Preface

Silicon carbide MOSFETs have become a key enabling technology for modern power electronic devices. Their electrical characteristics and thermal conductivity enable operation at elevated voltages, temperatures, and frequencies beyond the capabilities of conventional silicon devices. These advantages have accelerated the adoption of SiC MOSFETs in electric vehicles, renewable energy systems, industrial drives, aerospace electronics, and other applications where performance and reliability are paramount.

This special edition is devoted to the research on the durability and long-term performance of SiC-based power components under demanding operating conditions. The edition examines device reliability associated with high-temperature gate bias stress, extreme bias conditions, gate switching stress, and dynamic reverse bias stress, as well as environmental factors such as humidity-induced degradation. Particular emphasis is placed on reliability issues related to threshold voltage degradation, gate oxide stability, bias temperature instability, gate switching instability, and time-dependent dielectric breakdown, which directly affect device lifetime and operational safety.

In addition to individual devices, the reliability of SiC MOSFET power modules was also investigated. The electrothermal interactions and packaging constraints introduce additional challenges. The switching transients, short-circuit robustness, and power cycling capability are discussed in detail, together with methods for lifetime modelling and health assessment. These studies provide critical insight into failure mechanisms and enable the design of more resilient power modules and systems.

This special edition is intended for researchers, engineers and graduate students engaged in the development of advanced wide-bandgap power electronics.

We hope that the research results presented in this edition will support the establishment of reliability analysis methodologies and accelerate the deployment of SiC technologies in applications where long-term stability and operational robustness are essential.