Scalable Non-Volatile Cross-Point Memory Technology based on Oxide Dual-Layer Memory Elements

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Abstract - We report a nonvolatile cross-point memory technology based on a dual oxide layer as the active memory element. The resistance change memory element is formed by a noble metal and a conductive metal oxide separated by an oxide tunnel barrier. A variation of the tunnel barrier thickness allows control of the nominal current density and is targeted to meet the cell requirements for a high density cross-point architecture. Excellent scaling of program and erase current with electrode area and a continuous transition between program and erase state indicate that a uniform rather than a filamentary switching mechanism controls the device current both in the high and the low resistive state. A prior forming step is not required.

The observed resistance change is caused by the exchange of oxygen ions between the conductive metal oxide and the tunnel oxide. Ion motion at room temperature is enabled by an increase of the ion mobility under high electric fields during program and erase operation. Change in device resistance is explained by a change in the tunneling current due to an increase/decrease in effective tunnel barrier height. The barrier height varies as a function of oxygen ions moving into or out of the tunnel barrier and the consequent change in charge within the barrier.