

Preface

In the last two decades basic semiconductor research has increasingly focussed attention away from cubic crystal III-V and II-VI compounds toward the “wide-bandgap semiconductors” Ga, Al, In binary and ternary nitrides, and silicon carbide. These smaller anion compounds pack more densely in hexagonal crystals, with the consequence of very high spontaneous and deformation induced electrostatic polarization.

The importance and potential functionality of was rapidly recognized in the late 1990s. In 2000 the Multi-disciplinary University Research Initiative (MURI) of “Polarization Effects in Wide Bandgap Semiconductors” was initiated by the Office of Naval Research to accelerate and consolidate understanding, engineering and device application of the extra electro-physical parameter space. The winning program, “Polaris” by teams centered at UC San Diego, and Cornell University, was one of the most productive in the history of the MURI program, and is testament to the value of sponsored collaborative research so ardently defended by the Director of Defense Research and Engineering (DDR&E) Office of the Secretary of Defense (OSD).

Electronic polarization has profound consequences on the electrostatics and electrodynamics of epitaxial films and heterostructures. Polaris team members developed a comprehensive scientific understanding and made many conceptual advances in polarization-related semiconductor physics. As a result, many electronic and optical devices have been significantly improved and novel devices conceived and realized.

This book is an attempt to ensure that the pioneering advances of the Polaris investigators are collected and expanded to allow efficient recognition and understanding of the many new scientific and engineering principles, considerations and applications developed in the 5 year program.

Each chapter addresses aspects of polarization effects from a different perspective, and for different purposes. There is some overlap in the introductory content in several chapters, albeit each with its own unique flavor. The editors decided to retain this format as it serves to make each chapter self-contained, so that readers

have the option of perusing them independently without loss of continuity, and to guide readers more effectively to the subtle differences in perspectives.

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