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Short Circuit Analysis of Trench Gate Silicon Carbide MOSFET

This paper presents an in-depth analysis of the short-circuit behavior of 600V Trench Gate Silicon Carbide (SiC) MOSFETs using TCAD software Silvaco, which are increasingly utilized in high-power and high-temperature applications due to their superior material properties. The unique trench gate structure of SiC MOSFETs contributes to enhanced electric field distribution, lower on-resistance, and improved breakdown voltage, making them particularly resilient in extreme operating conditions. However, under short-circuit scenarios, these devices are subjected to rapid current surges and significant thermal stress, which can lead to potential failure if not properly managed. In order to combat this issue, a p-layer has been incorporated in the drift region. It has been found that short circuit time has been increased from the 3us to 12 us while restraining the current to below 10%. The study also discusses potential mitigation strategies, including gate drive optimization and thermal management techniques, to enhance the reliability and performance of SiC MOSFETs in demanding power electronics applications. Through this investigation, the findings aim to contribute to the design of more resilient SiC-based power devices, ensuring their safe operation in high-stress environments.

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