Reliability Projection and Polarity Dependence of TDDB for Ultra Thin CVD HfO$_2$ Gate Dielectrics

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Abstract

A systematic study of long-term reliability of ultra thin CVD HfO$_2$ gate stack (EOT=10.5Å) with TaN gate electrode is presented. The polarity and area dependence and temperature acceleration of time-to-breakdown ($T_{BD}$), defect generation rate, and critical defect density are studied. It is found that $T_{BD}$ is polarity-independent ($T_{BD,-V_g}=T_{BD,+V_g}$). After temperature acceleration of 150ºC, area scaling to 0.1cm$^2$, and the projection to low percentage failure rate of 0.01%, the maximum operating voltages are projected to be $V_g=0.6V$ for EOT $=8.6Å$ and $V_g=0.75V$ for EOT $=10.6Å$. 