



Semiconductor Photodetectors

Ram K. Gupta



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 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 by all the students of science and engineering students 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

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 *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 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

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 **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 *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 **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 **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 **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 **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 *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 Springer Handbook of Lasers and Optics Frank Träger, 2012-05-05 This new edition features numerous updates and additions Especially 4 new chapters on Fiber Optics Integrated Optics Frequency Combs and Interferometry reflect the changes since the first edition In addition major complete updates for the chapters Optical Materials and Their Properties Optical Detectors Nanooptics and Optics far Beyond the Diffraction Limit Features Contains over 1000 two color illustrations Includes over 120 comprehensive tables with properties of optical materials and light sources Emphasizes physical concepts over extensive mathematical derivations Chapters with summaries detailed index Delivers a wealth of up to date references **Radiation Detection** Douglas McGregor, J. Kenneth Shultis, 2020-08-19 Radiation Detection Concepts Methods and Devices provides a modern overview of radiation detection devices and radiation measurement methods The book topics have been selected on the basis of the authors many years of experience designing radiation detectors and teaching radiation detection and measurement in a classroom environment This book is designed to give the reader more than a glimpse at radiation detection devices and a few packaged equations Rather it seeks to provide an understanding that allows the reader to choose the appropriate detection technology for a particular application to design detectors and to competently perform radiation measurements The authors describe assumptions used to derive frequently encountered equations used in radiation detection and measurement thereby providing insight when and when not to apply the many approaches used in different aspects of radiation detection Detailed in many of the chapters are specific aspects of radiation detectors including comprehensive reviews of the historical development and current state of each topic Such a review necessarily entails citations to many of the important discoveries providing a resource to find quickly additional and more detailed information This book generally has five main themes Physics and Electrostatics needed to Design Radiation Detectors Properties and Design of Common Radiation Detectors Description and Modeling of the Different Types of

Radiation Detectors Radiation Measurements and Subsequent Analysis Introductory Electronics Used for Radiation Detectors Topics covered include atomic and nuclear physics radiation interactions sources of radiation and background radiation Detector operation is addressed with chapters on radiation counting statistics radiation source and detector effects electrostatics for signal generation solid state and semiconductor physics background radiations and radiation counting and spectroscopy Detectors for gamma rays charged particles and neutrons are detailed in chapters on gas filled scintillator semiconductor thermoluminescence and optically stimulated luminescence photographic film and a variety of other detection devices

Semiconductors and Superconductors Ron Legarski, Yash Patel, Zoltan Csernus, 2024-09-22 Semiconductors and Superconductors From Invention to Innovation is a comprehensive exploration of the fundamental technologies that power modern electronics energy systems and computing Written by Ron Legarski a leading expert in telecommunications and technology solutions this book delves into the discovery evolution and future applications of semiconductors and superconductors two cornerstones of modern science and engineering The book is designed for a wide audience from professionals in the tech industry and academic researchers to students and general readers interested in understanding the science and technology that drive today's digital world Semiconductors are the building blocks of every microchip transistor and integrated circuit essential components in everything from smartphones to solar cells Superconductors on the other hand have the potential to revolutionize fields like energy transmission quantum computing and medical imaging by enabling technologies that operate with zero electrical resistance This book covers the key milestones in the development of semiconductors and superconductors starting with the invention of the transistor and the discovery of superconductivity It also dives into the applications of these technologies in industries such as telecommunications computing energy systems and medical technology demonstrating their far reaching impact on society Key topics include The physics of semiconductors and superconductors explained in accessible language The history and evolution of transistors integrated circuits and quantum devices How superconducting materials are used in applications ranging from MRI machines to high speed trains The role of semiconductors in smartphones AI systems and energy efficient power grids Future research directions including the pursuit of room temperature superconductors and wide bandgap semiconductors like SiC and GaN The convergence of AI machine learning and nanotechnology in designing next generation semiconductor and superconductor devices The book also provides a forward looking perspective on how these technologies will shape the future particularly in fields like quantum computing artificial intelligence and renewable energy systems With chapters organized for easy navigation technical glossaries and suggested reading for further exploration Semiconductors and Superconductors From Invention to Innovation is an essential resource for anyone looking to understand the technological forces that are driving the world forward

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