

## Semiconductors to transform electricity to light

### LED

Light-emitting element that emits light visible to the human eye such as purple to red or white



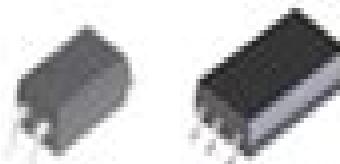
### Light-receiving device

Photodiode, light-receiving IC, etc.  
Products that output changes in light as electrical signals

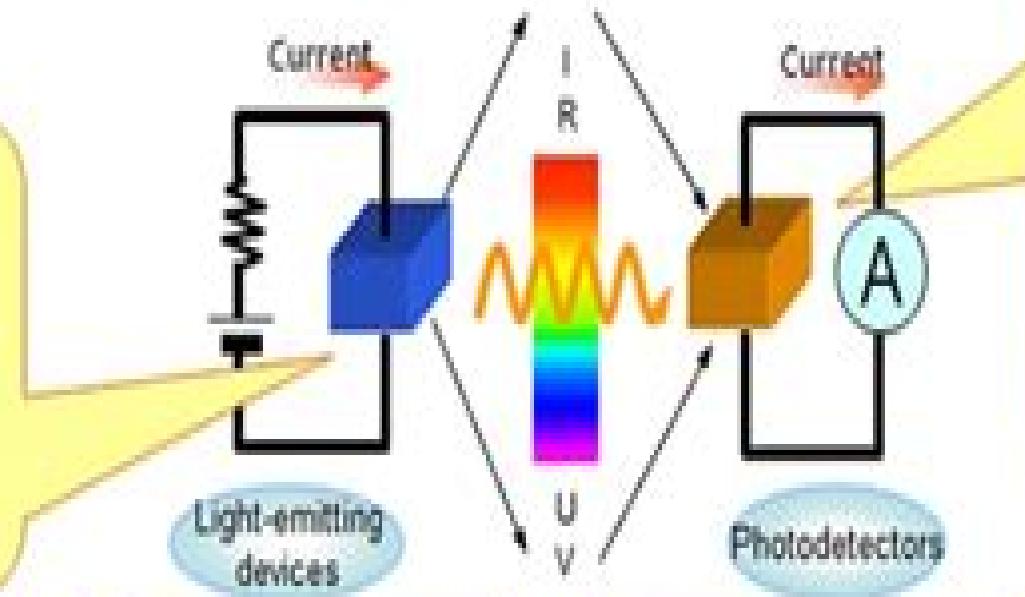


### Photocouplers

Composite device packaged with a light-emitting device and a light-receiving device.  
Products that transmit electrical signals while keeping them electrically isolated



## Semiconductors to transform light to electricity



### Fiber couplers

A product that performs electrical-to-optical conversion and vice versa for communication using an optical fiber.



# Optical Semiconductor Devices

**Jasprit Singh**

## **Optical Semiconductor Devices:**

**Optical Semiconductor Devices** Mitsuo Fukuda, 1998-12-24 This book is devoted to optical semiconductor devices and their numerous applications in telecommunications optoelectronics and consumer electronics areas where signal processing or the transmission of signals across fiber optic cables is paramount. It introduces a new generation of devices that includes optical modulators quantum well QW lasers and photodiodes and explores new applications of more established devices such as semiconductor lasers light emitting diodes and photodiodes. Mitsuo Fukuda examines the material properties operation principles fabrication packaging reliability and applications of each device and offers a unique industrial perspective discussing everything engineers and scientists need to know at different phases of research development and production. This guide to the state of the art of optical semiconductor devices helps you choose the right device for a given application. Covers important performance data such as temperature and optical feedback noise in lasers. Highlights epitaxial growth techniques and fabrication for each device. Features one hundred figures and an extensive bibliography. Provides a clear and concise treatment unencumbered by excessive theory. *Optical Semiconductor Devices* is an essential resource for engineers and researchers in telecommunications and optoelectronics equipment designers and manufacturers and graduate students and scholars interested in this rapidly evolving field.

*Optical Semiconductor Devices* 1990 Nihon Denki Kabushiki Kaisha, 1990

**Optoelectronic Semiconductor Devices** David Wood, 1994 Optoelectronic Semiconductor Devices is a comprehensive new textbook offering a complete blend of theory and practice. Starting with basic semiconductor theory it moves on through a discussion of light emitters and detectors and then to their actual manufacture. Features of the book include full coverage of basic semiconductors and semiconductor lasers not seen in most optoelectronic textbooks of this level treatment of all types of detectors not just pin and avalanche diodes details of materials and fabrication and extensive references conceptual and numerical problems and worked examples. Optoelectronic Semiconductor Devices can be used by undergraduate and postgraduate students in departments of physics or electrical engineering.

Semiconductor Devices for Optical Communication H. Kressel, 2006-01-21 With contributions by numerous experts

Semiconductor Devices for Optical Communication

Henry Kressel, 1979

**Optical Semiconductor Devices** NEC Electronics, 1993

**Semiconductor Devices for Optical Communication**

H. Kressel, 2014-01-15

*Optical Semiconductor Devices* NEC Electronics, 1995

**Semiconductor Devices for High-speed Optoelectronics** Giovanni Ghione, 2009 Providing an all inclusive treatment of electronic and optoelectronic devices used in high speed optical communication systems this book emphasizes circuit applications advanced device design solutions and noise in sources and receivers. Core topics covered include semiconductors and semiconductor optical properties high speed circuits and transistors detectors sources and modulators. It discusses in detail both active devices heterostructure field effect and bipolar transistors and passive components lumped and distributed for high speed electronic integrated circuits. It also describes recent advances in high speed devices for 40 Gbps systems.

Introductory elements are provided making the book open to readers without a specific background in optoelectronics whilst end of chapter review questions and numerical problems enable readers to test their understanding and experiment with realistic data

**Semiconductor Physical Electronics** Sheng S. Li, 2012-12-06 The purpose of this book is to provide the reader with a self contained treatment of fundamental solid state and semiconductor device physics. The material presented in the text is based upon the lecture notes of a one year graduate course sequence taught by this author for many years in the Department of Electrical Engineering of the University of Florida. It is intended as an introductory textbook for graduate students in electrical engineering. However many students from other disciplines and backgrounds such as chemical engineering, materials science and physics have also taken this course sequence and will be interested in the material presented herein. This book may also serve as a general reference for device engineers in the semiconductor industry. The present volume covers a wide variety of topics on basic solid state physics and physical principles of various semiconductor devices. The main subjects covered include crystal structures, lattice dynamics, semiconductor statistics, energy band theory, excess carrier phenomena and recombination mechanisms, carrier transport and scattering mechanisms, optical properties, photoelectric effects, metal semiconductor devices, the p-n junction diode, bipolar junction transistor, MOS devices, photonic devices, quantum effect devices and high speed III-V semiconductor devices. The text presents a unified and balanced treatment of the physics of semiconductor materials and devices. It is intended to provide physicists and materials scientists with more device backgrounds and device engineers with a broader knowledge of fundamental solid state physics.

Materials and Reliability Handbook for Semiconductor Optical and Electron Devices Osamu Ueda, Stephen J. Pearton, 2012-09-24 Materials and Reliability Handbook for Semiconductor Optical and Electron Devices provides comprehensive coverage of reliability procedures and approaches for electron and photonic devices. These include lasers and high speed electronics used in cell phones, satellites, data transmission systems and displays. Lifetime predictions for compound semiconductor devices are notoriously inaccurate due to the absence of standard protocols. Manufacturers have relied on extrapolation back to room temperature of accelerated testing at elevated temperature. This technique fails for scaled high current density devices. Device failure is driven by electric field or current mechanisms or low activation energy processes that are masked by other mechanisms at high temperature. The Handbook addresses reliability engineering for III-V devices including materials and electrical characterization, reliability testing and electronic characterization. These are used to develop new simulation technologies for device operation and reliability which allow accurate prediction of reliability as well as the design specifically for improved reliability. The Handbook emphasizes physical mechanisms rather than an electrical definition of reliability. Accelerated aging is useful only if the failure mechanism is known. The Handbook also focuses on voltage and current acceleration stress mechanisms

*Semiconductor Optoelectronic Devices* Joachim Piprek, 2013-10-22 Optoelectronics has become an important part of our lives. Wherever light is used to transmit information

tiny semiconductor devices are needed to transfer electrical current into optical signals and vice versa Examples include light emitting diodes in radios and other appliances photodetectors in elevator doors and digital cameras and laser diodes that transmit phone calls through glass fibers Such optoelectronic devices take advantage of sophisticated interactions between electrons and light Nanometer scale semiconductor structures are often at the heart of modern optoelectronic devices Their shrinking size and increasing complexity make computer simulation an important tool to design better devices that meet ever rising performance requirements The current need to apply advanced design software in optoelectronics follows the trend observed in the 1980 s with simulation software for silicon devices Today software for technology computer aided design TCAD and electronic design automation EDA represents a fundamental part of the silicon industry In optoelectronics advanced commercial device software has emerged recently and it is expected to play an increasingly important role in the near future This book will enable students device engineers and researchers to more effectively use advanced design software in optoelectronics Provides fundamental knowledge in semiconductor physics and in electromagnetics while helping to understand and use advanced device simulation software Demonstrates the combination of measurements and simulations in order to obtain realistic results and provides data on all required material parameters Gives deep insight into the physics of state of the art devices and helps to design and analyze of modern optoelectronic devices

### **Semiconductor Devices**

Jasprit Singh,1994 The basic semiconductor devices are explored at two levels 1 a mathematically rigorous but simple model for each device is developed and then 2 the motivations of modern devices which are more complex are provided By discussing silicon gallium arsenide and other semiconductor based devices the text provides a state of the art discussion of modern electronic devices Most subsections end with a solved example so that the reader develops a feel of real numbers and the importance of device design

**The Physics of Semiconductors** Marius Grundmann,2006-11-22

Semiconductor devices are now a days commonplace in every household In the late 1940s the invention of the transistor was the start of a rapid development towards ever faster and smaller electronic components Complex systems are built with these components The main driver of this development was the economical benefit from packing more and more wiring transistors and functionality on a single chip Now every human is left with about 100 million transistors on average Semiconductor devices have also enabled economically reasonable fiber based optical communication optical storage and high frequency amplification and have only recently revolutionized photography display technology and lighting Along with these tremendous technological developments semiconductors have changed the way we work communicate entertain and think The technological sophistication of semiconductor materials and devices is progressing continuously with a large worldwide effort in human and monetary capital partly evolutionary partly revolutionary embracing the possibilities of nanotechnology For students semiconductors offer a rich diverse and exciting field with a great tradition and a bright future This book is based on the two semester semiconductor physics course taught at Universit at Leipzig The

material gives the students an overview of the subject as a whole and brings them to the point where they can specialize and enter supervised laboratory research For the interested reader some additional topics are included in the book that are taught in subsequent more specialized courses The first semester contains the fundamentals of semiconductor physics Part I Chaps 1

17 **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

Physics of Optoelectronic Devices Shun Lien Chuang, 1995-09-08 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 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 speed modulation of semiconductor lasers using linear and nonlinear gains Features new subjects such as the theories on the band structures of strained semiconductors and strained quantum well lasers Covers key areas behind the operation of semiconductor lasers modulators and photodetectors An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department

**Analysis and Simulation of Semiconductor Devices** S. Selberherr, 1984-07 The invention of semiconductor devices is a fairly recent one considering classical time scales in human life The bipolar transistor was announced in 1947 and the MOS transistor in a practically usable manner was demonstrated in 1960 From these beginnings the semiconductor device field has grown rapidly The first integrated circuits which contained just a few devices became commercially available in the early 1960s Immediately thereafter an evolution has taken place so that today less than 25 years later the manufacture of integrated circuits with over 400 000 devices per single chip is possible Coincident with the growth in semiconductor device development the literature concerning semiconductor device and technology issues has literally exploded In the last decade

about 50 000 papers have been published on these subjects The advent of so called Very Large Scale Integration VLSI has certainly revealed the need for a better understanding of basic device behavior The miniaturization of the single transistor which is the major prerequisite for VLSI nearly led to a breakdown of the classical models of semiconductor devices

**Introduction to Semiconductor Integrated Optics** Hans P. Zappe, 1995 This comprehensive book introduces semiconductors and integrated optics and provides in depth derivations and analysis of key integrated optical components for more advanced study The author emphasizes practical application developing and explaining the concepts and techniques needed to understand the engineering issues and solve real world problems With its clear explanations and design examples the book provides experienced and budding engineers with the information necessary to design the structure and fabrication process of a semiconductor integrated optical device Invaluable for engineers and applied scientists in optics semiconductors R D engineers in communications sensors and medicine and graduate students Complete with 280 equations and 95 illustrations

**Electronic and Optoelectronic Properties of Semiconductor Structures** Jasprit Singh, 2007-03-26 A graduate textbook presenting the underlying physics behind devices that drive today's technologies The book 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 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 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 lectures are available for instructors from solutions.cambridge.org

**Radiative Properties of Semiconductors** N.M. Ravindra, Sita Rajyalaxmi Marthi, Asahel Banobre, 2017-08-21 Optical properties particularly in the infrared range of wavelengths continue to be of enormous interest to both material scientists and device engineers The need for the development of standards for data of optical properties in the infrared range of wavelengths is very timely considering the on going transition of nano technology from fundamental R D to manufacturing Radiative properties play a critical role in the processing process control and manufacturing of semiconductor materials devices circuits and systems The design and implementation of real time process control methods in manufacturing requires the knowledge of the radiative properties of materials Sensors and imagers operate on the basis of the radiative properties of materials This book reviews the optical properties of various semiconductors in the infrared range of wavelengths Theoretical and experimental studies of the radiative properties of semiconductors are presented Previous studies potential applications and future developments are outlined In Chapter 1 an introduction to the radiative properties is

presented Examples of instrumentation for measurements of the radiative properties is described in Chapter 2 In Chapters 3 11 case studies of the radiative properties of several semiconductors are elucidated The modeling and applications of these properties are explained in Chapters 12 and 13 respectively In Chapter 14 examples of the global infrastructure for these measurements are illustrated

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