



# SEMICONDUCTOR MATERIAL AND DEVICE CHARACTERIZATION

THIRD EDITION

DIETER K. SCHRODER

# Semiconductor Material And Device Characterization

**Dieter K. Schroder, Janet L. Benton, P.  
Rai-Choudhury**



## **Semiconductor Material And Device Characterization:**

Semiconductor Material and Device Characterization Dieter K. Schroder, 2006-02-10 This Third Edition updates a landmark text with the latest findings The Third Edition of the internationally lauded Semiconductor Material and Device Characterization brings the text fully up to date with the latest developments in the field and includes new pedagogical tools to assist readers Not only does the Third Edition set forth all the latest measurement techniques but it also examines new interpretations and new applications of existing techniques Semiconductor Material and Device Characterization remains the sole text dedicated to characterization techniques for measuring semiconductor materials and devices Coverage includes the full range of electrical and optical characterization methods including the more specialized chemical and physical techniques Readers familiar with the previous two editions will discover a thoroughly revised and updated Third Edition including Updated and revised figures and examples reflecting the most current data and information 260 new references offering access to the latest research and discussions in specialized topics New problems and review questions at the end of each chapter to test readers understanding of the material In addition readers will find fully updated and revised sections in each chapter Plus two new chapters have been added Charge Based and Probe Characterization introduces charge based measurement and Kelvin probes This chapter also examines probe based measurements including scanning capacitance scanning Kelvin force scanning spreading resistance and ballistic electron emission microscopy Reliability and Failure Analysis examines failure times and distribution functions and discusses electromigration hot carriers gate oxide integrity negative bias temperature instability stress induced leakage current and electrostatic discharge Written by an internationally recognized authority in the field Semiconductor Material and Device Characterization remains essential reading for graduate students as well as for professionals working in the field of semiconductor devices and materials An Instructor s Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department

Semiconductor Material and Device Characterization Dieter K. Schroder, 2015-06-29 This Third Edition updates a landmark text with the latest findings The Third Edition of the internationally lauded Semiconductor Material and Device Characterization brings the text fully up to date with the latest developments in the field and includes new pedagogical tools to assist readers Not only does the Third Edition set forth all the latest measurement techniques but it also examines new interpretations and new applications of existing techniques Semiconductor Material and Device Characterization remains the sole text dedicated to characterization techniques for measuring semiconductor materials and devices Coverage includes the full range of electrical and optical characterization methods including the more specialized chemical and physical techniques Readers familiar with the previous two editions will discover a thoroughly revised and updated Third Edition including Updated and revised figures and examples reflecting the most current data and information 260 new references offering access to the latest research and discussions in specialized topics New problems and review questions at the end of each

chapter to test readers understanding of the material In addition readers will find fully updated and revised sections in each chapter Plus two new chapters have been added Charge Based and Probe Characterization introduces charge based measurement and Kelvin probes This chapter also examines probe based measurements including scanning capacitance scanning Kelvin force scanning spreading resistance and ballistic electron emission microscopy Reliability and Failure Analysis examines failure times and distribution functions and discusses electromigration hot carriers gate oxide integrity negative bias temperature instability stress induced leakage current and electrostatic discharge Written by an internationally recognized authority in the field Semiconductor Material and Device Characterization remains essential reading for graduate students as well as for professionals working in the field of semiconductor devices and materials An Instructor s Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department

**Semiconductor Material and Device Characterization** Schroder,1998-12-01      Analytical and Diagnostic Techniques for Semiconductor Materials, Devices, and Processes 7 Dieter K. Schroder,2007 Diagnostic characterization techniques for semiconductor materials devices and device processing are addressed at this symposium It will cover new techniques as well as advances in routine analytical technology applied to semiconductor process development and manufacture The hardcover edition includes a CD ROM of ECS Transactions Volume 10 Issue 1 Analytical Techniques for Semiconductor Materials and Process Characterization 5 ALTECH 2007 The PDF edition also includes the ALTECH 2007 papers

**Defects in Microelectronic Materials and Devices** Daniel M. Fleetwood,Ronald D. Schrimpf,2008-11-19 Uncover the Defects that Compromise Performance and ReliabilityAs microelectronics features and devices become smaller and more complex it is critical that engineers and technologists completely understand how components can be damaged during the increasingly complicated fabrication processes required to produce them A comprehensive survey of defe

**Proceedings of the Symposium on Diagnostic Techniques for Semiconductor Materials and Devices** Dieter K. Schroder,Janet L. Benton,P. Rai-Choudhury,1994      *Analytical and Diagnostic Techniques for Semiconductor Materials, Devices and Processes* Bernd O. Kolbesen (Chemiker.),1999      *Semiconductor Materials* B.G. Yacobi,2006-04-18 The technological progress is closely related to the developments of various materials and tools made of those materials Even the different ages have been defined in relation to the materials used Some of the major attributes of the present day age i e the electronic materials age are such common tools as computers and fiber optic telecommunication systems in which semiconductor materials provide vital components for various mic electronic and optoelectronic devices in applications such as computing memory storage and communication The field of semiconductors encompasses a variety of disciplines This book is not intended to provide a comprehensive description of a wide range of semiconductor properties or of a continually increasing number of the semiconductor device applications Rather the main purpose of this book is to provide an introductory perspective on the basic principles of semiconductor materials and their applications that are described in a

relatively concise format in a single volume Thus this book should especially be suitable as an introductory text for a single course on semiconductor materials that may be taken by both undergraduate and graduate engineering students This book should also be useful as a concise reference on semiconductor materials for researchers working in a wide variety of fields in physical and engineering sciences

**Analytical and Diagnostic Techniques for Semiconductor Materials, Devices, and Processes** Bernd O. Kolbesen, 2003 ALTECH 2003 was Symposium J1 held at the 203rd Meeting of the Electrochemical Society in Paris France from April 27 to May 2 2003 Symposium M1 Diagnostic Techniques for Semiconductor Materials and Devices was part of the 202nd Meeting of the Electrochemical Society held in Salt Lake City Utah from October 21 to 25 2002 p iii

*Dopants and Defects in Semiconductors, Second Edition* Matthew D. McCluskey, Eugene E. Haller, 2018-02-19 Praise for the First Edition The book goes beyond the usual textbook in that it provides more specific examples of real world defect physics an easy reading broad introductory overview of the field Materials Today well written with clear lucid explanations Chemistry World This revised edition provides the most complete up to date coverage of the fundamental knowledge of semiconductors including a new chapter that expands on the latest technology and applications of semiconductors In addition to inclusion of additional chapter problems and worked examples it provides more detail on solid state lighting LEDs and laser diodes The authors have achieved a unified overview of dopants and defects offering a solid foundation for experimental methods and the theory of defects in semiconductors Matthew D McCluskey is a professor in the Department of Physics and Astronomy and Materials Science Program at Washington State University WSU Pullman Washington He received a Physics Ph D from the University of California UC Berkeley Eugene E Haller is a professor emeritus at the University of California Berkeley and a member of the National Academy of Engineering He received a Ph D in Solid State and Applied Physics from the University of Basel Switzerland

**Fundamentals of Photonics** Bahaa E. A. Saleh, Malvin Carl Teich, 2020-03-04 Fundamentals of Photonics A complete thoroughly updated full color third edition Fundamentals of Photonics Third Edition is a self contained and up to date introductory level textbook that thoroughly surveys this rapidly expanding area of engineering and applied physics Featuring a blend of theory and applications coverage includes detailed accounts of the primary theories of light including ray optics wave optics electromagnetic optics and photon optics as well as the interaction of light and matter Presented at increasing levels of complexity preliminary sections build toward more advanced topics such as Fourier optics and holography photonic crystal optics guided wave and fiber optics LEDs and lasers acousto optic and electro optic devices nonlinear optical devices ultrafast optics optical interconnects and switches and optical fiber communications The third edition features an entirely new chapter on the optics of metals and plasmonic devices Each chapter contains highlighted equations exercises problems summaries and selected reading lists Examples of real systems are included to emphasize the concepts governing applications of current interest Each of the twenty four chapters of the second edition has been thoroughly updated

**Radiation Effects in Advanced**

**Semiconductor Materials and Devices** C. Claeys, E. Simoen, 2013-11-11 In the modern semiconductor industry there is a growing need to understand and combat potential radiation damage problems Space applications are an obvious case but beyond that today's device and circuit fabrication rely on increasing numbers of processing steps that involve an aggressive environment where inadvertent radiation damage can occur This book is both aimed at post graduate researchers seeking an overview of the field and will also be immensely useful for nuclear and space engineers and even process engineers A background knowledge of semiconductor and device physics is assumed but the basic concepts are all briefly summarized Finally the book outlines the shortcomings of present experimental and modeling techniques and gives an outlook on future developments

**Wide-Bandgap Semiconductor Materials and Devices 11 -and- State-of-the-Art Program on Compound Semiconductors 52 (SOTAPOCS 52)** J. Kim, 2010-04 This issue of ECS Transactions focuses on issues pertinent to development of wide bandgap semiconductor materials and device applications inorganic wide bandgap semiconductor materials including III nitrides II oxides SiC diamond II VI and emerging materials

*Metal-Dielectric Interfaces in Gigascale Electronics* Ming He, Toh-Ming Lu, 2012-02-02 Metal dielectric interfaces are ubiquitous in modern electronics As advanced gigascale electronic devices continue to shrink the stability of these interfaces is becoming an increasingly important issue that has a profound impact on the operational reliability of these devices In this book the authors present the basic science underlying the thermal and electrical stability of metal dielectric interfaces and its relationship to the operation of advanced interconnect systems in gigascale electronics Interface phenomena including chemical reactions between metals and dielectrics metallic atom diffusion and ion drift are discussed based on fundamental physical and chemical principles Schematic diagrams are provided throughout the book to illustrate interface phenomena and the principles that govern them Metal Dielectric Interfaces in Gigascale Electronics provides a unifying approach to the diverse and sometimes contradictory test results that are reported in the literature on metal dielectric interfaces The goal is to provide readers with a clear account of the relationship between interface science and its applications in interconnect structures The material presented here will also be of interest to those engaged in field effect transistor and memristor device research as well as university researchers and industrial scientists working in the areas of electronic materials processing semiconductor manufacturing memory chips and IC design

*Dopants and Defects in Semiconductors* Matthew D. McCluskey, Eugene E. Haller, 2012-02-23 Dopants and Defects in Semiconductors covers the theory experimentation and identification of impurities dopants and intrinsic defects in semiconductors The book fills a crucial gap between solid state physics and more specialized course texts The authors first present introductory concepts including basic semiconductor theory defect classifications crystal growth and doping They then explain electrical vibrational optical and thermal properties Moving on to characterization approaches the text concludes with chapters on the measurement of electrical properties optical spectroscopy particle beam methods and microscopy By treating dopants and defects in semiconductors as a unified

subject this book helps define the field and prepares students for work in technologically important areas. It provides students with a solid foundation in both experimental methods and the theory of defects in semiconductors. *Principles of Semiconductor Devices* Sima Dimitrijevic, 2012. The dimensions of modern semiconductor devices are reduced to the point where classical semiconductor theory including the concepts of continuous particle concentration and continuous current becomes questionable. Further questions relate to two dimensional transport in the most important field effect devices and one dimensional transport in nanowires and carbon nanotubes. Designed for upper level undergraduate and graduate courses *Principles of Semiconductor Devices* Second Edition presents the semiconductor physics and device principles in a way that upgrades classical semiconductor theory and enables proper interpretations of numerous quantum effects in modern devices. The semiconductor theory is directly linked to practical applications including the links to the SPICE models and parameters that are commonly used during circuit design. The text is divided into three parts. Part I explains semiconductor physics. Part II presents the principles of operation and modeling of the fundamental junctions and transistors and Part III provides supplementary topics including a dedicated chapter on the physics of nanoscale devices, description of the SPICE models and equivalent circuits that are needed for circuit design, introductions to the most important specific devices: photonic devices, JFETs and MESFETs, negative resistance diodes and power devices and an overview of integrated circuit technologies. The chapters and the sections in each chapter are organized so as to enable instructors to select more rigorous and design related topics as they see fit. **Semiconductors and Electronic Materials** Andreas Mandelis, Peter Hess, 2000.

Semiconductors and electronic materials have benefitted from photoacoustic and photothermal techniques since the late 1970s. This volume the fourth in a series on photothermal and photoacoustic science and technology PPST presents a comprehensive review of the diverse progress made in PPST of semiconductors and electronic materials during the 1990s. The 10 chapters review leading research activities in several subfields of PPST. These include applications of novel analytical and/or experimental techniques to traditional semiconductor materials and devices as well as applications of conventional techniques to novel materials and devices. As with other volumes in the series this text is useful as a reference for practising scientists and engineers and as a supplement to upper level graduate courses in various areas of PPST and its subfields.

*Handbook of Semiconductor Manufacturing Technology* Yoshio Nishi, Robert Doering, 2017-12-19. Retaining the comprehensive and in depth approach that cemented the bestselling first edition's place as a standard reference in the field the *Handbook of Semiconductor Manufacturing Technology* Second Edition features new and updated material that keeps it at the vanguard of today's most dynamic and rapidly growing field. Iconic experts Robert Doering and Yoshio Nishi have again assembled a team of the world's leading specialists in every area of semiconductor manufacturing to provide the most reliable authoritative and industry leading information available. Stay Current with the Latest Technologies. In addition to updates to nearly every existing chapter this edition features five entirely new contributions on Silicon on insulator SOI.

materials and devices Supercritical CO<sub>2</sub> in semiconductor cleaning Low dielectrics Atomic layer deposition Damascene copper electroplating Effects of terrestrial radiation on integrated circuits ICs Reflecting rapid progress in many areas several chapters were heavily revised and updated and in some cases rewritten to reflect rapid advances in such areas as interconnect technologies gate dielectrics photomask fabrication IC packaging and 300 mm wafer fabrication While no book can be up to the minute with the advances in the semiconductor field the Handbook of Semiconductor Manufacturing Technology keeps the most important data methods tools and techniques close at hand

**Wide Bandgap Semiconductors for Power Electronics** Peter Wellmann, Noboru Ohtani, Roland Rupp, 2022-01-10 Wide Bandgap Semiconductors for Power Electronic A guide to the field of wide bandgap semiconductor technology Wide Bandgap Semiconductors for Power Electronics is a comprehensive and authoritative guide to wide bandgap materials silicon carbide gallium nitride diamond and gallium III oxide With contributions from an international panel of experts the book offers detailed coverage of the growth of these materials their characterization and how they are used in a variety of power electronics devices such as transistors and diodes and in the areas of quantum information and hybrid electric vehicles The book is filled with the most recent developments in the burgeoning field of wide bandgap semiconductor technology and includes information from cutting edge semiconductor companies as well as material from leading universities and research institutions By taking both scholarly and industrial perspectives the book is designed to be a useful resource for scientists academics and corporate researchers and developers This important book Presents a review of wide bandgap materials and recent developments Links the high potential of wide bandgap semiconductors with the technological implementation capabilities Offers a unique combination of academic and industrial perspectives Meets the demand for a resource that addresses wide bandgap materials in a comprehensive manner Written for materials scientists semiconductor physicists electrical engineers Wide Bandgap Semiconductors for Power Electronics provides a state of the art guide to the technology and application of SiC and related wide bandgap materials

Dielectrics for Nanosystems ,2004



The Top Books of the Year Semiconductor Material And Device Characterization The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous compelling novels captivating the hearts of readers worldwide. Lets delve into the realm of popular books, exploring the engaging narratives that have enthralled audiences this year. Semiconductor Material And Device Characterization : Colleen Hoover's "It Ends with Us" This touching tale of love, loss, and resilience has gripped readers with its raw and emotional exploration of domestic abuse. Hoover skillfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph. Uncover the Best : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This captivating historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids compelling storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Discover the Magic : Delia Owens "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens spins a tale of resilience, survival, and the transformative power of nature, entrancing readers with its evocative prose and mesmerizing setting. These bestselling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and suspenseful novel that will keep you guessing until the very end. The novel is a cautionary tale about the dangers of obsession and the power of evil.

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