MBE and ALD grown High k Dielectrics Gate Stacks on GaN

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compound semiconductors are attractive for high-temperature and high-power
MOSFET applications due to their intrinsic properties of wide band gap, high
breakdown field, and high saturation velocity under high fields. In this work GaN-based
high k MOS diodes were fabricated using MBE-grown Ga$_2$O$_3$(Gd$_2$O$_3$), MBE-grown
HfO$_2$ and ALD-grown HfO$_2$ as the gate dielectrics with dielectric constants of 14.7,
17.4 and 16.5, respectively. All MOS diodes exhibited low leakage (\(<10^{-6} \text{ A/cm}^2\)
at $V_{fb}+1$) and well behaved capacitance-voltage curves with a low interfacial density of
states of $\sim10^{11} \text{ cm}^{-2}\text{eV}^{-1}$. Energy-band diagrams of the MOS structures have been
determined by extracting valance-band offset ($\Delta E_V$) from HR-XPS and with the
bandgaps of the oxides. For example, the ALD-grown HfO$_2$-GaN at the interfaces
gave approximately $\Delta E_C$ and $\Delta E_V$ of 1.2 eV and 1.1 eV, respectively.

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