Gate Oxide Sentaurus Model for Wide-bandgap Devices

Motivation:
• Wide-bandgap (WBG) devices offer system level benefits to power conversion systems (PCS) for grid-tied energy storage systems (ESS)

Objective:
• Reliability is achieved through stability on the atomic level, therefore need cohesive materials, capable of operating under high-stress environments, for WBG devices (SiC, GaN)
• Weak-link for WBG MOSFETs is the gate oxide. Desire high quality oxide material(s) \( \rightarrow \) low interface state density \( (D_{it}) \)
• Validate measured \( D_{it} \) using a TCAD spatial solver to simulate the MgO/GaN material stack of experimental MOSCAP structures

Accomplishments:
• Reproduced measured \( D_{it} \) via device-level MOSCAP models for \( \text{Al}_2\text{O}_3 \) & MgO
• Parameter script and command files created for Sentaurus material library
• Confirms most effective gate oxide on GaN to date

Potential Impact:
• Offers reliable, intimate control for more robust PCS for ESS material
• Predictive-analysis, simulation-first approach for exploration of new gate oxide materials on WBG semiconductors

<table>
<thead>
<tr>
<th>10 kW - Cost Comparison</th>
<th>Silicon</th>
<th>WBG</th>
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</thead>
<tbody>
<tr>
<td>Semiconductors</td>
<td>5% of BOM</td>
<td>18% of BOM</td>
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<tr>
<td>Total System</td>
<td>$161.40</td>
<td>$137.19 (15% less)</td>
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