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Electrical Switching Characteristics of Ge-Se Thin Films for ReRAM Cell Applications

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It has been known since the mid 1960s that Ag can be photodissolved in chalcogenide glasses to form materials with interesting technological properties. In the 40 years since, this effect has been used in diverse applications such as the fabrication of relief images in optical elements, micro photolithographic schemes, and for direct imaging by photoinduced Ag surface deposition. ReRAM, also known as conductive bridging RAM (CBRAM), is a resistive switching memory based on non-volatile formation and dissolution of a conductive filament in a solid electrolyte. Especially, Ag-doped chalcogenide glasses and thin films have become attractive materials for fundamental research of their structure, properties, and preparation. Ag-doped chalcogenide glasses have been used in the formation of solid electrolyte which is the active medium in ReRAM devices.

In this paper, we investigated the nature of thin films formed by the photo-dissolution of Ag into Ge-Se glasses for use in ReRAM devices. These devices rely on ion transport in the film so produced to create electrically programmable resistance states. [1-3]

We have demonstrated functionalities of Ag doped chalcogenide glasses based on their capabilities as solid electrolytes. Formation of such amorphous systems by the introduction of Ag^+ ions photo-induced diffusion in thin chalcogenide films is considered. The influence of Ag^+ ions is regarded in terms of diffusion kinetics and Ag saturation is related to the composition of the hosting material. Saturated Ag^+ ions have been used in the formation of conductive filaments at the solid electrolyte which is the active medium in ReRAM devices.

Following fabrication, the cell displays a metal-insulator-metal structure. We measured the I-V characteristics of a cell, similar results were obtained with different via sizes, due to the filamentary nature of resistance switching in ReRAM cell. As the voltage is swept from 0 V to a positive top electrode voltage, the device switches from a high resistive to a low resistive, or set. The low conducting, or reset, state can be restored by means of a negative voltage sweep where the switch-off of the device usually occurs.

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