped ZnO layer having a very low resistivity acting as the transparent conductive electrode. Promising resistive switching behaviour is found in the 2% Cu-doped ZnO sample grown at P(O2)=0.026 Pa with the choice of Au as the metal layer. Resistive switching test is replicated for 80+ cycles, showing stable resistive switching of the device. Also, the newly developed device is capable of producing different levels of resistive switching at different applied voltage. The resistive switching behaviour is associated to a conductive filament (CF) model. The ultra-violet (UV) emission in the PL spectra also shows the memory effect, for which the UV intensity is controllable by the memory states. Such behaviour is able to be replicated under stable conditions, showing promising future development for the applications in memory devices or light-emitting diodes with memory function.