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Charge carrier trapping into mobile, ionic defects in nanoporous ultra-low-k dielectric materials[1] JOEL PLAWSKY, JUAN BORJA, TOH-MING LU, WILLIAM GILL, Rensselaer Polytyechnic Institute — Reliability and robustness of low-k materials for advanced interconnects has become a major challenge for the continuous down-scaling of silicon semiconductor devices. Metal catalyzed time dependent breakdown (TDDB) is a major force preventing the integration of sub-32nm process technology nodes. We investigate how ionic species can become trapping centers (mobile defects) for charge carriers. A mechanism for describing and quantifying the trapping of charge carriers into mobile ions under bias and temperature stress is presented and experimentally investigated. The dynamics of trapping into ionic centers are severely impacted by temperature and species mass transport. After extended bias and temperature stress, the magnitude of charge trapping into ionic centers decreases asymptotically. Various processes such as the reduction of ionic species, moisture outgassing, and the inhibition of ionic drift via the distortion of local fields were investigated as possible cause for the reduction in charge trapping. Simulations suggest that built-in fields reduce the effect of an externally applied field in directing ionic drift, which can lead to the inhibition of the trapping mechanism. In addition, conduction mechanisms are investigated for reactive and inert electrodes.

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