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**Oxygen vacancy mediated dielectric breakdown in ultrathin high-k gate dielectric stacks** BLANKA MAGYARI-KOPE, YOSHIO NISHI, Stanford University — The reliability of the high-k gate stack becomes a significant challenge with the continuous scaling of the metal-oxide-semiconductor-field-effect-transistors, due to deposition techniques of ultrathin oxides and defects in the gate stack. One of the key problems associated with ultrathin oxide layers is the degradation of the gate oxides under electrical stress, due to traps generated by oxygen vacancies present in these materials. First principles methods based on density functional theory combined with non-equilibrium Green's function calculations are employed to calculate the tunneling current through ultrathin oxide layers of $HfO_2$ and $SiO_2$ in a gate stack structure with TiN metal electrode. Model systems that incorporate the atomistic description of a conductive filament formation due to ordering of oxygen vacancies in the oxide layers and the oxide-oxide interface of the gate stack were investigated. The microscopic effects of defects ordering on the electronic transport through the gate oxides are analyzed and discussed.

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