Preface

The rapid development of wide-bandgap semiconductor technologies has transformed the landscape of modern electronics, enabling devices to operate under conditions once beyond the reach of conventional materials. Silicon carbide (SiC) and gallium nitride (GaN) have emerged as the base of this technological revolution due to their exceptional electrical, thermal, and mechanical properties. Their wide band gaps, high breakdown electric fields, superior thermal conductivity, and excellent radiation resistance make them indispensable for power electronics, high-frequency systems, aerospace applications, and use in harsh-environment devices.

This special edition brings together fundamental and applied aspects of semiconductor materials science with advanced device fabrication and characteristics evaluation techniques. Particular attention is devoted to the analysis of radiation-induced defects, carrier removal rates, and charge-carrier lifetimes, which play critical roles in determining the performance and reliability of electronic materials and devices. The diagnostic approaches are explored to provide deeper insight into the physical mechanisms governing material behaviour and final devices.

The edition also addresses features of key stages of device processing, including wafer processing, channel implantation, PN-junction formation, and the fabrication of SiC-MOSFET structures. Electrical characteristics, including breakdown voltage, high-voltage reverse current, and carrier transport properties, are examined in detail, highlighting the relationships among material quality, technological conditions, and device performance. Together, these topics establish a comprehensive framework for understanding how advanced characterisation techniques and precise processing technologies enable the development of modern reliable and high-efficiency semiconductor devices.

By harmoniously integrating recent advances from materials science, semiconductor physics, and electronic engineering, this book is intended to serve as a valuable resource for researchers, engineers, and graduate students working in wide-bandgap semiconductors and power device technology. We hope that the contributions presented herein will support advanced next-generation electronic systems for energy, transportation, and space applications.