



Semiconductor Photodetectors

Edward T. Yu



Semiconductor Photodetectors:

Semiconductor Photodetectors Surik Khudaverdyan, Ashok Vaseashta, 2024-10-07 The exponential increase of the Internet of Things IoTs has revolutionized lives but it has also resulted in massive resource consumption and environmental pollution In conjunction with Green IoTs GIoTs there is a parallel effort to create highly sensitive devices by device design to conserve power Furthermore numerous applications require deciphering information from very weak optical signals such as from radiation medical imaging industrial non destructive testing quantum technologies astronomy and various other such routine measurements It is necessary to design photodetectors with high photosensitivity using various technological innovations to reduce the noise level such as with two inversely directed barriers as proposed by the authors in which the currents of devices mutually compensate each other and create low dark current with high photosensitivity thresholds The implementation of internal amplification of photocurrents in them can provide high photosensitivity The book presents the mechanism for the injection amplification of the photocurrent in devices based on cadmium telluride and silicon with a high resistance sublayer as well as the study of creating highly sensitive devices that are resistant to radiation of optical and X ray ranges of electromagnetic waves Particular attention is drawn to the mutual compensation process for photocurrents arising in opposite potential barriers covering the layer during longitudinal absorption of radiation in the sublayer Using structures on the base cadmium telluride and silicon as an example the phenomenon of a change in the sign of the spectral photocurrent and the possibilities of wave measurement is provided by this phenomenon Photoelectronic processes occurring in these semiconductor structures are investigated and expressions are obtained that relate the parameters of optical radiation and the structure The algorithm developed using these expressions is based on a new spectral analysis mechanism which is implemented to prepare inexpensive reduced dimensions with the need for less materials and energy intensive devices All this is considered in the context of solving urgent problems of quantitative remote identification of the components of an optically transparent medium The global spectral analysis market is focused on the development of semiconductor photodetectors with spectral selective sensitivity for spectral analysis The use of such a photodetector in spectrometry will eliminate the use of opticalmechanical systems due to the new physical principle used in it and will ensure high resolution and reliability of spectrum recording As environmental threats become increasingly unpredictable there is also a growing need to develop remote spectral analysis identification and assessment of substances in air water and food assessment of the effects of substances on humans animals and vegetation and detection and elimination of pollution sources Here the spectral analysis of the electromagnetic radiation transmitting the information from the object with the help of primary sensors is essential

Semiconductor Photodetectors ,2006 **Photodetectors** Bahram Nabet, 2023-02-10

Every bit of information that circulates the internet across the globe is a pulse of light that at some point will need to be converted to an electric signal in order to be processed by the electronic circuitry in our data centers computers and cell

phones Photodetectors PD s perform this conversion with ultra high speed and efficiency in addition to being ubiquitously present in many other devices ranging from the mundane TV remote controls to ultra high resolution instrumentation used in Laser Interferometer Gravitational Wave Observatory LIGO that reach the edge of the universe and measure gravitational waves The second edition of Photodetectors fully updates the popular first edition with updated information covering the state of the art in modern photodetectors The 2nd edition starts with basic metrology of photodetectors and common figures of merit to compare various devices It follows with chapters that discuss single photon detection with Avalanche Photodiodes organic photodetectors that can be inkjet printed and silicon germanium PDs popular in burgeoning field of Silicon Photonics Internationally recognized experts contribute chapters on one dimensional nanowire PDs as well as high speed zero dimensional quantum dot versions that increase the spectral span as well as speed and sensitivity of PDs and can be produced on various substrates Solar blind PDs that operate in harsh environments such as deep space or rocket engines are reviewed and new devices in GaN technology Novel Plasmonic PDs as well as devices which employ micro plasma of confined charge in order to make devices that overcome speed limitation of transfer of electronic charge are covered in other chapters Using different novel technologies CMOS compatible devices are described in two chapters and ultra high speed PDs that use low temperature grown GaAs LT GaAs to detect fast THz signals are reviewed in another chapter Photodetectors used in application areas of Silicon Photonics and Microwave Photonics are reviewed in final chapters of this book All chapters are of a review nature providing a perspective of the field before concentrating on particular advancements As such the book should appeal to a wide audience that ranges from those with general interest in the topic to practitioners graduate students and experts who are interested in the state of the art in photodetection Addresses various photodetector devices from ultra high speed to ultra high sensitivity capable of operation in harsh environments Considers a range of applications for this important technology including silicon photonics and photonic integrated circuits Includes discussions of detectors based on reduced dimensional systems such as quantum wells nanowires and quantum dots as well as travelling wave and plasmonic detectors

Photodetectors Sanka Gateva, 2012-03-23 In this book some recent advances in development of photodetectors and photodetection systems for specific applications are included In the first section of the book nine different types of photodetectors and their characteristics are presented Next some theoretical aspects and simulations are discussed The last eight chapters are devoted to the development of photodetection systems for imaging particle size analysis transfers of time measurement of vibrations magnetic field polarization of light and particle energy The book is addressed to students engineers and researchers working in the field of photonics and advanced technologies

Photodetectors, 2015-10-24 Photodetectors Materials Devices and Applications discusses the devices that convert light to electrical signals key components in communication computation and imaging systems In recent years there has been significant improvement in photodetector performance and this important book reviews some of the key advances in the field Part one covers

materials detector types and devices and includes discussion of silicon photonics detectors based on reduced dimensional charge systems carbon nanotubes graphene nanowires low temperature grown gallium arsenide plasmonic Si photomultiplier tubes and organic photodetectors while part two focuses on important applications of photodetectors including microwave photonics communications high speed single photon detection THz detection resonant cavity enhanced photodetection photo capacitors and imaging Reviews materials detector types and devices Addresses fabrication techniques and the advantages and limitations and different types of photodetector Considers a range of application for this important technology Includes discussions of silicon photonics detectors based on reduced dimensional charge systems carbon nanotubes graphene nanowires and more

Handbook of Semiconductors Ram K. Gupta, 2024-07-10 This book provides readers with state of the art knowledge of established and emerging semiconducting materials their processing and the fabrication of chips and microprocessors In addition to covering the fundamentals of these materials it details the basics and workings of many semiconducting devices and their role in modern electronics and explores emerging semiconductors and their importance in future devices Provides readers with latest advances in semiconductors Covers diodes transistors and other devices using semiconducting materials Covers advances and challenges in semiconductors and their technological applications Discusses fundamentals and characteristics of emerging semiconductors for chip manufacturing This book provides directions to scientists engineers and researchers in materials engineering and related disciplines to help them better understand the physics characteristics and applications of modern semiconductors

Photodetectors and Fiber Optics Hari Singh Nalwa, 2012-12-02 Photodetectors and Fiber Optics is an outgrowth of the recently published 10 volume set *Handbook of Advanced Electronic and Photonic Materials and Devices* The objective of this book is to present a highly coherent coverage of photodetectors and optical fibers This book covers a broad spectrum of photodetectors including types of materials their fabrication physical properties and industrial applications Many industries around the world are engaged in developing fiber optics technology for the new millennium The applications of photodetectors in fiber optics and the role of optical fibers in present communication technology are extensively discussed Covers a broad spectrum of the photodetectors Include types of materials their fabrication physical properties and industrial applications Applications of photodetectors in fiber optics Role of optical fibers in present communication technology A very special topic presented in a timely manner and in a format

Handbook of Emerging Materials for Semiconductor Industry Young Suh Song, Laxman Raju Thoutam, Shubam Tayal, Shiromani Balmukund Rahi, T. S. Arun Samuel, 2024-05-31 The proposed book will be a one stop place for all the young material researchers to understand the recent and reliable material making process characterization and reliability test tools The proposed book is designed to provide basic knowledge to understand and analyse structure property relationship for reliable emerging material systems for next generation of semiconductor technologies The book is suggested to engineers and scientists across the world working on various new and novel materials for reliable semiconductor device applications

The book is expected to serve as a reference guide for young scientists and engineers in the field of material science and electronic engineers to acquire latest state of art experimental and computational tools to encourage their research activities. Since the scope of the book is generic, the book can be referred to by all the students of science and engineering to create a common awareness about the latest material systems and state of art characterization tools that have been broadly utilized to study the physical and chemical properties of different material systems. It introduces the readers to a wide variety of new emerging materials systems including their synthesis, fabrication, measurement, reliability test, modelling and simulations with in depth analysis of selective applications. This book contains the state of art research updates in the various fields of semiconductor, artificial intelligence, AI, bio sensor, biotechnology with respect to reliable material research. Therefore, various students who are eager to get a job in semiconductor, AI, Autonomous car, biotechnology are strongly recommended to read this book and learn about related state of art knowledge.

Semiconductor Opto-Electronics T.S. Moss, G.J.

Burrell, B. Ellis, 2013-10-22. Semiconductor Opto Electronics focuses on opto electronics covering the basic physical phenomena and device behavior that arise from the interaction between electromagnetic radiation and electrons in a solid. The first nine chapters of this book are devoted to theoretical topics discussing the interaction of electromagnetic waves with solids, dispersion theory and absorption processes, magneto optical effects and non linear phenomena. Theories of photo effects and photo detectors are treated in detail including the theories of radiation generation and the behavior of semiconductor lasers and lamps. The rest of this text deals with the group IV elements, III V compounds and selection of the most important chalcogenides. This publication is intended primarily for physicists engaged in academic research or commercial device development and for honors students specializing in solid state physics.

Ultrafast Phenomena in

Semiconductors and Nanostructure Materials XI and Semiconductor Photodetectors IV Kong Thon Tsen, 2007

Proceedings of SPIE present the original research papers presented at SPIE conferences and other high quality conferences in the broad ranging fields of optics and photonics. These books provide prompt access to the latest innovations in research and technology in their respective fields. Proceedings of SPIE are among the most cited references in patent literature.

Bands and Photons in III-V Semiconductor Quantum Structures Igor Vurgaftman, Matthew P. Lumb, Jerry R.

Meyer, 2020-12-10. This book takes the reader from the very basics of III V semiconductors, some preparation in quantum mechanics and electromagnetism is helpful and shows how seemingly obscure results such as detailed forms of the Hamiltonian, optical transition strengths and recombination mechanisms follow.

III-V Nitride Semiconductors Edward

T. Yu, 2022-10-30. The concepts in this book will provide a comprehensive overview of the current state for a broad range of nitride semiconductor devices as well as a detailed introduction to selected materials and processing issues of general relevance for these applications. This compilation is very timely given the level of interest and the current stage of research in nitride semiconductor materials and device applications. This volume consists of chapters written by a number of leading

researchers in nitride materials and device technology addressing Ohmic and Schottky contacts AlGaInN multiple quantum well laser diodes nitride vertical cavity emitting lasers and ultraviolet photodetectors This unique volume provides a comprehensive review and introduction to application and devices based on GaN and related compounds for newcomers to the field and stimulus to further advances for experienced researchers

Semiconductor Physical Electronics Sheng S. Li, 2007-01-16 Semiconductor Physical Electronics Second Edition provides comprehensive coverage of fundamental semiconductor physics that is essential to an understanding of the physical and operational principles of a wide variety of semiconductor electronic and optoelectronic devices This text presents a unified and balanced treatment of the physics characterization and applications of semiconductor materials and devices for physicists and material scientists who need further exposure to semiconductor and photonic devices and for device engineers who need additional background on the underlying physical principles This updated and revised second edition reflects advances in semiconductor technologies over the past decade including many new semiconductor devices that have emerged and entered into the marketplace It is suitable for graduate students in electrical engineering materials science physics and chemical engineering and as a general reference for processing and device engineers working in the semiconductor industry

Modern Semiconductor Physics and Device Applications Vitalii Dugaev, Vladimir Litvinov, 2021-11-14 This textbook provides a theoretical background for contemporary trends in solid state theory and semiconductor device physics It discusses advanced methods of quantum mechanics and field theory and is therefore primarily intended for graduate students in theoretical and experimental physics who have already studied electrodynamics statistical physics and quantum mechanics It also relates solid state physics fundamentals to semiconductor device applications and includes auxiliary results from mathematics and quantum mechanics making the book useful also for graduate students in electrical engineering and material science

Key Features Explores concepts common in textbooks on semiconductors in addition to topics not included in similar books currently available on the market such as the topology of Hilbert space in crystals Contains the latest research and developments in the field Written in an accessible yet rigorous manner

Photonics Vittorio Degiorgio, Ilaria Cristiani, 2015-08-22 This extended and revised edition will serve as a concise self contained up to date introduction to Photonics for undergraduate students It can also be used as a primer by researchers and professionals who start working in the field Blending theory with technical descriptions the book covers a wide range of topics including the general mechanism of laser action continuous and pulsed laser operation optical propagation in isotropic and anisotropic media operating principles and structure of passive optical components electro optic and acousto optic modulation solid state lasers semiconductor lasers and LEDs nonlinear optical phenomena and optical fiber components and devices The book concludes with an overview of applications including optical communications telemetry and sensing industrial and biomedical applications solid state lighting displays and photovoltaics This second edition includes a set of problems at the end of all but the last chapter These problems deal with numerical

computations designed to illustrate the magnitudes of important quantities and are also intended to test the student's ability to apply theoretical formulas

Semiconductor Radiation Detection Systems Krzysztof Iniewski, 2018-10-03 Semiconductor Radiation Detection Systems addresses the state of the art in the design of semiconductor detectors and integrated circuit design in the context of medical imaging using ionizing radiation. It addresses exciting new opportunities in X-ray detection, Computer Tomography, CT bone dosimetry, and nuclear medicine PET/SPECT. In addition to medical imaging, the book explores other applications of semiconductor radiation detection systems in security applications such as luggage scanning, dirty bomb detection, and border control. Features a chapter written by well-known Gamma Ray Imaging authority Tadayuki Takahashi. Assembled by a combination of top industrial experts and academic professors, this book is more than just a product manual. It is practical enough to provide a solid explanation of presented technologies incorporating material that offers an optimal balance of scientific and academic theory. With less of a focus on math and physical details, the author concentrates more on exploring exactly how technologies are being used. With its combined coverage of new materials and innovative new system approaches as well as a succinct overview of recent developments, this book is an invaluable tool for any engineer, professional, or student working in electronics or an associated field.

Nitride Semiconductors Pierre Ruterana, Martin Albrecht, Jörg Neugebauer, 2006-05-12 Semiconductor components based on silicon have been used in a wide range of applications for some time now. These elemental semiconductors are now well researched and technologically well developed. In the meantime, the focus has switched to a new group of materials: ceramic semiconductors based on nitrides are currently the subject of research due to their optical and electronic characteristics. They open up new industrial possibilities in the field of photosensors as light sources or as electronic components. This collection of review articles provides a systematic and in-depth overview of the topic on both a high and current level. It offers information on the physical basics as well as the latest results in a compact yet comprehensive manner. The contributions cover the physical processes involved in manufacture from semiconductor growth via their atomic structures and the related characteristics right up to future industrial applications. A highly pertinent book for anyone working in applied materials research or the semiconductor industry.

Quantum Physics of Semiconductor Materials and Devices Debdeep Jena, 2022 Aimed at upper level undergraduate students and graduate students in Electrical Engineering, Physics, Applied Physics, Materials Science, and Engineering, this textbook covers the quantum physics of semiconductors including their practical applications in various areas and their future potential.

Handbook of Nitride Semiconductors and Devices, GaN-based Optical and Electronic Devices Hadis Morkoç, 2009-07-30 The three volumes of this handbook treat the fundamentals, technology, and nanotechnology of nitride semiconductors with an extraordinary clarity and depth. They present all the necessary basics of semiconductor and device physics and engineering together with an extensive reference section. Volume 3 deals with nitride semiconductor devices and device technology. Among the application areas that feature prominently here are LEDs, lasers,

FETs and HBTs detectors and unique issues surrounding solar blind detection *Physics of Semiconductors* Aditya Saxena, 2025-02-20 *Physics of Semiconductors Core Principles* is a comprehensive guide that demystifies how semiconductors function from the fundamental physics to the devices we use daily. We cater to a general audience with a focus on readers in the United States. We begin with the basics of quantum mechanics and solid state physics before diving into how these principles apply to semiconductors like silicon and gallium arsenide. We explain crucial concepts such as band theory, the flow of electricity through semiconductors, and their use in devices like transistors and solar cells. Additionally, we discuss the manufacturing processes of semiconductors and highlight the advancements scientists are making in developing new and improved semiconductors. *Physics of Semiconductors Core Principles* is an excellent resource for anyone eager to understand the intricacies of this essential technology.

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