Preface

Gallium nitride and related semiconductor materials enable a wide range of novel devices, some of which already improve our everyday life. Examples are full-color video displays, solid-state lighting, and high-definition DVD players. Nanometer-scale nitride semiconductor structures are often at the heart of such applications, allowing for the generation of short-wavelength light ranging from green to blue to ultraviolet. GaN-based devices also enable innovations in high-speed and high-power electronics. Driven by vast consumer markets, research and development of nitride semiconductor devices has experienced tremendous growth worldwide. Recently, advanced software tools have emerged which facilitate the design and understanding of ever more sophisticated device structures. As these trends continue, physics-based nitride device modeling and simulation is expected to gain importance in the coming years.

This is the first book to be published on physical principles, mathematical models, and practical simulation of GaN-based semiconductor devices. It is intended for scientists and engineers who are interested in employing computer simulation for nitride device design and analysis. The book presents the joint effort of more than forty leading researchers. Its first part covers essential material parameters of nitride semiconductors which are crucial ingredients of device models. Some of these material properties are still under investigation, for instance thermal properties of quaternary compounds, which are briefly described in the introduction. Chapters 2 to 5 summarize electronic and optical properties of bulk nitrides, while Chapters 6 to 9 focus on nanometer-scale structures such as quantum wells and quantum dots. The second and main part of the book investigates a broad selection of state-of-the-art devices, from transistors to light-emitting diodes to laser diodes. Several novel device concepts are described in detail, such as optical switches and modulators, as well as vertical-cavity lasers and nanowire lasers. Each chapter provides a background in device theory, plus practical simulation results which offer deep insight into internal device physics. Some of the software packages are available to the public, on a commercial or noncommercial basis.

Nitride Semiconductor Devices: Principles and Simulation. Joachim Piprek (Ed.)

ISBN: 978-3-527-40667-8

I would like to sincerely thank all authors for their contributions to this book. Interested readers are encouraged to contact me or any author with questions or suggestions.

Newark, December 2006 *Joachim Piprek*