

Handbook Of Silicon Photonics

Given silicon's versatile material properties, use of low-cost silicon photonics continues to move beyond light-speed data transmission through fiber-optic cables and computer chips. Its application has also evolved from the device to the integrated-system level. A timely overview of this impressive growth, *Silicon Photonics for Telecommunications and Biomedicine* summarizes state-of-the-art developments in a wide range of areas, including optical communications, wireless technologies, and biomedical applications of silicon photonics. With contributions from world experts, this reference guides readers through fundamental principles and focuses on crucial advances in making commercial use of silicon photonics a viable reality in the telecom and biomedical industries. Taking into account existing and anticipated industrial directions, the book balances coverage of theory and practical experimental research to explore solutions for obstacles to the viable commercialization of silicon photonics. The book's special features include: A section on silicon plasmonic waveguides Detailed coverage of novel III-V applications A chapter on 3D integration Discussion of applications for energy harvesting/photovoltaics This book reviews the most important technological trends and challenges. It presents topics involving major silicon photonics applications in telecommunications, high-power photonics, and biomedicine. It includes discussion of silicon plasmonic waveguides, piezoelectric tuning of silicon's optical properties, and applications of two-photon absorption. Expert authors with industry research experience examine the challenge of hybridizing III-V compound semiconductors on silicon to achieve monolithic light sources. They also address economic compatibility and heat dissipation issues in CMOS chips, challenges in designing electronic photonics integrated circuits, and the need for standardization in computer-aided design of industrial chips. This book gives an authoritative summary of the latest research in this emerging field, covering key topics for readers from various disciplines with an interest in integrated photonics. This comprehensive handbook gives a fully updated guide to lasers and laser technologies, including the complete range of their technical applications. This fourth volume covers laser applications in the medical, metrology and communications fields. Key Features: • Offers a complete update of the original, bestselling work, including many brand-new chapters. • Deepens the introduction to fundamentals, from laser design and fabrication to host matrices for solid-state lasers, energy level diagrams, hosting materials, dopant energy levels, and lasers based on nonlinear effects. • Covers new laser types, including quantum cascade lasers, silicon-based lasers, titanium sapphire lasers, terahertz lasers, bismuth-doped fiber lasers, and diode-pumped alkali lasers. • Discusses the latest applications, e.g., lasers in microscopy, high-speed imaging, attosecond metrology, 3D printing, optical atomic clocks, time-resolved spectroscopy, polarization and profile measurements, pulse measurements, and laser-induced fluorescence detection. • Adds new sections on laser materials processing, laser spectroscopy, lasers in imaging, lasers in environmental sciences, and lasers in communications. This handbook is the ideal companion for scientists, engineers, and students working with lasers, including those in optics, electrical engineering, physics, chemistry, biomedicine, and other relevant areas.

Since it was first published in 1995, Photonic Crystals has remained the definitive text for both undergraduates and researchers on photonic band-gap materials and their use in controlling the propagation of light. This newly expanded and revised edition covers the latest developments in the field, providing the most up-to-date, concise, and comprehensive book available on these novel materials and their applications. Starting from Maxwell's equations and Fourier analysis, the authors develop the theoretical tools of photonics using principles of linear algebra and symmetry, emphasizing analogies with traditional solid-state physics and quantum theory. They then investigate the unique phenomena that take place within photonic crystals at defect sites and surfaces, from one to three dimensions. This new edition includes entirely new chapters describing important hybrid structures that use band gaps or periodicity only in some directions: periodic waveguides, photonic-crystal slabs, and photonic-crystal fibers. The authors demonstrate how the capabilities of photonic crystals to localize light can be put to work in devices such as filters and splitters. A new appendix provides an overview of computational methods for electromagnetism. Existing chapters have been considerably updated and expanded to include many new three-dimensional photonic crystals, an extensive tutorial on device design using temporal coupled-mode theory, discussions of diffraction and refraction at crystal interfaces, and more. Richly illustrated and accessibly written, Photonic Crystals is an indispensable resource for students and researchers. Extensively revised and expanded Features improved graphics throughout Includes new chapters on photonic-crystal fibers and combined index-and band-gap-guiding Provides an introduction to coupled-mode theory as a powerful tool for device design Covers many new topics, including omnidirectional reflection, anomalous refraction and diffraction, computational photonics, and much more.

A benchmark publication, the first edition of the Phosphor Handbook, published in 1998, set the standard for references in the field. The second edition, updated and published in 2007, began exploring new and emerging fields. However, in the last 14 years, since the second edition was published, many notable advances and broader phosphor applications have occurred. Completely revised, updated, and expanded into three separate volumes, this third edition of the Handbook covers the most recent developments in phosphor research, characterization, and applications. This volume on 'Fundamentals of Luminescence' elucidates the theoretical background and fundamental properties of luminescence as applied to solid-state phosphor materials. The book includes the chapters that cover: Basic principles of luminescence, the principal phosphor materials, and their optical properties New developments in principal phosphors in nitrides, perovskite, and silicon carbide Revised lanthanide level locations and its impact on phosphor performance Detailed descriptions of energy transfer and upconversion processes in bulk and nanoscaled particles and core-shell structures Rapid developing organic and polymer luminescent materials and devices

Photonic Crystals

Handbook of Silicon Photonics

Handbook of Fiber Optic Data Communication

Handbook of Silicon Based MEMS Materials and Technologies

Fundamentals of Luminescence

Basic Principles, Present Status, and Perspectives, Second Edition

An optical cavity confines light within its structure and constitutes an integral part of a laser device. Unlike traditional gas lasers, semiconductor lasers are invariably much smaller in dimensions, making optical confinement more critical than ever. In this book, modern methods that control and manipulate light at the micrometer and nanometer scales by using a variety of cavity geometries and demonstrate optical resonance from ultra-violet (UV) to infra-red (IR) bands across multiple material platforms are explored. The book has a comprehensive collection of chapters that cover a wide range of topics pertaining to resonance in optical cavities and are contributed by leading researchers in the field. The topics include theory, design, simulation, fabrication, and characterization of micrometer- and nanometer-scale structures and devices that support cavity resonance via various mechanisms such as Fabry-Pérot, whispering gallery, photonic bandgap, and plasmonic modes. The chapters discuss optical cavities that resonate from UV to IR wavelengths and are based on prominent III-V material systems, including Al, In, and Ga nitrides, ZnO, and GaAs.

Silicon photonics is beginning to play an important role in driving innovations in communication and computation for an increasing number of applications, from health care and biomedical sensors to autonomous driving, datacenter networking, and security. In recent years, there has been a significant amount of effort in industry and academia to innovate, design, develop, analyze, optimize, and fabricate systems employing silicon photonics, shaping the future of not only Datacom and telecom technology but also high-performance computing and emerging computing paradigms, such as optical computing and artificial intelligence. Different from existing books in this area, *Silicon Photonics for High-Performance Computing and Beyond* presents a comprehensive overview of the current state-of-the-art technology and research achievements in applying silicon photonics for communication and computation. It focuses on various design, development, and integration challenges, reviews the latest advances spanning materials, devices, circuits, systems, and applications. Technical topics discussed in the book include:

- Requirements and the latest advances in high-performance computing systems
- Device- and

system-level challenges and latest improvements to deploy silicon photonics in computing systems • Novel design solutions and design automation techniques for silicon photonic integrated circuits • Novel materials, devices, and photonic integrated circuits on silicon • Emerging computing technologies and applications based on silicon photonics

Silicon Photonics for High-Performance Computing and Beyond presents a compilation of 19 outstanding contributions from academic and industry pioneers in the field. The selected contributions present insightful discussions and innovative approaches to understand current and future bottlenecks in high-performance computing systems and traditional computing platforms, and the promise of silicon photonics to address those challenges. It is ideal for researchers and engineers working in the photonics, electrical, and computer engineering industries as well as academic researchers and graduate students (M.S. and Ph.D.) in computer science and engineering, electronic and electrical engineering, applied physics, photonics, and optics.

The growing demand for instant and reliable communication means that photonic circuits are increasingly finding applications in optical communications systems. One of the prime candidates to provide satisfactory performance at low cost in the photonic circuit is silicon. Whilst silicon photonics is less well developed as compared to some other material technologies, it is poised to make a serious impact on the telecommunications industry, as well as in many other applications, as other technologies fail to meet the yield/performance/cost trade-offs. Following a sympathetic tutorial approach, this first book on silicon photonics provides a comprehensive overview of the technology. Silicon Photonics explains the concepts of the technology, taking the reader through the introductory principles, on to more complex building blocks of the optical circuit. Starting with the basics of waveguides and the properties peculiar to silicon, the book also features: Key design issues in optical circuits. Experimental methods. Evaluation techniques. Operation of waveguide based devices. Fabrication of silicon waveguide circuits. Evaluation of silicon photonic systems. Numerous worked examples, models and case studies. Silicon Photonics is an essential tool for photonics engineers and young professionals working in the optical network, optical communications and semiconductor

industries. This book is also an invaluable reference and a potential main text to senior undergraduates and postgraduate students studying fibre optics, integrated optics, or optical network technology.

The first encompassing treatise of this new, but very important field puts the known physical limitations for classic 2D electronics into perspective with the requirements for further electronics developments and market necessities. This two-volume handbook presents 3D solutions to the feature density problem, addressing all important issues, such as wafer processing, die bonding, packaging technology, and thermal aspects. It begins with an introductory part, which defines necessary goals, existing issues and relates 3D integration to the semiconductor roadmap of the industry. Before going on to cover processing technology and 3D structure fabrication strategies in detail. This is followed by fields of application and a look at the future of 3D integration. The contributions come from key players in the field, from both academia and industry, including such companies as Lincoln Labs, Fraunhofer, RPI, ASET, IMEC, CEA-LETI, IBM, and Renesas.

Molding the Flow of Light - Second Edition
Applied Optical Electronics (Volume Three)
Nanophotonics and Plasmonics
Fundamentals of Photonics

Forward the Next Generation Supercomputer

The creation of affordable high speed optical communications using standard semiconductor manufacturing technology is a principal aim of silicon photonics research. This would involve replacing copper connections with optical fibres or waveguides, and electrons with photons. With applications such as telecommunications and information processing, light detection, spectroscopy, holography and robotics, silicon photonics has the potential to revolutionise electronic-only systems. Providing an overview of the physics, technology and device operation of photonic devices using exclusively silicon and related alloys, the book includes: Basic Properties of Silicon Quantum Wells, Wires, Dots and Superlattices Absorption Processes in Semiconductors Light Emitters in Silicon Photodetectors , Photodiodes and Phototransistors Raman Lasers including Raman Scattering Guided Lightwaves Planar Waveguide Devices Fabrication Techniques and Material Systems Silicon Photonics: Fundamentals and Devices outlines the basic principles of operation of devices, the

structures of the devices, and offers an insight into state-of-the-art and future developments.

Handbook of Optoelectronics offers a self-contained reference from the basic science and light sources to devices and modern applications across the entire spectrum of disciplines utilizing optoelectronic technologies. This second edition gives a complete update of the original work with a focus on systems and applications. Volume I covers the details of optoelectronic devices and techniques including semiconductor lasers, optical detectors and receivers, optical fiber devices, modulators, amplifiers, integrated optics, LEDs, and engineered optical materials with brand new chapters on silicon photonics, nanophotonics, and graphene optoelectronics. Volume II addresses the underlying system technologies enabling state-of-the-art communications, imaging, displays, sensing, data processing, energy conversion, and actuation. Volume III is brand new to this edition, focusing on applications in infrastructure, transport, security, surveillance, environmental monitoring, military, industrial, oil and gas, energy generation and distribution, medicine, and free space. No other resource in the field comes close to its breadth and depth, with contributions from leading industrial and academic institutions around the world. Whether used as a reference, research tool, or broad-based introduction to the field, the Handbook offers everything you need to get started. John P. Dakin, PhD, is professor (emeritus) at the Optoelectronics Research Centre, University of Southampton, UK. Robert G. W. Brown, PhD, is chief executive officer of the American Institute of Physics and an adjunct full professor in the Beckman Laser Institute and Medical Clinic at the University of California, Irvine.

Silicon photonics uses chip-making techniques to fabricate photonic circuits. The emerging technology is coming to market at a time of momentous change. The need of the Internet content providers to keep scaling their data centers is becoming increasingly challenging, the chip industry is facing a future without Moore's law, while telcos must contend with a looming capacity crunch due to continual traffic growth. Each of these developments is significant in its own right. Collectively, they require new thinking in the design of chips, optical components, and systems. Such change also signals new business opportunities and disruption. Notwithstanding challenges, silicon photonics' emergence is timely because it is the future of several industries. For the optical industry, the technology will allow designs to be tackled in new ways. For the chip industry, silicon photonics will become the way of scaling post-Moore's law. New system architectures enabled by silicon photonics will improve large-scale computing and optical communications. Silicon Photonics: Fueling the Next Information Revolution outlines the history and status of silicon photonics. The book discusses the trends driving the datacom and telecom industries, the main but not the only markets for silicon photonics. In particular, developments in optical transport and the data center are discussed as are the challenges. The book details the many roles silicon photonics will play, from wide area networks down to the chip level. Silicon photonics is set to change the optical components and chip industries; this book explains how. Captures the latest research assessing silicon photonics development and prospects Demonstrates how silicon photonics addresses the challenges of managing bandwidth over distance and within systems Explores potential applications of SiP, including servers, datacenters, and Internet of Things This book sets out to build bridges between the domains of photonic device physics and neural networks, providing a comprehensive overview of the emerging field of "neuromorphic photonics." It includes a thorough discussion of evolution

of neuromorphic photonics from the advent of fiber-optic neurons to today's state-of-the-art integrated laser neurons, which are a current focus of international research. Neuromorphic Photonics explores candidate interconnection architectures and devices for integrated neuromorphic networks, along with key functionality such as learning. It is written at a level accessible to graduate students, while also intending to serve as a comprehensive reference for experts in the field.

Silicon Photonics for Telecommunications and Biomedicine

Systems and Applications

Semiconductor Device Physics and Design

Laser Applications: Medical, Metrology and Communication (Volume Four)

Fundamentals of Optical Computing Technology

Silicon Photonics for High-Performance Computing and Beyond

The Handbook includes chapters on all the major industry standards, quick reference tables, helpful appendices, plus a new glossary and list of acronyms. This practical handbook can stand alone or as a companion volume to DeCusatis: Fiber Optic Data Communication: Technological Advances and Trends (February 2002, ISBN: 0-12-207892-6), which was developed in tandem with this book. * Includes emerging technologies such as Infiniband, 10 Gigabit Ethernet, and MPLS Optical Switching * Describes leading edge commercial products, including LEAF and MetroCore fibers, dense wavelength multiplexing, and Small Form Factor transceiver packages * Covers all major industry standards, often written by the same people who designed the standards themselves * Includes an expanded listing of references on the World Wide Web, plus hard-to-find references for international, homologation, and type approval requirements * Convenient tables of key optical datacom parameters and glossary with hundreds of definitions and acronyms * Industry buzzwords explained, including SAN, NAS, and MAN networking * Datacom market analysis and future projections from industry leading forecasters

This hands-on introduction to silicon photonics engineering equips students with everything they need to begin creating foundry-ready designs.

Dramatic increases in processing power have rapidly scaled on-chip aggregate bandwidths into the Tb/s range. This necessitates a corresponding increase in the amount of data communicated between chips, so as not to limit overall system performance. To meet the increasing demand for interchip communication bandwidth, researchers are investigating the use of high-speed optical interconnect architectures. Unlike their electrical counterparts, optical interconnects offer high bandwidth and negligible frequency-dependent loss, making possible per-channel data rates of more than 10 Gb/s. High-Speed Photonics Interconnects explores some of the groundbreaking technologies and applications that are based on photonics interconnects. From the Evolution of High-Speed I/O Circuits to the Latest in Photonics Interconnects Packaging and Lasers Featuring contributions by experts from academia and industry, the book

brings together in one volume cutting-edge research on various aspects of high-speed photonics interconnects. Contributors delve into a wide range of technologies, from the evolution of high-speed input/output (I/O) circuits to recent trends in photonics interconnects packaging. The book discusses the challenges associated with scaling I/O data rates and current design techniques. It also describes the major high-speed components, channel properties, and performance metrics. The book exposes readers to a myriad of applications enabled by photonics interconnects technology. Learn about Optical Interconnect Technologies Suitable for High-Density Integration with CMOS Chips This richly illustrated work details how optical interchip communication links have the potential to fully leverage increased data rates provided through complementary metal-oxide semiconductor (CMOS) technology scaling at suitable power-efficiency levels. Keeping the mathematics to a minimum, it gives engineers, researchers, graduate students, and entrepreneurs a comprehensive overview of the dynamic landscape of high-speed photonics interconnects. Ultrafast photonics has become an interdisciplinary topic of high international research interest because of the spectacular development of compact and efficient lasers producing optical pulses with durations in the femtosecond time domain. Present day long-haul telecommunications systems are almost entirely based on the transmission of short burst

Silicon Photonics III

Manufacture and Applications

Principles and Applications

Silicon-On-Insulator (SOI) Technology

Handbook of Optical Microcavities

Silicon Photonics

This graduate-level textbook presents the principles, design methods, simulation, and materials of photonic circuits. It provides state-of-the-art examples of silicon, indium phosphide, and other materials frequently used in these circuits, and includes a thorough discussion of all major types of devices. In addition, the book discusses the integrated photonic circuits (chips) that are currently increasingly employed on the international technology market in connection with short-range and long-range data communication.

Featuring references from the latest research in the field, as well as chapter-end summaries and problem sets, Principles of Photonic Integrated Circuits is ideal for any graduate-level course on integrated photonics, or optical technology and communication.

This book is volume III of a series of books on silicon photonics. It reports on the development of fully integrated systems where many different photonics component are integrated together to build complex circuits. This is the demonstration of the fully potentiality of silicon photonics. It contains a number of chapters written by engineers and scientists of the main companies, research centers and universities active

in the field. It can be of use for all those persons interested to know the potentialities and the recent applications of silicon photonics both in microelectronics, telecommunication and consumer electronics market.

Handbook of Silicon Based MEMS Materials and Technologies, Third Edition is a comprehensive guide to MEMS materials, technologies, and manufacturing with a particular emphasis on silicon as the most important starting material used in MEMS. The book explains the fundamentals, properties (mechanical, electrostatic, optical, etc.), materials selection, preparation, modeling, manufacturing, processing, system integration, measurement, and materials characterization techniques of MEMS structures. The third edition of this book provides an important up-to-date overview of the current and emerging technologies in MEMS making it a key reference for MEMS professionals, engineers, and researchers alike, and at the same time an essential education material for undergraduate and graduate students. Provides comprehensive overview of leading-edge MEMS manufacturing technologies through the supply chain from silicon ingot growth to device fabrication and integration with sensor/actuator controlling circuits Explains the properties, manufacturing, processing, measuring and modeling methods of MEMS structures Reviews the current and future options for hermetic encapsulation and introduces how to utilize wafer level packaging and 3D integration technologies for package cost reduction and performance improvements Geared towards practical applications presenting several modern MEMS devices including inertial sensors, microphones, pressure sensors and micromirrors This book provides a broad overview of photonic crystals and, as the title suggests, covers their principles and applications. It is written from a physics point of view with an emphasis on materials science. Equations are well explained and often completely avoided to increase the readability of the book. The book is divided into eight chapters, starting with a brief introduction. The second chapter deals with different dimensionalities of the photonic crystals and their properties. The third chapter is very interestingly written and provides a survey of the various synthesis methods used for production of photonic crystals, including chemical routes, lithography, and self-assembly of colloidal photonic crystals. Chapters 4-8 constitute the bulk of the book and provide examples of applications of these photonic crystals. Chapter 4 offers a good explanation of optical switching. Bandgap and defect mode switching are also brought into focus along with many other mechanisms—14 different switching mechanisms in all, including thermal, electro, and magneto switching. Frequency tuning of photonic crystal filters with special attention to nanosize photonic crystals is illustrated, providing a direct perspective on applications of these materials in integrated photonic circuits. The transition from chapter 5 to 6 dealing with photonic crystal lasers is smooth, especially after a clear description of frequency tuning. Here, one- to three-dimensional photonic lasers are explained along with laser oscillations produced by a variety of microcavity methods. Metallodielectric and liquid-crystal photonic lasers are equally well illustrated. Chapter 7 introduces logic devices based on photonic crystals. This chapter clearly explains, with the help of simple illustrations, how to obtain AND, OR, and XOR logic gates. Chapter 8

concludes the book by presenting possible applications, including gas, chemical, fluid, and cell sensing; their workings are very well described from a fundamental point of view. The diagrams and illustrations are appropriate and eye catching. There are ample references; thus readers are able to find more detailed information to satisfy their curiosity if the book does not suffice. Even though the introduction provides basics of these photonic crystals, I do get the impression that the bigger picture is missing. A nonexpert may not understand the direct application of such materials right from the beginning of the book. A flowchart or a diagram of these photonic crystals, illustrating applications in daily life at the beginning of the book, could attract a broader readership. In this regard, I believe that this book is most adapted to physicists with a materials science background or vice versa. However, one should take into consideration that the principles of photonic crystals cannot be explained without physics, and therefore the quality of this book remains intact and could very well serve as a textbook for future physicists.

Silicon-Based Photonics

Ultrafast Photonics

Field Guide to Optoelectronics and Photonics

Practical Applications of Microresonators in Optics and Photonics

Technology and Applications of 3D Integrated Circuits

From Devices to Systems

The second, updated edition of this essential reference book provides a wealth of detail on a wide range of electronic and photonic materials, starting from fundamentals and building up to advanced topics and applications. Its extensive coverage, with clear illustrations and applications, carefully selected chapter sequencing and logical flow, makes it very different from other electronic materials handbooks. It has been written by professionals in the field and instructors who teach the subject at a university or in corporate laboratories. The Springer Handbook of Electronic and Photonic Materials, second edition, includes practical applications used as examples, details of experimental techniques, useful tables that summarize equations, and, most importantly, properties of various materials, as well as an extensive glossary. Along with significant updates to the content and the references, the second edition includes a number of new chapters such as those covering novel materials and selected applications. This handbook is a valuable resource for graduate students, researchers and practicing professionals working in the area of electronic, optoelectronic and photonic materials. This book gives a fascinating picture of the state-of-the-art in silicon photonics and a perspective on what can be expected in the near future. It is composed of a selected number of reviews authored by world leaders in the field and is written from both academic and industrial viewpoints. An in-depth discussion of the route towards fully integrated silicon photonics is presented. This book will be useful not only to physicists, chemists, materials

scientists, and engineers but also to graduate students who are interested in the fields of microphotonics and optoelectronics.

Silicon photonics has evolved rapidly as a research topic with enormous application potential. The high refractive index contrast of silicon-on-insulator (SOI) shows great promise for submicron waveguide structures suited for integration on the chip scale in the near-infrared region. Ge- and GeSn-Si heterostructures with different elastic strain levels already provide expansion of the spectral range, high-speed operation, efficient modulation and switching of optical signals, and enhanced light emission and lasing. This book focuses on the integration of heterostructure devices with silicon photonics. The authors have attempted to merge a concise treatment of classical silicon photonics with a description of principles, prospects, challenges, and technical solution paths of adding silicon-based heterostructures. The book discusses the basics of heterostructure-based silicon photonics, system layouts, and key device components, keeping in mind the application background. Special focus is placed on SOI-based waveguide configurations and Ge- and GeSn-Si heterostructure devices for light detection, modulation, and light emission and lasing. The book also provides an overview of the technological and materials science challenges connected with integration on silicon. The first half of the book is mainly for readers who are interested in the topic because of its increasing importance in different fields, while the latter half covers different device structures for light emission, detection, modulation, extension of the wavelength beyond 1.6 μm , and lasing, as well as future challenges.

This handbook--a sequel to the widely used Handbook of Optical Constants of Solids--contains critical reviews and tabulated values of indexes of refraction (n) and extinction coefficients (k) for almost 50 materials that were not covered in the original handbook. For each material, the best known n and k values have been carefully tabulated, from the x-ray to millimeter-wave region of the spectrum by expert optical scientists. In addition, the handbook features thirteen introductory chapters that discuss the determination of n and k by various techniques. * Contributors have decided the best values for n and k * References in each critique allow the reader to go back to the original data to examine and understand where the values have come from * Allows the reader to determine if any data in a spectral region needs to be filled in * Gives a wide and detailed view of experimental techniques for measuring the optical constants n and k * Incorporates and describes crystal structure, space-group symmetry, unit-cell dimensions, number of optic and acoustic modes, frequencies of optic modes, the irreducible representation, band gap, plasma frequency, and static dielectric constant

Springer Handbook of Electronic and Photonic Materials

Handbook of 3D Integration, Volume 1

Materials, Device Physics, Guided Wave Design

Encyclopedic Handbook of Integrated Optics

Phosphor Handbook

Photonic Integration and Photonics-Electronics Convergence on Silicon Platform

This book addresses fabrication as well as characterization and modeling of semiconductor nanostructures in the optical regime, with a focus on nonlinear effects. The visible range as well as near and far infrared spectral region will be considered with a view to different envisaged applications. The book covers the current key challenges of the research in the area, including: exploiting new material platforms, fully extending the device operation into the nonlinear regime, adding re-configurability to the envisaged devices and proposing new modeling tools to help in conceiving new functionalities. • Explores several topics in the field of semiconductor nonlinear nanophotonics, including fabrication, characterization and modeling of semiconductor nanostructures in the optical regime, with a focus on nonlinear effects • Describes the research challenges in the field of optical metasurfaces in the nonlinear regime • Reviews the use and achievements of all-dielectric nanoantennas for strengthening the nonlinear optical response • Describes both theoretical and experimental aspects of photonic devices based on semiconductor optical nanoantennas and metasurfaces • Gathers contributions from several leading groups in this research field to provide a thorough and complete overview of the current state of the art in the field of semiconductor nonlinear nanophotonics

Costantino De Angelis has been full professor of electromagnetic fields at the University of Brescia since 1998. He is an OSA Fellow and has been responsible for several university research contracts in the last 20 years within Europe, the United States, and Italy. His technical interests are in optical antennas and nanophotonics. He is the author of over 150 peer-reviewed scientific journal articles. Giuseppe Leo has been a full professor in physics at Paris Diderot University since 2004, and in charge of the nonlinear devices group of MPQ Laboratory since 2006. His research areas include nonlinear optics, micro- and nanophotonics, and optoelectronics, with a focus on AlGaAs platform. He has coordinated several research programs and coauthored 100 peer-reviewed journal articles, 200 conference papers, 10 book chapters and also has four patents. Dragomir Neshev is a

professor in physics and the leader of the experimental photonics group in the Nonlinear Physics Centre at Australian National University (ANU). His activities span over several branches of optics, including nonlinear periodic structures, singular optics, plasmonics, and photonic metamaterials. He has coauthored 200 publications in international peer-reviewed scientific journals.

Fundamentals of Photonics A complete, thoroughly updated, full-color third edition **Fundamentals of Photonics, Third Edition** is a self-contained and up-to-date introductory-level textbook that thoroughly surveys this rapidly expanding area of engineering and applied physics. Featuring a blend of theory and applications, coverage includes detailed accounts of the primary theories of light, including ray optics, wave optics, electromagnetic optics, and photon optics, as well as the interaction of light and matter. Presented at increasing levels of complexity, preliminary sections build toward more advanced topics, such as Fourier optics and holography, photonic-crystal optics, guided-wave and fiber optics, LEDs and lasers, acousto-optic and electro-optic devices, nonlinear optical devices, ultrafast optics, optical interconnects and switches, and optical fiber communications. The third edition features an entirely new chapter on the optics of metals and plasmonic devices. Each chapter contains highlighted equations, exercises, problems, summaries, and selected reading lists. Examples of real systems are included to emphasize the concepts governing applications of current interest. Each of the twenty-four chapters of the second edition has been thoroughly updated.

Silicon photonics technology, which has the DNA of silicon electronics technology, promises to provide a compact photonic integration platform with high integration density, mass-producibility, and excellent cost performance. This technology has been used to develop and to integrate various photonic functions on silicon substrate. Moreover, photonics-electronics convergence based on silicon substrate is now being pursued. Thanks to these features, silicon photonics will have the potential to be a superior technology used in the construction of energy-efficient cost-effective apparatuses for various applications, such as communications, information processing, and sensing. Considering the material characteristics of silicon and difficulties in

microfabrication technology, however, silicon by itself is not necessarily an ideal material. For example, silicon is not suitable for light emitting devices because it is an indirect transition material. The resolution and dynamic range of silicon-based interference devices, such as wavelength filters, are significantly limited by fabrication errors in microfabrication processes. For further performance improvement, therefore, various assisting materials, such as indium-phosphide, silicon-nitride, germanium-tin, are now being imported into silicon photonics by using various heterogeneous integration technologies, such as low-temperature film deposition and wafer/die bonding. These assisting materials and heterogeneous integration technologies would also expand the application field of silicon photonics technology. Fortunately, silicon photonics technology has superior flexibility and robustness for heterogeneous integration. Moreover, along with photonic functions, silicon photonics technology has an ability of integration of electronic functions. In other words, we are on the verge of obtaining an ultimate technology that can integrate all photonic and electronic functions on a single Si chip. This e-Book aims at covering recent developments of the silicon photonic platform and novel functionalities with heterogeneous material integrations on this platform.

Silicon-On-Insulator (SOI) Technology: Manufacture and Applications covers SOI transistors and circuits, manufacture, and reliability. The book also looks at applications such as memory, power devices, and photonics. The book is divided into two parts; part one covers SOI materials and manufacture, while part two covers SOI devices and applications. The book begins with chapters that introduce techniques for manufacturing SOI wafer technology, the electrical properties of advanced SOI materials, and modeling short-channel SOI semiconductor transistors. Both partially depleted and fully depleted SOI technologies are considered. Chapters 6 and 7 concern junctionless and fin-on-oxide field effect transistors. The challenges of variability and electrostatic discharge in CMOS devices are also addressed. Part two covers recent and established technologies. These include SOI transistors for radio frequency applications, SOI CMOS circuits for ultralow-power applications, and improving device performance by using 3D

integration of SOI integrated circuits. Finally, chapters 13 and 14 consider SOI technology for photonic integrated circuits and for micro-electromechanical systems and nano-electromechanical sensors. The extensive coverage provided by Silicon-On-Insulator (SOI) Technology makes the book a central resource for those working in the semiconductor industry, for circuit design engineers, and for academics. It is also important for electrical engineers in the automotive and consumer electronics sectors. Covers SOI transistors and circuits, as well as manufacturing processes and reliability Looks at applications such as memory, power devices, and photonics

Handbook of Optical Constants of Solids

Neuromorphic Photonics

Principles of Photonic Integrated Circuits

Silicon Nanophotonics

Handbook of Laser Technology and Applications

An Introduction

The development of integrated silicon photonic circuits has recently been driven by the Internet and the push for high bandwidth as well as the need to reduce power dissipation induced by high data-rate signal transmission. To reach these goals, efficient passive and active silicon photonic devices, including waveguide, modulators, photodetectors,

Semiconductor Device Physics and Design teaches readers how to approach device design from the point of view of someone who wants to improve devices and can see the opportunity and challenges. It begins with coverage of basic physics concepts, including the physics behind polar heterostructures and strained heterostructures. The book then details the important devices ranging from p-n diodes to bipolar and field effect devices. By relating device design to device performance and then relating device needs to system use the student can see how device design works in the real world.

Handbook of Silicon Photonics Taylor & Francis

As optical technologies move closer to the core of modern computer architecture, there arise many challenges in building optical capabilities from the network to the motherboard. Rapid advances in integrated optics technologies are making this a reality. However, no comprehensive, up-to-date reference is available to the technologies and principles underlying the field. The Encyclopedic Handbook of Integrated Optics fills this void, collecting the work of 53 leading experts into a compilation of the most important concepts, phenomena, technologies, and terms covering all related fields. This unique book consists of two types of entries: the first is a detailed, full-length description; the other, a concise overview of the topic. Additionally, the coverage can be divided into four broad areas: A survey of the basics of integrated optics, exploring theory, practical concerns, and the fundamentals behind optical devices

Focused discussion on devices and components such as arrayed waveguide grating, various types of lasers, optical amplifiers, and optoelectronic devices In-depth examination of subsystems including MEMS, optical pickup, and planar lightwave circuits Finally, systems considerations such as multiplexing, demultiplexing, 3R circuits, transmission, and reception Offering a broad and complete treatment of the field, the Encyclopedic Handbook of Integrated Optics is the complete guide to the fundamentals, principles, and applications of integrated optics technology.

Handbook of Optoelectronics, Second Edition

The Handbook of Photonics

High-Speed Photonics Interconnects

Integrated Photonics

Handbook of Optoelectronics

Fueling the Next Information Revolution

This book presents the principles, experimental technologies, up-to-date research findings and applications of various optical-computing technologies and devices. It also discusses semiconductor multiple quantum well (MQW) photoelectronic devices, vertical-cavity surface-emitting lasers (VCSELs), lasers, micro optical elements and diffractive optical elements, optical storage, optical parallel interconnections, and optical-buffer technology as the main technologies for optical computing. Furthermore, it explores the potential of optical-computing technology. It offers those involved in optical design, photonics, and photoelectronic research and related industries insights into the fundamentals and theories of optical computing, enabling them and to extend and develop the functions of fundamental elements to meet the requirement of optical-computing systems.

Photonics is a key technology of this century. The combination of photonics and silicon technology is of great importance because of the potentiality of coupling electronics and optical functions on a single chip. Many experimental and theoretical studies have been performed to understand and design the photonic properties of silicon nanocrystals.

Generation of light in silicon is a challenging perspective in the field; however, the issue of light-emitting devices does not limit the activity in the field. Research is also focused on light modulators, optical waveguides and interconnectors, optical amplifiers, detectors, memory elements, photonic crystals, etc. A particularly important task of silicon nanostructures is to

generate electrical energy from solar light. Understanding the optical properties of silicon-based materials is central in designing photonic components. It is not possible to control the optical properties of nanoparticles without fundamental information on their microscopic structure, which explains a large number of theoretical works on this subject. Many fundamental and practical problems should be solved in order to develop this technology. In addition to open fundamental questions, it is even more difficult to develop the known experimental results towards practical realization. However, the world market for silicon photonics is expected to be huge; thus, more research activity in the field of silicon nanophotonics is expected in the future. This book describes different aspects of silicon nanophotonics, from fundamental issues to practical devices. The second edition is essentially different from the book published in 2008. Eight chapters of the first edition are not included in the new book, because the recent progress on those topics has not been large enough. Instead, seven new chapters appear. The other eight chapters are essentially modified to describe recent achievements in the field.

From design and simulation through to testing and fabrication, this hands-on introduction to silicon photonics engineering equips students with everything they need to begin creating foundry-ready designs. In-depth discussion of real-world issues and fabrication challenges ensures that students are fully equipped for careers in industry. Step-by-step tutorials, straightforward examples, and illustrative source code fragments guide students through every aspect of the design process, providing a practical framework for developing and refining key skills. Offering industry-ready expertise, the text supports existing PDKs for CMOS UV-lithography foundry services (OpSIS, ePIXfab, imec, LETI, IME and CMC) and the development of new kits for proprietary processes and clean-room based research. Accompanied by additional online resources to support students, this is the perfect learning package for senior undergraduate and graduate students studying silicon photonics design, and academic and industrial researchers involved in the development and manufacture of new silicon photonics systems.

"This Field Guide covers the physics of semiconductors, from the materials used in optoelectronics and photonics to charge statistics and transport to PN junctions and their

applications. It then addresses the physics of the interactions between radiation and matter at different levels--macroscopic, microscopic, and quantum level--and includes the fundamental concepts of waveguides, fiber optics, and photonics devices such as light modulators. It finally highlights important applications of the field in engineering and applied physics. The guide summarizes the scientific and engineering foundations of optoelectronics and photonics and thus can be used as a textbook for college students, although it could be useful for practicing scientists and engineers as well"--

An Integrated View

Nonlinear Meta-Optics

Fundamentals and Devices

Silicon Photonics Design

Concepts, Devices, and Techniques (Volume One)

Assembling an international team of experts, this book reports on the progress in the rapidly growing field of monolithic micro- and nanoresonators. The book opens with a chapter on photonic crystal-based resonators (nanocavities). It goes on to describe resonators in which the closed trajectories of light are supported by any variety of total internal reflection in curved and polygonal transparent dielectric structures. The book also covers distributed feedback microresonators for slow light, controllable dispersion, and enhanced nonlinearity. A portion of coverage is dedicated to the unique properties of resonators, which are extremely efficient tools when conducting multiple applications.

This book provides a first integrated view of nanophotonics and plasmonics, covering the use of dielectric, semiconductor, and metal nanostructures to manipulate light at the nanometer scale. The presentation highlights similarities and advantages, and shows the common underlying physics, targets, and methodologies used for different materials (optically transparent materials for nanophotonics, vs opaque materials for plasmonics). Ultimately, the goal is to provide a basis for developing a unified platform for both fields. In addition to the fundamentals and detailed theoretical background, the book showcases the main device applications. Ching Eng (Jason) Png is Director of the Electronics and Photonics Department at the Institute of High Performance Computing, Agency for Science Technology and Research, Singapore. Yuriy A. Akimov is a scientist in the Electronics and Photonics Department at the Institute of High Performance Computing, Agency for Science Technology and Research, Singapore.

Reflecting changes in the field in the ten years since the publication of the first edition, The Handbook of Photonics,

Second Edition explores recent advances that have affected this technology. In this new, updated second edition editor Mool Gupta is joined by John Ballato, strengthening the handbook with their combined knowledge and the continued contributions of world-class researchers. New in the Second Edition: Information on optical fiber technology and the economic impact of photonics Coverage of emerging technologies in nanotechnology Sections on optical amplifiers, and polymeric optical materials The book covers photonics materials, devices, and systems, respectively. An introductory chapter, new to this edition, provides an overview of photonics technology, innovation, and economic development. Resting firmly on the foundation set by the first edition, this new edition continues to serve as a source for introductory material and a collection of published data for research and training in this field, making it the reference of first resort.

Handbook of Optoelectronics offers a self-contained reference from the basic science and light sources to devices and modern applications across the entire spectrum of disciplines utilizing optoelectronic technologies. This second edition gives a complete update of the original work with a focus on systems and applications. Volume I covers the details of optoelectronic devices and techniques including semiconductor lasers, optical detectors and receivers, optical fiber devices, modulators, amplifiers, integrated optics, LEDs, and engineered optical materials with brand new chapters on silicon photonics, nanophotonics, and graphene optoelectronics. Volume II addresses the underlying system technologies enabling state-of-the-art communications, imaging, displays, sensing, data processing, energy conversion, and actuation. Volume III is brand new to this edition, focusing on applications in infrastructure, transport, security, surveillance, environmental monitoring, military, industrial, oil and gas, energy generation and distribution, medicine, and free space. No other resource in the field comes close to its breadth and depth, with contributions from leading industrial and academic institutions around the world. Whether used as a reference, research tool, or broad-based introduction to the field, the Handbook offers everything you need to get started. (The previous edition of this title was published as Handbook of Optoelectronics, 9780750306461.) John P. Dakin, PhD, is professor (emeritus) at the Optoelectronics Research Centre, University of Southampton, UK. Robert G. W. Brown, PhD, is chief executive officer of the American Institute of Physics and an adjunct full professor in the Beckman Laser Institute and Medical Clinic at the University of California, Irvine.