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Ion-induced quantum transport in ultrathin amorphous silicon dioxide films[1] NIKOLAI SERGUEEV, YEVGENIY PUZYREV, Vanderbilt University, MATTHEW BECK, Vanderbilt University, University of Kentucky, KALMAN VARGA, RON SCHRIMPF, DAN FLEETWOOD, Vanderbilt University, SOKRATES PANTELIDES, Vanderbilt University, Oak Ridge National Laboratory — Heavy-ion beams impinging on electronic devices are known to produce conducting paths in oxide thin films. Here we report the results of first-principles calculations of the effect of ion-induced atomic displacements on the current-voltage characteristics of ultrathin oxides. We use density functional theory and the recently developed "Source and Sink" method to calculate currents in defected amorphous silicon dioxide layers sandwiched between two Al electrodes. The resulting current-voltage characteristics show significant enhancement of the electron tunneling and are found to depend on both the spatial distribution of ion-induced defects and the distribution of the defect energy levels in the oxide band gap. The quantum transport results are used to define a percolation model using Mott defect-to-defect tunneling. The calculated currents are in agreement with experimental data.

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