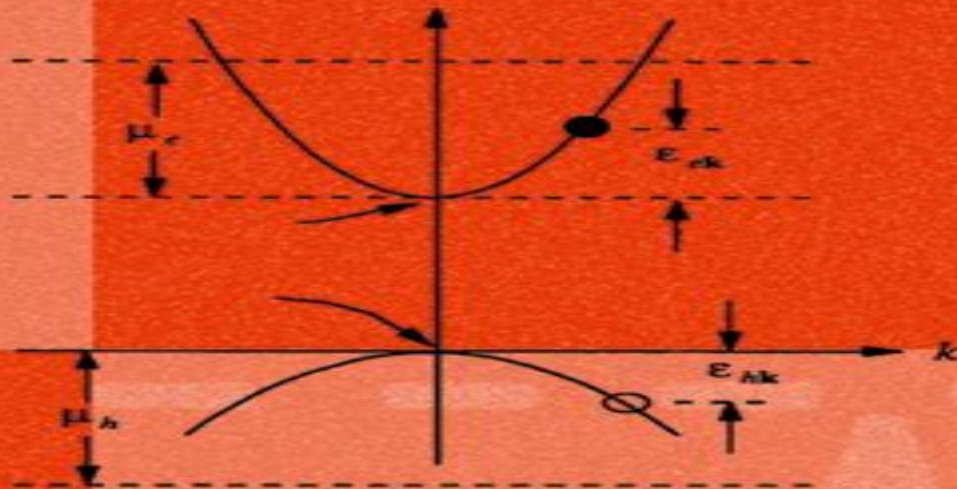


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# Semiconductor – Laser Fundamentals

Physics of the Gain Materials



Springer

# Semiconductorlaser Fundamentals Physics Of The Gain Materials

**Massimo Rudan, Rossella  
Brunetti, Susanna Reggiani**



## **Semiconductorlaser Fundamentals Physics Of The Gain Materials:**

Semiconductor-Laser Fundamentals Weng W. Chow,Stephan W. Koch,1999-07-21 This in depth title discusses the underlying physics and operational principles of semiconductor lasers It analyzes the optical and electronic properties of the semiconductor medium in detail including quantum confinement and gain engineering effects The text also includes recent developments in blue emitting semiconductor lasers

**Semiconductor-Laser Fundamentals** Weng W. Chow,Stephan W. Koch,2013-01-08 This in depth title discusses the underlying physics and operational principles of semiconductor lasers It analyzes the optical and electronic properties of the semiconductor medium in detail including quantum confinement and gain engineering effects The text also includes recent developments in blue emitting semiconductor lasers

**Semiconductor-Laser Fundamentals** Weng W. Chow,Stephan W. Koch,2013-03-09 Since Fall of 1993 when we completed the manuscript of our book Semi conductor Laser Physics W W Chow S W Koch and M Sargent III Springer Berlin Heidelberg 1994 many new and exciting developments have taken place in the world of semiconductor lasers Novel laser and ampli fier structures were developed and others for example the VCSEL vertical cavity surface emitting laser and monolithic MOPA master oscillator power amplifier made the transition from research and development to production When investigating some of these systems we discovered instances when de vice performance and thus design depend critically on details of the gain medium properties e g spectral shape and carrier density dependence of the gain and refractive index New material systems were also introduced with optical emission wave lengths spanning from the mid infrared to the ultraviolet Particularly note worthy are laser and light emitting diodes based on the wide bandgap group III nitride and II VI compounds These devices emit in the visible to ultra violet wavelength range which is important for the wide variety of optoelectronic applications While these novel semiconductor laser materi als show many similarities with the more conventional near infrared systems they also possess rather different material parameter combinations These dif ferences appear as band structure modifications and as increased importance of Coulomb effects such that e g excitonic signatures resulting from the at tractive electron hole interaction are generally significantly more prominent in the wide bandgap systems

Physics of Photonic Devices Shun Lien Chuang,2012-11-07 The most up to date book available on the physics of photonic devices This new edition of Physics of Photonic Devices incorporates significant advancements in the field of photonics that have occurred since publication of the first edition Physics of Optoelectronic Devices New topics covered include a brief history of the invention of semiconductor lasers the Lorentz dipole method and metal plasmas matrix optics surface plasma waveguides optical ring resonators integrated electroabsorption modulator lasers and solar cells It also introduces exciting new fields of research such as surface plasmonics and micro ring resonators the theory of optical gain and absorption in quantum dots and quantum wires and their applications in semiconductor lasers and novel microcavity and photonic crystal lasers quantum cascade lasers and GaN blue green lasers within the context of advanced semiconductor lasers Physics of Photonic Devices

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temperature is high This study paves the way for developing uncooled and isolator free PIC 3 The limited phase noise level and optical bandwidth of the laser are the bottlenecks for further increasing the transmission capacity To improve the transmission capacity and meet the requirement of the next generation of high speed optical communication we introduce the QD based optical frequency comb OFC laser in this book Benefiting from the gain broadening effect and the low noise properties of QD the OFC laser is realized with high optical bandwidth and low phase noise We also provide approaches to further improve the laser performance including the external optical feedback and the optical injection 4 Platform with rich optical nonlinearities is highly desired by future integrated quantum technologies In this book we investigate the nonlinear properties and four wave mixing FWM of QD laser on Si This study reveals that the FWM efficiency of QD laser is more than ten times higher than that of quantum well laser which gives insight into developing a QD based silicon platform for quantum states of light generation Based on the results in this book scientists researchers and engineers can come up with an informed judgment in utilizing the QD laser for applications ranging from classical silicon PIC to integrated quantum technologies

**Photonics Modelling and Design** Slawomir Sujecki, 2018-09-03 Photonics Modeling and Design delivers a concise introduction to the modeling and design of photonic devices Assuming a general knowledge of photonics and the operating principles of fibre and semiconductor lasers this book Describes the analysis of the light propagation in dielectric media Discusses heat diffusion and carrier transport Applies the presented theory to develop fibre and semiconductor laser models Addresses the propagation of short optical pulses in optical fibres Puts all modeling into practical context with examples of devices currently in development or on the market Providing hands on guidance in the form of MATLAB scripts tips and other downloadable content Photonics Modeling and Design is written for students and professionals interested in modeling photonic devices either for gaining a deeper understanding of the operation or to optimize the design

**Lasers and Electro-optics** Christopher C. Davis, 2014-03-20 Covering a broad range of topics in modern optical physics and engineering this textbook is invaluable for undergraduate students studying laser physics optoelectronics photonics applied optics and optical engineering This new edition has been re organized and now covers many new topics such as the optics of stratified media quantum well lasers and modulators free electron lasers diode pumped solid state and gas lasers imaging and non imaging optical systems squeezed light periodic poling in nonlinear media very short pulse lasers and new applications of lasers The textbook gives a detailed introduction to the basic physics and engineering of lasers as well as covering the design and operational principles of a wide range of optical systems and electro optic devices It features full details of important derivations and results and provides many practical examples of the design construction and performance characteristics of different types of lasers and electro optic devices

**Contemporary Optoelectronics** Oleksiy Shulika, Igor Sukhoivanov, 2015-09-11 This book presents a collection of extended contributions on the physics and application of optoelectronic materials and metamaterials The book is divided into three parts respectively covering materials

metamaterials and optoelectronic devices Individual chapters cover topics including phonon polariton interaction semiconductor and nonlinear organic materials metallic dielectric and gyrotropic metamaterials singular optics parity time symmetry nonlinear plasmonics microstructured optical fibers passive nonlinear shaping of ultrashort pulses and pulse preserving supercontinuum generation The book contains both experimental and theoretical studies and each contribution is a self contained exposition of a particular topic featuring an extensive reference list The book will be a useful resource for graduate and postgraduate students researchers and engineers involved in optoelectronics photonics quantum electronics optics and adjacent areas of science and technology

Applied Nanophotonics Sergey V. Gaponenko, Hilmi Volkan Demir, 2019 An accessible yet rigorous introduction to nanophotonics covering basic principles technology and applications in lighting lasers and photovoltaics Providing a wealth of information on materials and devices and over 150 color figures it is the go to guide for students in electrical engineering taking courses in nanophotonics

**Springer Handbook of Semiconductor Devices** Massimo Rudan, Rossella Brunetti, Susanna Reggiani, 2022-11-10 This Springer Handbook comprehensively covers the topic of semiconductor devices embracing all aspects from theoretical background to fabrication modeling and applications Nearly 100 leading scientists from industry and academia were selected to write the handbook's chapters which were conceived for professionals and practitioners material scientists physicists and electrical engineers working at universities industrial R D and manufacturers Starting from the description of the relevant technological aspects and fabrication steps the handbook proceeds with a section fully devoted to the main conventional semiconductor devices like e g bipolar transistors and MOS capacitors and transistors used in the production of the standard integrated circuits and the corresponding physical models In the subsequent chapters the scaling issues of the semiconductor device technology are addressed followed by the description of novel concept based semiconductor devices The last section illustrates the numerical simulation methods ranging from the fabrication processes to the device performances Each chapter is self contained and refers to related topics treated in other chapters when necessary so that the reader interested in a specific subject can easily identify a personal reading path through the vast contents of the handbook

Optoelectronic Devices Joachim Piprek, 2006-01-26 Optoelectronic devices transform electrical signals into optical signals and vice versa by utilizing the interaction of electrons and light Advanced software tools for the design and analysis of such devices have been developed in recent years However the large variety of materials devices physical mechanisms and modeling approaches often makes it difficult to select appropriate theoretical models or software packages This book presents a review of devices and advanced simulation approaches written by leading researchers and software developers It is intended for scientists and device engineers in optoelectronics who are interested in using advanced software tools Each chapter includes the theoretical background as well as practical simulation results that help the reader to better understand internal device physics Real world devices such as edge emitting or surface emitting laser diodes light emitting diodes solar cells

photodetectors and integrated optoelectronic circuits are investigated The software packages described in the book are available to the public on a commercial or noncommercial basis so that the interested reader is quickly able to perform similar simulations      *Physical Effects of Geometric Phases* Qian Niu,Ming-Che Chang,Biao Wu,Di Xiao,Ran

Cheng,2017-08-28 Berry phase has been widely used in condensed matter physics in the past two decades This volume is a timely collection of essential papers in this important field which is highlighted by 2016 Nobel Prize in physics and recent exciting developments in topological matters Each chapter has an introduction which helps readers to understand the reprints that follow      III-Nitride Semiconductors Hongxing Jiang,2002-07-26 This second part presents a comprehensive overview of fundamental optical properties of the III Nitride Semiconductor All optoelectronic applications based on III nitrides are due to their unique optical properties and characterizations of III nitrides Much information which is critical to the design and improvement of optoelectronic devices based on III nitrides has been obtained in the last several years This is the second of a two part Volume in the series Optoelectronic Properties of Semiconductors and Superlattices Part II consists of chapters with emphasis on the optical spectroscopy of highly excited group III nitrides theoretical calculations and experimental measurements of optical constants of III nitrides The remaining five chapters focus on the relationships and properties of GaN and InGaN as relating to III Nitrides This unique volume provides a comprehensive review and introduction of the defects and structural properties of GaN and related compounds for newcomers to the field and will be a stimulus to further advances for experienced researchers The chapters contained in this volume constitutes a representative sampling of the broad range of research on nitride semiconductor materials and defect issues currently being pursued in academic government and industrial laboratories worldwide      *Handbook of Optoelectronic Device Modeling and Simulation* Joachim Piprek,2017-10-10 Optoelectronic devices are now ubiquitous in our daily lives from light emitting diodes LEDs in many household appliances to solar cells for energy This handbook shows how we can probe the underlying and highly complex physical processes using modern mathematical models and numerical simulation for optoelectronic device design analysis and performance optimization It reflects the wide availability of powerful computers and advanced commercial software which have opened the door for non specialists to perform sophisticated modeling and simulation tasks The chapters comprise the know how of more than a hundred experts from all over the world The handbook is an ideal starting point for beginners but also gives experienced researchers the opportunity to renew and broaden their knowledge in this expanding field      Lasers Charles Blain,2002 Developments in lasers continue to enable progress in many areas such as eye surgery the recording industry and dozens of others This book presents citations from the book literature for the last 25 years and groups them for ease of access which is also provided by subject author and titles indexes      **Lasers and Optoelectronics** Anil K. Maini,2013-08-05 With emphasis on the physical and engineering principles this book provides a comprehensive and highly accessible treatment of modern lasers and optoelectronics Divided into four parts it explains laser



fundamentals types of lasers laser electronics optoelectronics and laser applications covering each of the topics in their entirety from basic fundamentals to advanced concepts Key features include exploration of technological and application related aspects of lasers and optoelectronics detailing both existing and emerging applications in industry medical diagnostics and therapeutics scientific studies and Defence simple explanation of the concepts and essential information on electronics and circuitry related to laser systems illustration of numerous solved and unsolved problems practical examples chapter summaries self evaluation exercises and a comprehensive list of references for further reading This volume is a valuable design guide for R D engineers and scientists engaged in design and development of lasers and optoelectronics systems and technicians in their operation and maintenance The tutorial approach serves as a useful reference for under graduate and graduate students of lasers and optoelectronics also PhD students in electronics optoelectronics and physics

*Physics and Simulation of Optoelectronic Devices*, 2001      *Handbook of Defence Electronics and Optronics* Anil K. Maini, 2018-03-26 Handbook of Defence Electronics and Optronics Anil K Maini Former Director Laser Science and Technology Centre India First complete reference on defence electronics and optronics Fundamentals Technologies and Systems This book provides a complete account of defence electronics and optronics The content is broadly divided into three categories topics specific to defence electronics topics relevant to defence optronics and topics that have both electronics and optronics counterparts The book covers each of the topics in their entirety from fundamentals to advanced concepts military systems in use and related technologies thereby leading the reader logically from the operational basics of military systems to involved technologies and battlefield deployment and applications Key features Covers fundamentals operational aspects involved technologies and application potential of a large cross section of military systems Discusses emerging technology trends and development and deployment status of next generation military systems wherever applicable in each category of military systems Amply illustrated with approximately 1000 diagrams and photographs and around 30 tables Includes salient features technologies and deployment aspects of hundreds of military systems including military radios ground and surveillance radars laser range finder and target designators night visions devices EW and EO jammers laser guided munitions and military communications equipment and satellites Handbook of Defence Electronics and Optronics is an essential guide for graduate students R D scientists engineers engaged in manufacturing defence equipment and professionals handling the operation and maintenance of these systems in the Armed Forces      **Optoelectronic Devices** Xun Li, 2009-06-11 Get hands on experience of optoelectronic device design and simulation using numerical methods



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