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The Committee on Technology Insight-

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Gauge, Evaluate & Review set up by the NRC at the request of the Defense Intelligence Agency, has selected a number of emerging technologies to investigate for their potential threats to and opportunities for national security. This first study focused on emerging applications of nanophotonics, which is

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about the interaction of matter and light at the scale of the wavelength of the light.

Manipulation of matter at that scale allows tailoring the optical properties to permit a wide-range of commercial and defense applications. This book presents a review of the nanoscale phenomena underpinning nanophotonics, an

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assessment of enabling technologies for developing new applications, an examination of potential military applications, and an assessment of foreign investment capabilities

A graduate textbook presenting the underlying physics behind devices that drive today's technologies. The book

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covers important details of structural properties, bandstructure, transport, optical and magnetic properties of semiconductor structures. Effects of low-dimensional physics and strain - two important driving forces in modern device technology - are also discussed. In addition to conventional semiconductor

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physics the book discusses self-assembled structures, mesoscopic structures and the developing field of spintronics. The book utilizes carefully chosen solved examples to convey important concepts and has over 250 figures and 200 homework exercises. Real-world applications are highlighted throughout the book, stressing the links

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between physical principles and actual devices. Electronic and Optoelectronic Properties of Semiconductor Structures provides engineering and physics students and practitioners with complete and coherent coverage of key modern semiconductor concepts. A solutions manual and set of viewgraphs for use in

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lectures are available for instructors, from solutions@cambridge.org.

A collection of review books with clear and concise explanations of all science concepts and formulas tested by the MCAT including practice passages and questions. The book is a history of Molecular Beam Epitaxy (MBE) as applied to the growth of

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semiconductor thin films (note that it does not cover the subject of metal thin films).

It begins by examining the origins of MBE, first of all looking at the nature of molecular beams and considering their application to fundamental physics, to the development of nuclear magnetic resonance and to the invention of the

microwave MASER. It shows how molecular beams of silane (SiH_4) were used to study the nucleation of silicon films on a silicon substrate and how such studies were extended to compound semiconductors such as GaAs. From such surface studies in ultra-high vacuum the technique developed into a method of

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growing high quality single crystal films of a wide range of semiconductors.

Comparing this with earlier evaporation methods of deposition and with other epitaxial deposition methods such as liquid phase and vapour phase epitaxy (LPE and VPE). The text describes the development of MBE machines from the

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early 'home-made' variety to that of commercial equipment and show how MBE was gradually refined to produce high quality films with atomic dimensions. This was much aided by the use of various in-situ surface analysis techniques, such as reflection high energy electron diffraction (RHEED) and mass

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spectrometry, a feature unique to MBE. It looks at various modified versions of the basic MBE process, then proceed to describe their application to the growth of so-called 'low-dimensional structures' (LDS) based on ultra-thin heterostructure films with thickness of order a few molecular monolayers. Further chapters

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cover the growth of a wide range of different compounds and describe their application to fundamental physics and to the fabrication of electronic and optoelectronic devices. The authors study the historical development of all these aspects and emphasise both the (often unexpected) manner of their discovery and

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*development and the unique features
which MBE brings to the growth of
extremely complex structures with
monolayer accuracy.*

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Early Detection of Neurological Disorders

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Electrical, Mechanical, and Optical

Properties

Properties of III-V Quantum Wells and

Superlattices

Covers both the

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fundamentals and the state-of-the-art technology used for MBE Written by expert researchers working on the frontlines of the field, this book covers fundamentals of Molecular Beam Epitaxy

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(MBE) technology and science, as well as state-of-the-art MBE technology for electronic and optoelectronic device applications. MBE applications to magnetic semiconductor materials are

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also included for future
magnetic and spintronic
device applications.

Molecular Beam Epitaxy:

Materials and Applications

for Electronics and

Optoelectronics is presented

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in five parts: Fundamentals of MBE; MBE technology for electronic devices application; MBE for optoelectronic devices; Magnetic semiconductors and spintronics devices; and

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Challenge of MBE to new materials and new researches. The book offers chapters covering the history of MBE; principles of MBE and fundamental mechanism of MBE growth; migration

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enhanced epitaxy and its application; quantum dot formation and selective area growth by MBE; MBE of III-nitride semiconductors for electronic devices; MBE for Tunnel-FETs; applications of

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III-V semiconductor quantum dots in optoelectronic devices; MBE of III-V and III-nitride heterostructures for optoelectronic devices with emission wavelengths from THz to ultraviolet; MBE of III-

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V semiconductors for mid-infrared photodetectors and solar cells; dilute magnetic semiconductor materials and ferromagnet/semiconductor heterostructures and their application to spintronic

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devices; applications of
bismuth-containing III-V
semiconductors in devices;
MBE growth and device
applications of Ga₂O₃;
Heterovalent semiconductor
structures and their device

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applications; and more.

Includes chapters on the fundamentals of MBE Covers new challenging researches in MBE and new technologies Edited by two pioneers in the field of MBE with

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contributions from well-known MBE authors including three AI Cho MBE Award winners Part of the Materials for Electronic and Optoelectronic Applications series Molecular Beam

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Epitaxy: Materials and Applications for Electronics and Optoelectronics will appeal to graduate students, researchers in academia and industry, and others interested in the area of

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epitaxial growth.

The first true "introduction" to semiconductor optoelectronic devices, this book provides an accessible, well-organized overview of optoelectronic devices that

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emphasizes basic principles. Coverage begins with an optional review of key concepts— such as properties of compound semiconductor, quantum mechanics, semiconductor

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statistics, carrier transport properties, optical processes, and junction theory— then progress gradually through more advanced topics. The "Second Edition" has been both updated and expanded

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to include the recent developments in the field. The characterization and precisely controlled building of atomic-scale multilayers have been the subject of intensive R&D worldwide.

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Nanometric structures based on III-V semiconductors have attracted particular attention. Since 1970, around 15,000 papers have been published in all, of which 10,000 have appeared

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in the last 6 years. The resulting improved materials control is enabling engineers to achieve major improvements in the performance of microelectronic and

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optoelectronic devices such as QW lasers, tunnelling devices, modulators, switches and photodetectors. In this book, the large volume of research results which have

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accumulated is evaluated and distilled down to a useful, manageable concentration of up-to-date knowledge for electronic engineers and solid-state physicists. This has been

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carried out by an invited international team of over 50 specialists under the editorship of Professor Bhattacharya with support from INSPEC, who also compiled the subject index.

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There are 40 individually-written, self-contained modules ("Datareviews"), each specially commissioned to fit into a pre-determined structure. Subjects reviewed in depth include historical

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perspective, theory, epitaxial growth and doping, structure (e.g. X-ray diffraction), electronic properties, optical properties, modulation doping and devices. Each Datareview comprises

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tables, text, figures and expert guidance to the literature, as appropriate. Properties of III-V quantum wells and superlattices is intended both as a look-up source of evaluated data and

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as a finely-structured state-of-the-art review for academic and industrial R&D workers.

This book focuses on the theory of phonon interactions in nanoscale

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structures with particular emphasis on modern electronic and optoelectronic devices. The continuing progress in the fabrication of semiconductor nanostructures with lower

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dimensional features has led to devices with enhanced functionality and even novel devices with new operating principles. The critical role of phonon effects in such semiconductor devices is

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well known. There is therefore a great need for a greater awareness and understanding of confined phonon effects. A key goal of this book is to describe tractable models of confined

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phonons and how these are applied to calculations of basic properties and phenomena of semiconductor heterostructures. The level of presentation is

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appropriate for
undergraduate and graduate
students in physics and
engineering with some
background in quantum
mechanics and solid state
physics or devices. A basic

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understanding of
electromagnetism and
classical acoustics is
assumed.

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Gallium Oxide

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Principles and Applications of
Optical Communications

Fundamentals of

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Photonic Sensing

Textbook presenting the

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**fundamentals of nanoscience
and nanotechnology with a
view to nanoelectronics.
Covers the underlying
physics; nanostructures,
including nanoobjects;
methods for growth,
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nanomaterials; and
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book presents both
fundamental theory and a
thorough overview of the
diverse range of
applications that have been
developed using laser**

technology based on novel nanostructures and nanomaterials. Technologies covered include nanocavity lasers, carbon dot lasers, 2D material lasers, plasmonic lasers, spasers, quantum dot lasers, quantum

dash and nanowire lasers. Each chapter outlines the fundamentals of the topic and examines material and optical properties set alongside device properties, challenges, issues and trends. Dealing with a scope

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of materials from organic to carbon nanostructures and nanowires to semiconductor quantum dots, this book will be of interest to graduate students, researchers and scientific professionals in a wide range of fields

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**relating to laser
development and
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Provides an overview of the
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material to specific
applications Gives an
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amplification using**

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coverage of a variety of light wave technologies not often found in other texts. Taking an applied approach to the subject, this text has utility in a number of different optical communications courses and

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in advanced signal processing. The coverage and approach reflect Dr. Liu's background in industry. They offer students exposure to the latest technologies and give strong preparation for industry positions in

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Emphasizes the theory of semiconductor optoelectronic devices, demonstrating comparisons between theoretical and experimental results. Presents such important topics as semiconductor heterojunctions and band structure calculations near the

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band edges for bulk and quantum-well semiconductors. Details semiconductor lasers including double-heterostructure, stripe-geometry gain-guided semiconductor, distributed feedback and surface-emitting. Systematically investigates high-

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design process raises several interesting questions. This book develops the answers to these questions and fits them into a roadmap for formal property verification – a roadmap that shows how to glue FPV technology into the traditional validation flow. The

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of the semiconductor world. The work is divided into three sections. The first section is concerned with the fundamental physics of semiconductors, showing how the electronic features and the lattice dynamics change drastically when systems vary from bulk to a low-

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dimensional structure and further to a nanometer size. Throughout this section there is an emphasis on the full understanding of the underlying physics. The second section deals largely with the transformation of the conceptual framework of solid state physics into devices and

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systems which require the growth of extremely high purity, nearly defect-free bulk and epitaxial materials. The last section is devoted to exploitation of the knowledge described in the previous sections to highlight the spectrum of devices we see all

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around us. Provides a comprehensive global picture of the semiconductor world Each of the work's three sections presents a complete description of one aspect of the whole Written and Edited by a truly international team of experts This book provides comprehensive

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coverage of the new wide-bandgap semiconductor gallium oxide (Ga_2O_3). Ga_2O_3 has been attracting much attention due to its excellent materials properties. It features an extremely large bandgap of greater than 4.5 eV and availability of large-size, high-quality native substrates

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produced from melt-grown bulk single crystals. Ga₂O₃ is thus a rising star among ultra-wide-bandgap semiconductors and represents a key emerging research field for the worldwide semiconductor community. Expert chapters cover physical properties,

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synthesis, and state-of-the-art applications, including materials properties, growth techniques of melt-grown bulk single crystals and epitaxial thin films, and many types of devices. The book is an essential resource for academic and industry readers who have an interest in, or

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plan to start, a new R&D project related to Ga₂O₃.

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*devices, the basic components
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responsible for the rapid growth of the electronics industry over the past fifty years. Because there is a growing need for faster and more complex systems for the information age, existing

semiconductor devices are constantly being studied for improvement, and new ones are being continually invented. As a result, a large number of types and variations of devices are available in the literature.

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of these devices. As in the First Edition, the value of this text lies in its comprehensive, yet highly readable presentation and its easy-to-use format, making it suitable for a wide range of audiences.

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detail, always including its history, its structure, its characteristics, and its applications The Second Edition has been significantly updated with eight new chapters, and the material

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rearranged to reflect recent developments in the field. As such, it remains an ideal reference source for graduate students who want a quick survey of the field, as well as for practitioners and

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researchers who need quick access to basic information, and a valuable pragmatic handbook for salespeople, lawyers, and anyone associated with the semiconductor industry.

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Optoelectronic devices impact many areas of society, from simple household appliances and multimedia systems to communications, computing, spatial scanning, optical monitoring, 3D measurements

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and medical instruments. This is the most complete book about optoelectromechanic systems and semiconductor optoelectronic devices; it provides an accessible, well-organized overview of

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optoelectronic devices and properties that emphasizes basic principles.

A detailed description of the basic physics of semiconductors. All the important equations

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describing the properties of these materials are derived without the help of other textbooks. The reader is assumed to have only a basic command of mathematics and some elementary

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semiconductor physics. The text covers a wide range of important semiconductor phenomena, from the simple to the advanced.

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*in Biology: Electrical,
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and technology of nanostructures and the science of biology. Moreover, this book supplements these past groundbreaking discoveries with discussions of promising new avenues of

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research that reveal the enormous potential of emerging approaches in nanobiotechnology. The topics include: - Biomedical applications of semiconductor quantum dots, - Integrating

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and tagging biological structures with nanoscale quantum dots, - Applications of carbon nanotubes in bioengineering, - Nanophysical properties of living cells, - Bridging natural nanotubes

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Bioinspired approaches to
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developments in*

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nanotechnology - as they apply to bioengineering and biology - is essential reading for all academics, biomedical engineers, medical physicists, and industry professionals wishing to take advantage of

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the latest developments and highly-promising discoveries in nanoscience underlying applications in bioengineering and biology.

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A Short History

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applications of
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and systems. The text
gives a detailed
description of optical
fibre waveguides,
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their characteristics,
manufacturing process
and drawing of optical
fibres. In addition, it
deals with photon
sources, photon
detectors, fibre optics

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as a medium and LAN and WAN systems, short and long haul optical fibre communication systems, electro-optic modulators and their characteristics. The

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second edition possesses a new section on Optical Fibre Based Broadband High Speed Network in Chapter 8, thus highlighting an updated version. Apart from

this, a new chapter on Intensity Dependent Refractive Index Effect has been introduced into the text that discusses the effect of focusing on spatial and

temperature profiles in a non-linear crystal medium. This chapter further explains the various physical phenomena like the creation of sharp opaque

filaments, irradiation induced damaging of the crystal, oscillatory waveguide propagation, saturation effects and other properties in detail. Primarily

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of electronics and
communication
engineering, the book
should also prove
extremely useful for the

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Discusses the
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in industry, military
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Describes optical
computing, optical gates
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numericals at the end of book for better understanding of topics. While doctors and physicians are more than capable of detecting diseases of the brain,

the most agile human mind cannot compete with the processing power of modern technology.

Utilizing algorithmic systems in healthcare in this way may provide a

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way to treat

neurological diseases

before they happen.

Early Detection of

Neurological Disorders

Using Machine Learning

Systems provides

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innovative insights into implementing smart systems to detect neurological diseases at a faster rate than by normal means. The topics included in this book

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are artificial intelligence, data analysis, and biomedical informatics. It is designed for clinicians, doctors, neurologists, physiotherapists,

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specialists, scholars,
academics, and students
interested in topics
centered on biomedical
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electronics, medical

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neurosciences, life
sciences, and physics.

This book is the first
to give a comprehensive
review of the theory,
fabrication,

characterisation, and device applications of abrupt, shallow, and narrow doping profiles in semiconductors. Such doping profiles are a key element in the

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development of modern semiconductor technology. After an introductory chapter setting out the basic theoretical and experimental concepts

involved, the fabrication of abrupt and narrow doping profiles by several different techniques, including epitaxial growth, is discussed.

The techniques for characterising doping distributions are then presented, followed by several chapters devoted to the inherent physical properties of narrow

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doping profiles. The latter part of the book deals with specific devices. The book will be of great interest to graduate students, researchers and

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adopted by previous
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introduction to
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or postgraduate, and

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practicing engineers
requiring a treatment
that is not too advanced
but gives a good
introduction to the
quantitative aspects of
the subject. The book

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aims to put special emphasis on the fundamental principles which underlie the operation of devices and systems. Readers will then be able to

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appreciate the operation of devices not covered in the book and to understand future developments within the subject. All the material in this edition

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PHOTONIC SENSING A

cutting-edge look at

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***photonic sensing
technology is
increasingly used in
early-detection and
early-warning systems
for biological hazards,
structural flaws, and***

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development of cutting-edge applications in diverse areas of safety and security, from biodetection to biometrics. The book brings together

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***and networking
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specific areas of safety
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are covered, including
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with promising***

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general updating of the
entire text. It includes
numerous problems at the
end of each chapter
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this book was to provide
a text that would be
comprehensive enough for
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***yet concise enough in
its mathematical
derivations to be easily
readable by a practicing
engineer who desires an
overview of the field.
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an early opportunity to produce this updated and improved second edition. This development is fortunate, because integrated optics is a very rapidly progressing

field, with significant new research being regularly reported. Hence, a new chapter (Chap. 17) has been added to review recent progress and to provide

numerous additional references to the relevant technical literature. Also, thirty-five new problems for practice have been included to supplement

those at the ends of chapters in the first edition. Chapters I through 16 are essentially unchanged, except for brief updating revisions and

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***corrections of
typographical errors.***

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it as a course text, it has been possible to include new references and to briefly describe recent developments only in Chapter 17. However, we hope to provide

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emphasizes basic
principles. Coverage begins with an
optional review of key
concepts—such as properties of
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mechanics, semiconductor statistics, carrier transport properties, optical processes, and junction theory—then progress gradually through more advanced topics. The Second Edition has been both updated and expanded to include the recent developments in

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processes upon which all semiconductor devices are based. Next, the author focuses on the operation of the important semiconductor devices along with issues relating to the optimization of device performance.

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developments with InGaAs. Leading researchers from the USA, Europe and Japan cover such issues as structural, thermal, mechanical and vibrational properties, the band structure of lattice-matched and strained alloys, transport and

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surface properties, radiative and non-radiative recombinations, expitaxial growth, doping, etching of InGaAs and related heterostructures, photodetectors, FETs, double heterostructure and quantum well lasers.

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provided. Readers of the book will come to understand the finer aspects of the theory, design, fabrication and test of these devices and have an excellent background for

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also: Provides a multi-
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explaining the theories
behind semiconductor
lasers, utilizing**

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illustrations and written
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