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POWER DEVICES WITH IMPROVED ON-RESISTANCE

A power device arrangement has been developed that increases short-circuit withstand time by decreasing gate oxide thickness and gate drive voltage, without negatively affecting normal operational parameters.

Researchers at Purdue University have developed a power device arrangement that mitigates short circuit conditions without sacrificing normal operational parameters. Short circuit in a device like a power metal oxide semiconductor field effect transistor (MOSFET) can be caused if the load resistance suddenly drops. The power device is subjected to high voltage of the supply and high current. Power electronic circuits generally include a short circuit protection scheme, but this takes 1-10 microseconds to complete. The Purdue researchers found that a decrease in gate oxide thickness to 5â€“20 nm and a decrease in the gate drive voltage decreases the saturation (short-circuit) current without increasing the on-resistance or the switching loss. Decreasing the oxide thickness increases the short-circuit withstand time; the researchers estimated 10â€“20 microseconds withstand time at a gate oxide thickness of 12 nm. The researchers created a design space involving parameters like oxide thickness, channel thickness, and gate drive voltage to maintain reliability of the gate insulator, minimize the saturation current, and prevent drain-induced barrier lowering.

Technology Validation: At a gate oxide thickness of 12 nm, the researchers estimated the short circuit withstand time of a MOSFET at 10â€“20 microseconds. This has been experimentally verified on SiC power DMOSFETs fabricated at XFAB Texas and measured by independent groups at Texas Tech University and Virginia Tech University.

Advantages

- Increased short circuit withstand time

Applications

- Design of MOSFETs, IGBTs, and MOS-controlled thyristors

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