

MATERIALS SCIENCE

Zhe Chuan Feng (Ed.)

# **SiC Power Materials**

Devices  
and Applications



Springer

# Sic Power Materials And Devices

**S. Jang,K. Shenai,G. W. Hunter,F.  
Ren,C. O'Dwyer,K. Mishra**



## **Sic Power Materials And Devices:**

SiC Power Materials Zhe Chuan Feng, 2004-06-09 In the 1950s Shockley predicted that SiC would quickly replace Si as a result of its superior material properties In many ways he was right and today there is an active industry based on SiC with new achievements being reported every year This book reviews the progress achieved in SiC research and development particularly over the past 10 years It presents the essential properties of 3C 6H and 4H SiC polytypes including structural electrical optical surface and interface properties describes existing key SiC devices and also the challenges in materials growth and device fabrication of the 21st century Overall it provides an up to date reference book suitable for a broad audience of newcomers graduate students and engineers in industrial R D SiC Materials and Devices Michael Shur, Sergey L. Rumyantsev, Mikhail Efimovich Levinshtein, 2006 After many years of research and development silicon carbide has emerged as one of the most important wide band gap semiconductors The first commercial SiC devices OCo power switching Schottky diodes and high temperature MESFETs OCo are now on the market This two volume book gives a comprehensive up to date review of silicon carbide materials properties and devices With contributions by recognized leaders in SiC technology and materials and device research SiC Materials and Devices is essential reading for technologists scientists and engineers who are working on silicon carbide or other wide band gap materials and devices The volumes can also be used as supplementary textbooks for graduate courses on silicon carbide and wide band gap semiconductor technology Contents SiC Material Properties G Pensl et al SiC Homoepitaxy and Heteroepitaxy A S Bakin Ohmic Contacts to SiC F Roccaforte et al Silicon Carbide Schottky Barrier Diode J H Zhao et al High Power SiC PiN Rectifiers R Singh Silicon Carbide Diodes for Microwave Applications K Vassilevski SiC Thyristors M E Levinshtein et al Silicon Carbide Static Induction Transistors G C DeSalvo Readership Technologists scientists engineers and graduate students working on silicon carbide or other wide band gap materials and devices **Handbook of Silicon Carbide Materials and Devices** Zhe Chuan Feng, 2023-05-31 This handbook presents the key properties of silicon carbide SiC the power semiconductor for the 21st century It describes related technologies reports the rapid developments and achievements in recent years and discusses the remaining challenging issues in the field The book consists of 15 chapters beginning with a chapter by Professor W J Choyke the leading authority in the field and is divided into four sections The topics include presolar SiC history vapor liquid solid growth spectroscopic investigations of 3C SiC Si developments and challenges in the 21st century CVD principles and techniques homoepitaxy of 4H SiC cubic SiC grown on 4H SiC SiC thermal oxidation processes and MOS interface Raman scattering NIR luminescent studies Mueller matrix ellipsometry Raman microscopy and imaging 4H SiC UV photodiodes radiation detectors and short wavelength and synchrotron X ray diffraction This comprehensive work provides a strong contribution to the engineering materials and basic science knowledge of the 21st century and will be of interest to material growers designers engineers scientists postgraduate students and entrepreneurs **Sic Materials And Devices -**

**Volume 1** Sergey Rumyantsev, Michael S Shur, Michael E Levinshtein, 2006-07-25 After many years of research and development silicon carbide has emerged as one of the most important wide band gap semiconductors The first commercial SiC devices power switching Schottky diodes and high temperature MESFETs are now on the market This two volume book gives a comprehensive up to date review of silicon carbide materials properties and devices With contributions by recognized leaders in SiC technology and materials and device research SiC Materials and Devices is essential reading for technologists scientists and engineers who are working on silicon carbide or other wide band gap materials and devices The volumes can also be used as supplementary textbooks for graduate courses on silicon carbide and wide band gap semiconductor technology

**SiC Power Materials** Zhe Chuan Feng, 2013-03-14 In the 1950s Shockley predicted that SiC would quickly replace Si as a result of its superior material properties In many ways he was right and today there is an active industry based on SiC with new achievements being reported every year This book reviews the progress achieved in SiC research and development particularly over the past 10 years It presents the essential properties of 3C 6H and 4H SiC polytypes including structural electrical optical surface and interface properties describes existing key SiC devices and also the challenges in materials growth and device fabrication of the 21st century Overall it provides an up to date reference book suitable for a broad audience of newcomers graduate students and engineers in industrial R D

Wide Bandgap Semiconductor Materials and Devices 19 J. Hite, V. Chakrapani, J. Zavada, T. J. Anderson, S. Kilgore, 2018-05-04

Wide Bandgap Semiconductor Materials and Devices 16 S. Jang, K. Shenai, G. W. Hunter, F. Ren, C. O'Dwyer, K. Mishra, 2015

*Advanced Semiconducting Materials and Devices* K.M. Gupta, Nishu Gupta, 2015-08-20 This book presents the latest developments in semiconducting materials and devices providing up to date information on the science processes and applications in the field A wide range of topics are covered including optoelectronic devices metal semiconductor junctions heterojunctions MISFETs LEDs semiconductor lasers photodiodes switching diodes tunnel diodes Gunn diodes solar cells varactor diodes IMPATT diodes and advanced semiconductors Detailed attention is paid to advanced and futuristic materials In addition clear explanations are provided of for example electron theories high field effects the Hall effect transit time effects drift and diffusion breakdown mechanisms equilibrium and transient conditions switching and biasing The book is designed to meet the needs of undergraduate engineering students and will also be very useful for postgraduate students it will assist in preparation for examinations at colleges and universities and for other examinations in engineering Practice questions are therefore presented in both essay and multiple choice format and many solved examples and unsolved problems are included

**Ferroelectric Crystals for Photonic Applications** Pietro Ferraro, Simonetta Grilli, Paolo De Natale, 2008-09-02 The idea to write a new book in the field of ferroelectric crystals arose from some considerations reported in the following In the last 5 years several groups all around the world in the field of engineering and characterization of ferroelectric crystals have published more than 300 papers The motivation for such an intense research activity is referable to the fact that the ferroelectric crystals are

a key element for the most attractive and useful photonic and optoelectronic devices In fact during the 60ies the scientists realized that the ferroelectric crystals could have been ciently used to generate new unavailable frequencies taking advantage of the freshly proposed birefringent phase matching method The synchronized rush for the development of novel coherent sources and for the discovery of the best suited nonlinear crystals for mixing and generation had started Consequently the range of applications of ferroelectric crystals has enormously widened in the last years es cially based on the use of periodically poled structures i e PPLN PPLT PPKTP or PPKTA to quasi phase match optical interactions A new generation of sources is nding increasing applications in various elds including high sensitivity trace gas monitoring and any kind of advanced spectroscopic set ups thus replacing old style gas lasers like Argon ion or dye lasers New possibilities are also being plored to engineer ferroelectric crystals with two or three dimensional geometries Results from this eld will allow developing photonic devices combining photonic band gap properties and nonlinear conversion processes i e nonlinear photonic crystals

Crystallography and the World of Symmetry Sanat K. Chatterjee,2008-09-19 Symmetry exists in realms from crystals to patterns in external shapes of living or non living objects as well as in the fundamental particles and the physical laws that govern them In fact the search for this symmetry is the driving force for the discovery of many fundamental particles and the formulation of many physical laws While one can not imagine a world which is absolutely symmetrical nor can one a world which is absolutely asymmetrical These two aspects of nature are intermingled with each other inseparably This is the basis of the existence of aperiodicity manifested in the liquid crystals and also quasi crystals also discussed in Crystallography and the World of Symmetry

Piezoelectricity Walter Heywang,Karl Lubitz,Wolfram Wersing,2008-11-14 Discovered in 1880 piezoelectric materials play a key role in an innovative market of several billions of dollars Recent advances in applications derive from new materials and their development as well as to new market requirements With the exception of quartz ferroelectric materials are used for they offer both high efficiency and sufficient versatility to meet adequately the multidimensional requirements for application Consequently strong emphasis is placed on tailoring materials and technology whether one deals with single crystals ceramics or plastic materials Tailoring requires a basic understanding of both physical principles and technical possibilities and limitations This report elucidates these developments by a broad spectrum of examples comprising ultrasound in medicine and defence industry frequency control signal processing by SAW devices sensors actuators including novel valves for modern motor management It delivers a mutual fertilization of technology push and market pull that should be of interest not only to materials scientists or engineers but also to managers who dedicate themselves to a sound future oriented R D policy

**Organic Semiconductors in Sensor Applications** Daniel A. Bernards,Róisín M. Owens,George G. Malliaras,2008-02-22 Organic semiconductors offer unique characteristics which have prompted the application of organic semiconductors and their devices in physical chemical and biological sensors This book covers this emerging field by discussing both optically and electrically based sensor

concepts Novel transducers based on organic light emitting diodes and organic thin film transistors as well as systems on a chip architectures are presented Functionalization techniques are also outlined **Gallium Nitride Electronics** Rüdiger Quay, 2008-04-05 This book is based on nearly a decade of materials and electronics research at the leading research institution on the nitride topic in Europe It is a comprehensive monograph and tutorial that will be of interest to graduate students of electrical engineering communication engineering and physics to materials device and circuit engineers in research and industry to all scientists with a general interest in advanced electronics Molecular Catalysts for Energy Conversion Tatsuhiro Okada, Masao Kaneko, 2008-10-10 Over the past decade the topic of energy and environment has been acknowledged among many people as a critical issue to be solved in 21st century since the Kyoto Protocol came into effect in 1997 Its political recognition was put forward especially at Heiligendamm in 2007 when the effect of carbon dioxide emission and its hazard in global climate were discussed and shared universally as common knowledge

Controlling the global warming in the economical framework of massive development worldwide through this new century is a very challenging problem not only among political economical or social circles but also among technological or scientific communities As long as the humans depend on the combustion of fossil for energy resources the waste heat exhaustion and CO emission are inevitable 2 In order to establish a new era of energy saving and environment benign society which is supported by technologies and with social consensus it is important to seek for a framework where new clean energy system is incorporated as infrastructure for industry and human activities Such a society strongly needs innovative technologies of least CO emission and efficient energy conversion and utilization from remaining fossil energies on the Earth Energy recycling system utilizing natural renewable energies and their conversion to hydrogen may be the most desirable option of future clean energy society Thus the society should strive to change its energy basis from fossil consuming energy to clean and recycling energy *Extended Defects in Germanium* Cor Claeys, Eddy Simoen, 2008-12-29 The aim is to give an overview of the physics of extended defects in Germanium i.e. dislocations line defects grain boundaries stacking faults twins and 311 defects two dimensional defects and precipitates bubbles etc The first part covers fundamentals describing the crystallographic structure and other physical and electrical properties mainly of dislocations Since dislocations are essential for the plastic deformation of Germanium methods for analysis and imaging of dislocations and to evaluate their structure are described Attention is given to the electrical and optical properties which are important for devices made in dislocated Ge The second part treats the creation of extended defects during wafer and device processing Issues are addressed such as defect formation during ion implantation necessary to create junctions which are an essential part in every device type Extended defects are also created during the deposition of thin or thick epitaxial layers on other substrates which are important for optoelectronic and photovoltaic applications In brief the book is intended to provide a fundamental understanding of the extended defect formation during Ge materials and device processing providing ways to distinguish

harmful from less detrimental defects and should point out ways for defect engineering and control

**Reactive Sputter Deposition** Diederik Depla, Stijn Mahieu, 2008-06-24 The most straightforward method to change the surface properties of a material is to deposit a thin film or coating on it. Hence it is not surprising that an overwhelming amount of scientific and technical papers is published each year on this topic. Sputter deposition is one of the many so-called physical vapour deposition (PVD) techniques. In most cases sputter deposition uses a magnetically enhanced glow discharge or magnetron discharge to produce the ions which bombard and sputter the cathode material. In the first chapter of this book (Chap 1) the details of the sputter process are discussed. Essential to sustain the discharge is the electron emission during ion bombardment. Indeed the emitted electrons are accelerated from the target and can ionize gas atoms. The formed ions bombard again the target completing the sustaining process. A complete chapter is assigned to this process to highlight its importance. Chap 2 Although the sustaining process can be described quite straightforward a complete understanding of the magnetron discharge and the influence of different parameters on the discharge characteristics is only possible by modelling (see Chap 3). With these three chapters the reader should be able to form an idea of the target and plasma processes occurring during a DC magnetron discharge.

The Physics of Organic Superconductors and Conductors Andrei Lebed, 2008-03-26 This bang up to date volume contains the distilled wisdom of some of the world's leading minds on the subject. Inside there is a treasure trove of general tutorial and topical reviews written by leading researchers in the area of organic superconductors and conductors. The papers hail from all over the world as far afield as the USA and Australia. They cover contemporary topics such as unconventional superconductivity, non-Fermi liquid properties and the quantum Hall effect.

*Into The Nano Era* Howard Huff, 2008-09-14 Even as we enter the nanotechnology era we are now encountering the 50th anniversary of the invention of the IC. Will silicon continue to be the pre-eminent material and will Moore's Law continue unabated albeit in a broader economic venue in the nanotechnology era. This monograph addresses these issues by a re-examination of the scientific and technological foundations of the microelectronics era. By better assessing and understanding the past five decades of this era it is proposed that a firmer foundation can be laid for the research that will ensue and possibly provide a glimpse of what is next to come in the nanotechnology era.

*Evolution of Thin Film Morphology* Matthew Pelliccione, Toh-Ming Lu, 2008-01-29 The focus of this book is on modeling and simulations used in research on the morphological evolution during film growth. The authors emphasize the detailed mathematical formulation of the problem. The book will enable readers themselves to set up a computational program to investigate specific topics of interest in thin film deposition. It will benefit those working in any discipline that requires an understanding of thin film growth processes.

*Lithium Niobate* Tatyana Volk, Manfred Wöhlecke, 2008-09-13 This book covers new research on LiNbO<sub>3</sub> including current studies on intrinsic and extrinsic point defects and the contribution of intrinsic defects to photoinduced charge transport. Applications of this material are also discussed.

## Enjoying the Song of Appearance: An Psychological Symphony within **Sic Power Materials And Devices**

In a global used by displays and the ceaseless chatter of instantaneous transmission, the melodic elegance and emotional symphony created by the written term frequently fade in to the backdrop, eclipsed by the constant sound and disruptions that permeate our lives. However, located within the pages of **Sic Power Materials And Devices** a charming fictional value overflowing with raw thoughts, lies an immersive symphony waiting to be embraced. Constructed by an outstanding composer of language, this interesting masterpiece conducts viewers on a mental trip, skillfully unraveling the concealed songs and profound influence resonating within each cautiously crafted phrase. Within the depths of the touching review, we will investigate the book is main harmonies, analyze its enthralling publishing design, and surrender ourselves to the profound resonance that echoes in the depths of readers souls.

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