Virtual Experiments with High Power Semiconductor Devices Along and Beyond the Rim of the Safe Operating Area

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Reliability and robustness against harsh operating conditions such as high temperature, hard unclamped switching, irradiation by cosmic particles, or mechanical vibrations are of utmost importance in the design of modern high power semiconductor devices.

Today's challenge is to make virtual experiments and tests on the computer, which are qualitatively correct and quantitatively accurate even for devices that have never been built before, and under operational conditions that very rarely occur as long as the device is kept within the so-called "safe operating area (SOA)". What we are interested in is to explore the rim of the SOA and even to go beyond it in order to study failure and, eventually, destruction mechanisms with a view to improving robustness and reliability of the devices. To this end, predictive high-fidelity computer simulations of "virtual destruction" have to be mastered.

While the physical models (typically energy-domain coupling continuous field models) which underlie the description of the inner life of electronic devices have become more and more elaborate and highly detailed, even under extreme and exceptional operating conditions, the capabilities and the quality of the simulation tools in which they are implemented still needs quite a lot of improvement. We will address these problems with reference to selected real-life examples, leading to a proclamation of improvements to be made towards a more judicious interpretation of numerical simulations w.r.t. accuracy, reliability and, hence, predictiveness.