

High-Frequency GaN Electronic Devices

Patrick Fay • Debdeep Jena • Paul Maki
Editors

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 Springer

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Preface

GaN and related materials (AlGaN, InGaN) have established themselves as a key material system for RF and microwave power electronics and are vying for the position in low-frequency power electronics applications as well. Perhaps, surprisingly, the material properties of the GaN material family are quite well-matched to the needs of ultrahigh-frequency electronics as well, with high carrier mobilities in polarization-induced 2D electron gases and comparatively high densities of states that enable both large current density and aggressive device scaling for high-frequency operation. However, scaling of conventional device architectures such as the high electron mobility transistor widely used in GaN for RF and microwave power applications is only one of the several possible routes to exceptional high-frequency performance in III-N devices. By leveraging the unique properties of the nitrides along with less conventional physical bases of operation, entirely new classes of devices with significant potential for high-frequency performance are possible. This volume brings together scientists and device engineers working on both aggressively scaled conventional transistors and unconventional high-frequency device concepts in the III-N material system. Device concepts for mm-wave to THz operation based on deeply scaled HEMTs, as well as distributed device designs based on plasma-wave propagation in polarization-induced 2DEG channels, tunneling, and hot-carrier injection are discussed in detail. In addition, advances in the underlying materials science that enable these demonstrations and advancements in metrology that permit the accurate characterization and evaluation of these emerging device concepts are also included. Targeting both academic and industrial researchers looking to push the envelope in GaN-based electronics device research, this book aims to provide readers with a current, comprehensive treatment of device concepts and physical phenomenology suitable for applying GaN and related materials to emerging ultrahigh-frequency applications.

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