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Electrical Properties of Metal-Oxide Quantum dot Hybrid Resistance Memory after 0.2-MeV-electron Beam Irradiation

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The resistance switching memory devices have several advantages to take breakthrough for the limitation of operation speed, retention, and device scale. Especially, the metal-oxide materials such as ZnO are able to fabricate on the flexible and visible transparent plastic substrate. Also, the quantum dots (QDs) embedded in dielectric layer could be improve the ratio between the low and the high resistance becauseof their Coulomb blockade, carrier trap and induced filament path formation. In this study, we irradiated 0.2-MeV-electron beam on the ZnO/QDs/ZnO structure to control the defect and oxygen vacancy of ZnO layer. The metal-oxide QDs embedded in ZnO layer on Pt/glass substrate were fabricated for a memory device and evaluated electrical properties after 0.2-MeV-electron beam irradiations. To formation bottom electrode, the Pt layer (200 nm) was deposited on the glass substrate by direct current sputter. The ZnO layer (100 nm) was deposited by ultra-high vacuum radio frequency sputter at base pressure 1×10^{-10} Torr. And then, the metal-oxide QDs on the ZnO layer were created by thermal annealing. Finally, the ZnO layer (100 nm) also was deposited by ultra-high vacuum sputter. Before the formation top electrode, 0.2 MeV liner accelerated electron beams with flux of 1×10^{13} and 10^{14} electrons/cm^2 were irradiated. We will discuss the electrical properties and the physical relationships among the irradiation condition, the dislocation density and mechanism of resistive switching in the hybrid memory device.

Keywords: Memory, Electron beam, ZnO, Quantum dot