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3D Predictive Fatigue Modeling of Power Modules

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Abstract:

As the demand for electric vehicles continues to grow, robust fatigue modeling tools will be a key enabler in the success of power module products and technology. Predictive modeling tools can help predict performance characteristics for customers, optimize design materials/geometries/features to take advantage of the superior characteristics of SiC, estimate fatigue and lifetime, reduce time to market by minimizing testing time and resources, and reduce product cost by minimizing unnecessary over design.

The fundamental challenge of simulating SiC power module characteristics is that they multi-physics problem comprised of several different fields including electrical, mechanical, thermal, chemical, and material science as well as combinations of each. Therefore, the simulation tools must be capable of coupling multi-physics models, boundary conditions, and material properties to accurately predict power module characteristics.

In this presentation, a predictive fatigue model will be presented highlighting tradeoffs highlighting the substrate attach thermal shock life based on sweeping multiple modules parameters.

Curriculum Vitae:

Brandon Passmore completed his B.S. in Electrical Engineering from Arkansas State University in 2003, M.S. in MicroEP in 2005, and Ph.D. in MicroEP in 2008. Brandon has been with Wolfspeed since 2010 where he is a Sr. Hardware Development Engineering Manager leading the Design Engineering Team in the Power Modules BU. At Wolfspeed, his group focuses on developing new SiC power modules rated from 650 V to 1.7 kV and 50 A to 800 A and beyond. In addition, his group has been heavily involved in several projects focused on developing new packaging designs, modeling techniques, materials, and processes to fully optimize the performance of SiC power devices. Some of these technologies include electrical-thermal-mechanical multi-physics modeling, wire bondless technologies, new die attach and substrate technologies, and high heat transfer and advanced cooling technologies for the advancement of high performance SiC power modules.

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