Optical Modulator Based On Gaas Photonic Crystals Spie

Bringing together international experts from 16 countries, Gallium Arsenide and Related Compounds 1992 focuses on device applications for Gallium Arsenide and related compounds. A topic of importance discussed is the first GaAs supercomputer from Fujitsu. The book also explores carbon doping and device applications in laser diodes, light modulators, and amplifiers, emphasizing business opportunity in consumer applications such as personal communications and TV tuners. It includes an account of the use of scanning tunneling microscopies in GaAs and related compounds. This book is ideal for physicists, materials scientists, and electronics and electrical engineers involved in III-V compound research.

The conference "Nonlinear Optics and Optical Computing" was held May 11-19, 1988 in Erice, Sicily. This was the 13th conference organized by the International School of Quantum Electronics, under the auspices of the "Ettore Majorana" Center for Scientific Culture. This volume contains both the invited and contributed papers presented at the conference, providing tutorial background, the latest research results, and future directions for the devices, structures and architectures of optical computing.

The invention of the transistor and the integrated circuit were followed by an explosion of application as ever faster and more complex microelectronics chips became available. The information revolution occa sioned by digital computers and optical communications is now reaching the limits of silicon semiconductor technology, but the demand for faster com putation is still accelerating. The fundamental limitations of information processing today derive from the performance and cost of three technical factors: speed, density, and software. Optical computation offers the potential for improvements in all three of these critical areas: Speed is provided by the transmission of impulses at optical veloc ities, without the delays caused by parasitic capacitance in the case of conventional electrical interconnects. Speed can also be achieved through the massive parallelism characteristic of many optical computing architec tures; Density can be provided in optical computers in two ways: by high spatial resolution, on the order of wavelengths of light, and by computa tion or interconnection in three dimensions.

The key technical objective for this research program is to integrate quantum well lasers (QWLs), detectors and GaAs MESFETs to produce a monolithic integrated microwave to optical modulator on semi-insulating GaAs substrates.

Optical Arbitrary Waveform Generation (OAWG) combines frequency combs and frequency-by- frequency pulse shapers to synthesize optical waveforms. The OAWG technique has a wide variety of applications, ranging from high resolution imaging, Light Detecting and Ranging (LIDAR) systems for high precision distance measuring, high-speed communication networks, and high capacity transmission systems. Frequency combs, generated by Ti:Sapphire mode-locked lasers, span the optical spectrum from A=0.65pm to 1.1pm and necessitate the development of compatible modulator devices which could be based on materials in the III-V semiconductor groups for the construction of an optical arbitrary waveform generation system. An OAWG system in the visible and near-infrared will motivate many novel applications yet to be envisioned, and will allow the transfer of technologies currently operating in the radio frequencies to the optical spectrum. The design of electrooptic ultra-broadband modulators operating at wavelengths longer than A=0.65ptm is investigated. Novel epitaxial heterostructures lattice-matched to GaAs - a p-i-n structure with a dilute core and a n-i-n Metal Oxide Semiconductor (MOS) heterostructure offering superior mode confinement - are modeled, and grown. The electric field distribution in the n-i-n MOS structure is examined through simulations and capacitancevoltage measurements. A Mach-Zehnder Interferometer modulator design is proposed, employing both multimode interferometers and Y-junctions as power splitters. A self-aligned fabrication mask set and process are developed and demonstrated, verifying the performance of the modulator epitaxial heterostructures through the demonstration of waveguiding and optical power splitting. A mask set is offered for improved processing yield and a fabrication process is designed to enable push-pull operation of the n-i-n MOS modulator.

This book presents a current review ofphotonic technologies and their applications. The papers published in this book are extended versions of the papers presented at the Inter national Conference on Applications ofPhotonic Technology (ICAPT'96) held in Montreal, Canada, on July 29 to August 1, 1996. The theme of this event was "Closing the Gap Between Theory, Developments and Applications. " The term photonics covers both optics and optical engineering areas of growing sci entific and commercial importance throughout the world. It is estimated that photonic tech nology-related applications to increase exponentially over the next few years and will play a significant role in the global economy by reaching a quarter of a trillion of US dollars by the year 2000. The global interest and advancements of this technology are represented in this book, where leading scientists of twenty-two countries with advanced technology in photon ics present their latest results. The papers selected herein are grouped to address six distinct areas ofphotonic tech nology. The reader will find throughout the book a combination of invited and contributed papers which reflect the state of the art today and provide some insight about the future of this technology. The first two papers are invited. They discuss business aspects ofphotonic engineer ing. One examines if chip-to-chip interconnections by means of optical technology are a good economic choice, while the other discusses the photonic technology from entre preneurial viewpoint. Papers related to materials and considered for photonic applications, e. g.

This cross-disciplinary title features contributions by key-note specialists from Europe, Israel and the United States. It deals with the rapidly growing area of microwave photonics, and includes an extended study of the interactions between optical signals and microwave and millimetre-wave electrical signals for broadband applications.

The introduction of GaAs/ AIGaAs double heterostructure lasers has opened the door to a new age in the application of compound semiconductor materials to microwave and optical technologies. A variety and combination of semiconductor materials have been investigated and applied to present commercial uses with these devices operating at wide frequencies and wavelengths. Semiconductor modulators are typical examples of this technical evolutions and hsve been developed for commercial use. Although these have a long history to date, we are not aware of any book that details this evolution. Consequently, we have written a book to provide a comprehensive account of semiconductor modulators with emphasis on historical details and experimantal reports. The objective is to provide an up-to-date understanding of semiconductor modulators. Particular attention has been paid to multiple quantum well (MQW) modulators operating at long wavelengths, taking into account the low losses and dispersion in silica fibers occuring at around 1.3 and 1.55 mm. At the present time, MQW structures have been investigated but these have not been sufficiently developed to provide characteristic features which would be instructive enough for readers. One problem is the almost daily publication of papers on semiconductor modulators. Not only do these papers provide additional data, but they often modify the interpretations of particular concepts. Almost all chapters refer to the large number of published papers that can be consulted for future study.

This books aims to present fundamental aspects of optical communication techniques and advanced modulation techniques and extensive applications of optical communications systems and networks employing single-mode optical fibers as the transmission system. New digital

techqniues such as chromatic dispersion, polarization mode dispersion, nonlinear phase distortion effects, etc. will be discussed. Practical models for practice and understanding the behavior and dynamics of the devices and systems will be included.
Successful miniaturization of complex electro-optic devices is a prerequisite for bringing quantum optical sensors to work outside optical labs in a real-world application scenario. Monolithic, i.e. chip-scale integration, holds the promise of achieving the highest level of compactness, robustness, and reliability at the lowest production cost possible. This work focuses on modelling, simulation, design, manufacturing, and testing of functional building blocks for photonic integrated circuits. GaAs-based waveguides, NxM multi-mode interference couplers, and electro-optic phase modulators were developed for applications of rubidium precision spectroscopy at 780 nm for the first time. As an example for photonic integrated circuits a monolithic amplitude modulator based on a Mach-Zehnder-interferometer was demonstrated. Further, GaAs-based phase modulators were developed for applications at 1064 nm. For operation at 780 nm single-mode waveguides with an exceptionally small loss of 1.2 dB/cm and phase modulators with an efficiency as large as 16 deg/(Vxmm) were demonstrated. This work additionally advances the experimental methods available to investigate the electro-optic properties of phase modulators: a novel method based on the I&Q-demodulation of time domain modulation signals derived with a heterodyne interferometer does not only provide access to the phase but also to the (residual) amplitude modulation and allows to separate linear from quadratic phase modulation effects. This provides novel experimental insights into the physical effects governing phase modulation. In fact, it is shown that the current understanding according to which carrier-density related effects contribute solely to the linearly of phase modulation is questionable.
In response to the increasing interest in developing photonic switching fabrics, this book gives an overview of the many technologies from a systems designer's perspective. Optically transparent devices, optical logic devices, and optical hardware are all discussed in detail and set into a systems context. Comprehensive, up-to-date, and profusely illustrated, the work will provide a foundation for the field, especially as broadband services are more fully developed.
Optically controlled Multiple Quantum Well (MWQ) modulators promise to be of great interest for all optical data processing. In this paper we analyze a device, based on a GaAs/AlAs MQW structure, whose principle of operation depends on the controlled excitonic absorption by means of free carrier generation. Such a device, experimentally tested in [1,2,3], is able to give a modulation depth close to one; its operation frequency is limited by carrier lifetime up to about some ten megahertz and it can be promising for high speed parallel processing. The numerical results show a good agreement with experimental data reported in [1],
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.
In two editions spanning more than a decade, The Electrical Engineering Handbook stands as the definitive reference to the multidisciplinary field of electrical engineering. Our knowledge continues to grow, and so does the Handbook. For the third edition, it has grown into a set of six books carefully focused on specialized areas or fields of study. Each one represents a concise yet definitive collection of key concepts, models, and equations in its respective domain, thoughtfully gathered for convenient access. Combined, they constitute the most comprehensive, authoritative resource available. Circuits, Signals, and Speech and Image Processing presents all of the basic information related to electric circuits and components, analysis of circuits, the use of the Laplace transform, as well as signal, speech, and image processing using filters and algorithms. It also examines emerging areas such as text to speech synthesis, real-time processing, and embedded signal processing. Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar delves into the fields of electronics, integrated circuits, power electronics, optoelectronics, electromagnetics, light waves, and radar, supplying all of the basic information required for a deep understanding of each area. It also devotes a section to electrical effects and devices and explores the emerging fields of microlithography and power electronics. Sensors, Nanoscience, Biomedical Engineering, and Instruments provides thorough coverage of sensors, materials and nanoscience, instruments and measurements, and biomedical systems and devices, including all of the basic information required to thoroughly understand each area. It explores the emerging fields of sensors, nanotechnologies, and biological effects. Broadcasting and Optical Communication Technology explores communications, information theory, and devices, covering all of the basic information needed for a thorough understanding of these areas. It also examines the emerging areas of adaptive estimation and optical communication. Computers, Software Engineering, and Digital Devices examines digital and logical devices, displays, testing, software, and computers, presenting the fundamental concepts needed to ensure a thorough understanding of each field. It treats the emerging fields of programmable logic, hardware description languages, and parallel computing in detail. Systems, Controls, Embedded Systems, Energy, and Machines explores in detail the fields of energy devices, machines, and systems as well as control systems. It provides all of the fundamental concepts needed for thorough, in-depth understanding of each area and devotes special attention to the emerging area of embedded systems. Encompassing the work of the world's foremost experts in their respective specialties, The Electrical Engineering Handbook, Third Edition remains the most convenient, reliable source of information available. This edition features the latest developments, the broadest scope of coverage, and new material on nanotechnologies, fuel cells, embedded systems, and biometrics. The engineering community has relied on the Handbook for more than twelve years, and it will continue to be a platform to launch the next wave of advancements. The Handbook's latest incarnation features a protective slipcase, which helps you stay organized without overwhelming your bookshelf. It is an attractive addition to any collection, and will help keep each volume of the Handbook as fresh as your latest research.
High-speed external modulators are necessary components for impressing signals onto lightwave carriers used in optical fibers for various transmission applications in telecommunications. III-V semiconductor waveguide electro-optic modulators offer the advantage of monolithic integration, which gives them an edge over lithium niobate modulators. We have used novel laser direct-writing techniques to masklessly define waveguide and electrode structures, and have fabricated an electro-optic polarization modulator in GaAs/AlGaAs. Our modulator exhibits a high extinction ratio and low value of Vpi.
This work describes all the major devices used in photonic systems. It provides a thorough overview of the field of photonics, detailing practical examples of photonic technology in a wide range of applications. Photonic systems and devices are discussed with a mathematical rigor that is precise enough for design purposes yet highly readable.
Reviews the properties and applications of photo-elastic, acousto-optic, magneto-optic, electro-optic, and photorefractive materials This book deals with the basic physical properties and applications of photo-elastic, acousto-optic, magneto-optic, electro-optic, and photorefractive

materials. It also provides up-to-date information on the design and applications of various optoelectronic devices based on these materials. The first chapter of Crystal Optics: Properties and Applications covers the basic concepts of crystal optics, such as index ellipsoid or optical indicatrix, crystal symmetry, wave surface, birefringence, and the polarization of light. Chapter 2 reviews the physical phenomena of crystal optics in isotropic and crystalline materials. It describes in detail research information on modern photoelastic materials and reviews the up-to-date photoelastic device applications. Chapter 3 develops the underlying theory of acousto-optics from first principles, formulating results suitable for subsequent calculations and design. The fourth chapter describes the basic principles of magneto-optic effects and mode of interaction with magnetic materials. The fifth chapter provides an understanding of the physical phenomenon of the linear and quadratic electro-optic effects in isotropic and crystalline materials. The last chapter collects many of the most important recent developments in photorefractive effects and materials, and pays special attention to recent scientific findings and advances on photorefractive materials and devices. -Features up to date information on the design and applications of various optoelectronic devices -Looks at the basic concepts of crystal optics, including the polarization of light, effects of reflection and transmission of polarization and light polarizing devices, and more -Pays special attention to design procedures for the entire range of acousto-optic devices and various applications of these devices -Provides research information on modern magneto-optic materials and reviews the up-to-date magneto-optic device applications?up to terahertz (THz) regime Crystal Optics: Properties and Applications is an excellent book for the scientific community working in the field, including researchers, lecturers, and advanced students.

Industrial Applications of Lasers focuses on how lasers have been used for practical applications in industry. This text aims to stimulate the imagination of the readers, who can then evaluate the potential application of lasers to solve their own problems. Comprised of 21 chapters, this book starts with an overview of the fundamental background of lasers, and then discusses the basic principles of how lasers operate. Other chapters provide an understanding of how holograms really work. This text also discusses several topics relevant to lasers, themselves, including the types of practical lasers and laser properties. This book considers laser safety, which is very important for anyone considering a laser application. Finally, this text explores the various developed laser applications, including scribing of ceramics, laser welding and cutting of metals, as well as applications in surveying, alignment, and metrology. This book is a valuable resource to laser technicians, physicists, scientists, researchers, and readers whose interests span a variety of fields.

This book provides a comprehensive introduction to integrated optical waveguides for information technology and data communications. Integrated coverage ranges from advanced materials, fabrication, and characterization techniques to guidelines for design and simulation. A concluding chapter offers perspectives on likely future trends and challenges. The dramatic scaling down of feature sizes has driven exponential improvements in semiconductor productivity and performance in the past several decades. However, with the potential of gigascale integration, size reduction is approaching a physical limitation due to the negative impact on resistance and inductance of metal interconnects with current copper-trace based technology. Integrated optics provides a potentially lower-cost, higher performance alternative to electronics in optical communication systems. Optical interconnects, in which light can be generated, guided, modulated, amplified, and detected, can provide greater bandwidth, lower power consumption, decreased interconnect delays, resistance to electromagnetic interference, and reduced crosstalk when integrated into standard electronic circuits. Integrated waveguide optics represents a truly multidisciplinary field of science and engineering, with continued growth requiring new developments in modeling, further advances in materials science, and innovations in integration platforms. In addition, the processing and fabrication of these new devices must be optimized in conjunction with the development of accurate and precise characterization and testing methods. Students and professionals in materials science and engineering will find Advanced Materials for Integrated Optical Waveguides to be an invaluable reference for meeting these research and development goals.

This book presents invited reviews and original short notes of recent results obtained in studies concerning the fabrication and application of nanostructures, which hold great promise for the new generation of electronic and optoelectronic devices.Governing exciting and relatively new topics such as fast-progressing nanoelectronics and optoelectronics, molecular electronics and spintronics, nanophotonics, nanosensorics and nanobiology as well as nanotechnology and quantum processing of information, this book gives readers a more complete understanding of the practical uses of nanotechnology and nanostructures.

In two editions spanning more than a decade, The Electrical Engineering Handbook stands as the definitive reference to the multidisciplinary field of electrical engineering. Our knowledge continues to grow, and so does the Handbook. For the third edition, it has expanded into a set of six books carefully focused on a specialized area or field of study. Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar represents a concise yet definitive collection of key concepts, models, and equations in these areas, thoughtfully gathered for convenient access. Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar delves into the fields of electronics, integrated circuits, power electronics, optoelectronics, electromagnetics, light waves, and radar, supplying all of the basic information required for a deep understanding of each area. It also devotes a section to electrical effects and devices and explores the emerging fields of microlithography and power electronics. Articles include defining terms, references, and sources of further information. Encompassing the work of the world’s foremost experts in their respective specialties, Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar features the latest developments, the broadest scope of coverage, and new material in emerging areas.

The electronics industry in Taiwan has shifted its emphasis from consumer- to information-based products. It is enjoying the bulk of the world market in computer motherboards, keyboards, scanners and PC monitors.Optoelectronics is a growing sub-group within information-based electronics. In addition to the established areas, other technologies such as optical storage, optical signal processing, optical switching and transmission are emerging. Research efforts at universities and research institutions are strongly supported by the official bodies of the government. The articles collected in this volume are contributed by the most active researchers in the area of optics and photonics in Taiwan. The subject areas covered such as Optical Materials, Devices and Systems are by no means representative of the breadth nor depth of optical research in Taiwan. Instead, they offer a snapshot of the ongoing work that will lead to success in the commercial world in future.

The book gives an in-depth description of the key devices of current and next generation fibre optic communication networks. In particular, the book covers devices such as semiconductor lasers, optical amplifiers, modulators, wavelength filters, and detectors but the relevant properties of optical fibres as well. The presentations include the physical principles underlying the various devices, the technologies used for the realization of the different devices, typical performance characteristics and limitations, and development trends towards more advanced components are also illustrated. Thus the scope of the book spans relevant principles, state-of-the-art implementations, the status of current research and expected future components.

This book maps out the frontiers of optical technology in two major subdisciplines: optical materials and optical devices. The optical materials and material architectures covered include nanostructured silicon, chiral sculptured thin films, magnetic photonic crystals, and switchable materials for efficient lighting and decorative optics. The optical devices addressed include silicon waveguides for integrated circuitry, high-speed electro-optic modulators, laser diodes coupled with fibre-tip lenses, and optical sensors. Reading the ten chapters, either altogether or piecemeal, the reader will receive a virtually up-to-date review of the state of the art.

"...provides the full, exciting story of optical modulators. ... a comprehensive review, from the fundamental science to the material and processing technology to the optimized device design to the multitude of applications for which broadband optical modulators bring great

value. ... Especially valuable in my view is that the authors are internationally known researchers, developers, and systems people who are experts in their field, writing now, with the perspective that time offers, about their groundbreaking work. " —Dr. Rodney C. Alferness, Senior Vice President of Optical Networking Research at Lucent Technologies' Bell Labs Considered the most comprehensive book yet published on this critical subject, Broadband Optical Modulators: Science, Technology, and Applications offers an incredibly wide-ranging yet in-depth overview of the state of the art in the design and use of optical modulators. A compilation of expert insights, this book covers fundamental and practical aspects, from materials to systems, addressing historical and more recent developments. Coverage includes: Optical and electro-optic properties of traditional single crystalline lithium niobate, silicon, and III-V compound semiconductors, as well as emerging electro-optic polymers and organic nonlinear optic crystals Discussion of factors important to modulator design, fabrication, and performance Fundamental topics, such as electro-optic effect in nonlinear optic crystals and semiconductors Leaders in the field created this invaluable reference for scientific researchers involved in high-speed device research and development, especially in the areas of optical transmitters and optical modulators for fiber-optics communication systems. Helping readers master optical modulation techniques, this book will be invaluable to engineers (system/subsystem designers, product developers, and technical and project managers) and other professionals in the telecommunications and defense industries. It offers the audience—which includes graduate students—an in-depth understanding of the new modulator architectures and technologies now available, as well as the strengths, weaknesses, advantages, and trade-offs associated with each.

It has attracted much attention to investigate the mechanisms responsible for the vertical transport of photogenerated carriers in semiconductor multiple quantum wells since all Photoconductive devices depend on it for their properties. The photoconductive rise time which is directly related to the carrier sweep-out time gives important characteristics such as switching time and risetime to SEED (Self Electro-optic Effect Device) - type logic devices and photodetectors. The ultrafast response depends on the detailed nature of the cross well carrier transport mechanisms. Previous measurements have employed the excite-probe technique with electrically biased MQWs to monitor thermionic emission and tunneling via transmission changes caused by the relaxation of the quantum confined Stark effect as carriers leaving the wells.

Intersubband transitions in quantum wells have attracted tremendous attention in recent years, mainly due to the promise of applications in the mid and far-infrared regions (2--20 mum). Many of the papers presented in Quantum Well Intersubband Transition Physics and Devices are on the basic linear intersubband transition processes, detector physics and detector application, reflecting the current state of understanding and detector applications, where highly uniform, large focal plane arrays have been demonstrated. Other areas are still in their early stages, including infrared modulation, harmonic generation and emission.

This book presents invited reviews and original short notes of recent results obtained in studies concerning the fabrication and application of nanostructures, which hold great promise for the new generation of electronic and optoelectronic devices. Governing exciting and relatively new topics such as fast-progressing nanoelectronics and optoelectronics, molecular electronics and spintronics, nanophotonics, nanosensorics and nanobiology as well as nanotechnology and quantum processing of information, this book gives readers a more complete understanding of the practical uses of nanotechnology and nanostructures.

This work offers comprehensive coverage of all aspects of spatial light modulators, from the various optical materials used for modulation, through the availability and characteristics of specific devices, to the main applications of SLMs and related systems. The gamut of SLMs is surveyed, including multiple-quantum-well, acousto-optical, magneto-optical, deformable-membrane, ferroelectric-liquid-crystal and smart-pixel modulators.

GaAs-based components for photonic integrated circuitsCuvillier Verlag

Since its inception in 1966, the series of numbered volumes known as Semiconductors and Semimetals has distinguished itself through the careful selection of well-known authors, editors, and contributors. The "Willardson and Beer" Series, as it is widely known, has succeeded in publishing numerous landmark volumes and chapters. Not only did many of these volumes make an impact at the time of their publication, but they continue to be well-cited years after their original release. Recently, Professor Eicke R. Weber of the University of California at Berkeley joined as a co-editor of the series. Professor Weber, a well-known expert in the field of semiconductor materials, will further contribute to continuing the series' tradition of publishing timely, highly relevant, and long-impacting volumes. Some of the recent volumes, such as Hydrogen in Semiconductors, Imperfections in III/V Materials, Epitaxial Microstructures, High-Speed Heterostructure Devices, Oxygen in Silicon, and others promise that this tradition will be maintained and even expanded. Reflecting the truly interdisciplinary nature of the field that the series covers, the volumes in Semiconductors and Semimetals have been and will continue to be of great interest to physicists, chemists, materials scientists, and device engineers in modern industry.