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Transport Physics Mechanisms in Thin-Film Oxides[1]**.** BRIAN D. TIERNEY, HAROLD P. HJALMARSON, ROBIN B. JACOBS-GEDRIM, CONRAD D. JAMES, MATTHEW M. MARINELLA, Sandia National Laboratories —
A physics-based model of electron transport mechanisms in metal-insulating oxide-metal (M-I-M) systems is presented focusing on transport through the metal-oxide interfaces and in the bulk of the oxide. Interface tunneling, such as electron tunneling between the metal and the conduction band, or to oxide defect states, is accounted for via a WKB model. The effects of thermionic emission are also included. In the bulk of the oxide, defect-site hopping is dominant. Corresponding continuum calculations are performed for Ta_2O_5 M-I-M systems utilizing two different metal electrodes, e.g., platinum and tantalum. Such an asymmetrical M-I-M structure, applicable to resistive memory applications or oxide-based capacitors, reveals that the current can be either bulk or interface limited depending on the bias polarity and concentration of oxygen vacancy defects. Also, the dominance of some transport mechanisms over others is shown to be due to a complex interdependence between the vacancy concentration and bias polarity.

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