



SiC Power Device Fabrication: Making the Transition from Silicon

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In an increasingly electrified technology driven world, power electronics is central to the entire manufacturing economy. Silicon (Si) power devices have dominated power electronics due to their low cost volume production, excellent starting material quality, ease of processing, and proven reliability. Although Si power devices continue to make significant progress, they are approaching their operational limits primarily due to their relatively low bandgap and critical electric field that result in high conduction and switching losses, and poor high temperature performance.

In this presentation, the favorable material properties of Silicon Carbide (SiC), which allow for highly efficient power devices with reduced form factor and reduced cooling requirements, will be highlighted. High impact application opportunities, where SiC devices are expected to displace their incumbent Si counterparts, will be discussed. These include variable frequency drives for efficient high power electric motors at reduced overall system cost; automotive and rail power electronics with reduced losses and reduced cooling requirements; novel data center topologies with reduced cooling loads and higher efficiencies; "more electric aerospace" with weight, volume, and cooling system reductions contributing to energy savings; and more efficient, flexible, and reliable grid applications with reduced system footprint.

Foundry considerations and cost reduction strategies will be emphasized elucidating the path to the projected \$1B SiC device market by 2022. Device fabrication aspects will be outlined with an emphasis on the processes that do not carry over from the mature Si manufacturing world and are thus specific to SiC. In particular, the presentation will stress the design and fabrication of SiC MOSFETs that are presently being inserted in the majority of SiC based power electronic systems.