

PREFACE

Group III-Nitrides semiconductor materials, including GaN, InN, AlN, InGaN, AlGaN and AlInGaN, i.e. (Al,In,Ga)N, are excellent semiconductors, covering the spectral range from UV to visible and to infrared, with unique properties very suitable for modern electronic and optoelectronic applications. Remarkable breakthroughs have been achieved in recent years for research and development (R&D) in these materials and devices, such as high-power and high brightness blue-green-white light emitting diodes (LEDs) and blue laser diodes (LDs) as well as other optoelectronics and electronics devices and applications. III-Nitrides-based industry is forming up and new economic developments from these materials are promising. It is expected that III-Nitrides-based LEDs might replace the traditional light bulbs to realize a revolution in lightings and change entire human life in this century, similar to Edison's invention of the electric light bulb more than one-hundred year ago.

Recently, I have edited a book, **III-Nitride Semiconductor Materials**, and also published by Imperial College Press, which focused on III-Nitride semiconductor materials. The current is a sister complementary book of above one, focusing more on III-Nitride devices and nanoengineering but containing some materials not covered in the 1st book, such as AlGaIn in Chapter 2.

The developments on these materials and devices are so quickly moving. Many data or knowledge, even just published quite recently, have been modified and needed to upgrade. This new book will cover the rapidly new developments and achievements in the field, in particular those made after entering the 21st century. It will face more to the engineering and materials side, not pure science.

The book is organized for a wide range of audiences and covers each of the basic and critical aspects of III-Nitrides science and technology. Each chapter, written by experts in the field, reviews the

important topics and achievements in recent years, discusses progresses made by different groups, and suggests further works needed. This book provides useful information to the device and nano-scale process, fabrication of LEDs, LDs, photodetectors and nano-devices, characterization, application and development on the III-Nitrides semiconductor devices and nanoengineering.

This book consists of 15 well-written review chapters and the topics of the book include: (1) An overview of the development of major light sources: From light bulbs to solid state lighting, (2) High pressure bulk crystal growth of (Ga,Al)N, (3) Structural and optical investigation of InGaN/GaN multiple quantum well light emitting diodes grown by metalorganic chemical vapor deposition, (4) MOCVD growth and efficiency improvement for ultraviolet light emitting diodes, (5) Fabrication of GaN light emitting diodes by laser-off technique, (6) High-resolution electron microscopy observations of GaN-based laser diodes, (7) Growth and development of III-nitride photodetectors, (8) Laser diodes grown on bulk GaN substrate, (9) III-Nitride lighting emitting diodes on Si, (10) Nitride Microdisplay and Micro-scale Light Emitting Diode Arrays, (11) III-nitride films and devices on Lithium metal oxides by molecular beam epitaxy, (12) III-Nitride light-emitting devices on patterned sapphire substrates, (13) Bandgap engineering of III-nitride devices on low-defect substrates, (14) III-Nitride nano-materials: growth and properties and (15) Recent trends in Indium Nitride nano-materials.

As seen, the current book presents the key properties of III-Nitrides devices and nanoengineering, describes key technologies and demonstrates the remaining challenging issues in nano-material preparation and device fabrication for future R&D in the 21st century. This book can serve well to material growers and evaluators, device design and processing engineers as well as potential users of III-Nitrides technologies, including new comers, postgraduate students, engineers and scientists in the III-Nitrides field.

Zhe Chuan Feng

(Professor in Photonics & Optoelectronics, and Electrical Engineering,
National Taiwan University, and MingDao University)