Preface

The continuous progress in modern power device technology is increasingly supported by power-specific modeling methodologies and dedicated simulation tools. These enable the detailed analysis of operational principles on the the device and on the system level; in particular, they allow the designer to perform trade-off studies by investigating the operation of competing design variants in a very early stage of the development process. Furthermore, using predictive computer simulation makes it possible to analyze the device and system behavior not only under regular operating conditions, but also at the rim of the safe-operating area and beyond of it, where destructive processes occur that limit the lifetime of a power system. Thus, virtual experimentation and virtual test by computer simulations have become an integral part of the design methodology for electronic power devices, modules, and entire components and systems in order to achieve cost-efficient and time-economizing development cycles. This is, in particular, relevant with a view to satisfying all requirements concerning robustness against harsh and exceptional operating conditions ("ruggedness"), long-term reliability, energy efficiency, and cost reduction by increasing integration of multiple functionality in one module.

A successful strategy for "virtual prototyping" of power systems requires modeling methodologies on different levels of abstraction and computational expense. This monography addresses the most important aspects to be focussed on in seven chapters contributed by world-known experts in their field. In the first and fifth chapter state-of-the-art high-voltage device models on the continuous field level and their implementation in numerical simulation are discussed, with emphasis on the consistent treatment of electro-thermally coupled fields and coupled domains. This kind of physically-based modeling is the indispensable prerequisite for predictive "high-fidelity" computer simulations, but computationally very expensive or even prohibitive, so that they cannot be used in a top-down/bottom-up design optimization loop.

It is therefore that over the past decades "order-reduced" compact models have been developed, which are simplified to an extent that the computational cost becomes affordable, but are still phyics-based and, hence, scalable and predictive.

The major part of this book deals with alternative approaches to accurate and efficient high-voltage device compact models as developed during the past years at renowned institutions around the world. While unipolar transport in power

MOSFETs is addressed in Chapters 2–4, distributed macromodels for bipolar transport in IGBTs are presented in Chapter 6.

The book concludes with an example of a modern web-based simulation platform ready for the easy-to-use implementation of the above-discussed compact modeling methodologies.

I feel that this monography may serve as a "catalytic link" between the communities of power device technologists, power electronic engineers, and IC designers in order to produce new synergies in the R&D of power systems, a field with a prosperous future in our high-tech societies.

Technische Universitaet Muenchen Prof. Dr. Gerhard Wachutka

http://www.springer.com/978-90-481-3045-0

POWER/HVMOS Devices Compact Modeling
Grabinski, W.; Gneiting, Th. (Eds.)
2010, XII, 200 p., Hardcover
ISBN: 978-90-481-3045-0