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Electro-Optic Modulator Based on Organic Planar Waveguide Integrated with Prism Coupler Phase-Only 128x128 Spatial Light Modulator Based on Laslm Technology An Electro-optic Modulator Based on a Thermosetting Polyurethane Polymer with Disperse Red Dye 19 Side Groups *Design of an Integrated Optical Electro-optical Modulator Based on PZT Containing Multilayer-stacks* Electro-optic Modulation for Photonic Networks Electro-optic Modulator Based on a Metal - Ferroelectric Nanocomposite High Contrast Electro-optic Polarization-rotation Modulator Based on [110]-oriented (In,Ga)As/(A1,Ga)As Multiple Quantum Wells *High Modulation Efficiency Electro-optic Modulator* Electro-optical Modulator Based on a Layered Semiconductor Crystal Structure Electrooptic Modulator Based on Thin Film BaTiO3 on MgO. *Polarisation State Modulator Based on Periodic Bending* Design of a High Modulation Efficiency Depletion-mode Silicon Microring Modulator Based on a Vertical Junction A 5kV, 3MHz Solid-State Modulator Based on the DSRD Switch for an Ultra-fast Beam Kicker *Integrated Silicon-based Optical Modulators* Polymer-Based Multi-Mode Coplanar Asymmetrical

Unidirectional Waveguide Modulator for Multi-Wavelength All-fiber Optical Modulator Based on No-core Fiber and Magnetic Fluid as Cladding*Project Supported by the Natural Science Foundation of Tianjin City, China (Grant No. 13JCYBJC16100), the National Natural Science Foundation of China (Grant No. 61107035), the National Key Scientific Instrument and Equipment Development Project of China (Grant No. 2013YQ03091502), and the National Basic Research Program of China (Grant Nos. 2010CB327802 and 2010CB327806). E-O Polymer Based Optical Phase Modulator and Its Performance Enhancement Using Slow-Wave Structures An Integrated-optics Intensity Modulator Based on Mode Coupling Circuits and Systems Based on Delta Modulation *Neuromorphic Photonics* Analysis of Optical Modulators for Radio Over Free Space Optical Communication Systems and Radio Over Fiber Systems Toward an Ultra-low Energy, CMOS-compatible Electro-optical Modulator for On-chip Optical Interconnects Pulse Width Modulation for Power Converters *Novel On-chip Optical Modulator Designs* Polymeric Microring Resonator Based Electro-optic Modulator Simulation of Electro-optic Effects in InGaAs/InP Quantum Wire Based Quantum Confined Stark Effet Modulators for Optical Communication Experimental Verification and assessment of an Ir radiation modulator based on a Fabry-Perot etalon

Design Rules and Optimization of Electro-optic Modulators Based on Coplanar Waveguides The Heterostructure Field Effect Optical Modulator *Pulsed Ytterbium-doped Fibre Laser with a Combined Modulator Based on Single-wall Carbon Nanotubes* Look-Ahead Based Sigma-Delta Modulation *A Experimental Verification and Assessment of an IR Radiation Modulator Based on a Fabry-Perot Etalon The Design of Low-Voltage, Low-Power Sigma-Delta Modulators* A Synthesized Electrooptic Directional-coupler Modulator at 1300-nanometer Wavelength with Low Switching Voltage Delta-sigma Modulator Based Digital Filter RF Bandpass Sigma Delta Modulator Based on Integrated Transmission Lines for Digital Radios *Electroabsorption-modulator Based Clock Recovery Circuit for High-speed Optical Non-return-to-zero (NRZ) Signals* Active and Passive Plasmonic Devices for Optical Communications Electro-optic Polymer Based Mid-index Phase Modulator in Silicon Nitride Waveguide Technology Mach-Zehnder Modulator Based Electronic-photonic Integrated Circuits for Optical Interconnects Applications

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. "This book discusses the principles and the latest progress of silicon optical modulators as cutting-edge integrated photonic devices on silicon-photonic platforms, which play key roles in modern optical communications with low power consumption, small footprints, and low manufacturing costs. Silicon Mach-Zehnder optical modulators are emphasized as the principal small-footprint optical modulator because of its superior performance in high-speed optical modulation at operational temperatures beyond 100 degrees Celsius without power-consuming thermo-electric cooling in spectral bands over 100 nm"-- * The first single volume resource for researchers in the field who previously had to depend on separate papers and conference records to attain a working knowledge of the subject. * Brings together the field's diverse approaches into an integrated and comprehensive theory of PWM This contract was for the purpose of building 128xl28 pixel

spatial light modulator capable of phase-only modulation using TI's unique flexure beam deformable mirror device (DMD) technology. The flexure beam DMD contains mirror elements that move vertically in response to an electrostatic force. The resulting piston-like motion provides broad range analog phase modulation with minimal amplitude modulation. Problems in the CCD addressing prevented the completion and delivery of a fully functioning device. Optical processing, Spatial light modulators, Phase-only filters, Target recognition, Electro-optic devices. This book is intended for students and professionals who are interested in the field of digital signal processing of delta-sigma modulated sequences. The overall focus is on the development of algorithms and circuits for linear, non-linear, and mixed mode processing of delta-sigma modulated pulse streams. The material presented here is directly relevant to applications in digital communication, DSP, instrumentation, and control. A low-switching-voltage electrooptic directional-coupler modulator for use in analog optical communication systems at the wavelength of 1300 nanometers was investigated. Conventional optical directional couplers have a pair of their constitutive waveguides running in parallel, and thus the coupling between them is constant throughout the length of the structure, and this gives rise to an approximate sinc-squared amplitude transfer

function. This transfer or response function is nonlinear, and therefore modulators based on the constant-coupling directional coupler may only have a small modulation depth of about 2%--5% for analog communication systems. In this work, the directional coupler was modified by varying the etch depth between the two constitutive waveguides while keeping the spacing between them constant along the length of the structure, so that the modulator's response function of the desired form was obtained and exhibited high linearity. Consequently, large dynamic range and low switching voltage operation may be realized with this directional-coupler modulator. Based on this concept, the device built in AlGaAs/GaAs semiconductor material was designed, fabricated and tested. The do experimental result shows that the directional-coupler modulator, which is 1.5 cm long, has a switching voltage of about 1.8 volts--one of the lowest values for electrooptic modulators built to date. With further investigation on the RF/microwave characteristics, the directional-coupler modulator based on this design might prove to be promising for use in the optical communication mainstream. This dissertation is concerned with developing next generation EO modulator based on epitaxially grown BaTiO3 on MgO. Basic theory has been reviewed in Chapter 2. EO modulator fabrication is presented in Chapter 3. First,

geometrical dimensions are determined by calculation. Thin film growth and characterization section follows it. Optical waveguide processes and gold electrodes deposition processes are explained in detail later. Chapter 4 is devoted to optical and electrical measurements of the BaTiO3 modulator. DC modulation experiments confirm that the modulation results from electrooptic effect. Vpi*L was measured with full modulation, low frequency measurement. Its broadband response was measured by small signal measurement. Radio over Free Space Optics (RoFSO) and Radio over Fiber (RoF) are recent technologies in optical communication systems. Both these technologies require some form of external optical modulator in the transmitter side. The commonly used optical modulators are Mach-Zehnder modulator (MZM) and Electro absorption modulator (EAM). In this paper, we analyze the performance of both Mach-Zehnder modulator and Electro absorption modulator for Radio over Free Space Optical Communication systems and it is compared with Radio over Fiber systems. We also discuss about the choice of optical modulator based on the intensity of output light signal. The objectives of the project, as they were formulated in the proposal, are the following: (1) Design and development of novel electro-optic modulator using single crystalline film of highly efficient electro-optic organic material integrated with

prism coupler; (2) Experimental characterization of the figures-of-merit of the modulator. It is expected to perform with an extinction ratio of 10 dB at a driving signal of 5 V; (3) Conclusions on feasibility of the modulator as an element of data communication systems of future generations. The accomplishments of the project are the following: (1) The design of the electro-optic modulator based on a single crystalline film of organic material NPP has been explored; (2) The evaluation of the figures-of-merit of the electro-optic modulator has been performed; (3) Based on the results of characterization of the figures-of-merit, the conclusion was made that the modulator based on a thin film of NPP is feasible and has a great potential of being used in optic communication with a modulation bandwidth of up to 100 GHz and a driving voltage of the order of 3 to 5 V.Sarkisov, Sergey S.Marshall Space Flight CenterCOUPLERS; DATA TRANSMISSION; ELECTRO-OPTICS; MODULATORS; WAVEGUIDES; OPTICAL COMMUNICATION; BANDWIDTH; MODULATION; ORGANIC MATERIALS; SINGLE CRYSTALS; THIN FILMS; PRISMS Xiv, 82 leaves : ill. ; 30 cm. The aim of this book is to expand and improve upon the existing knowledge on discrete-time 1-bit look-ahead sigma-delta modulation in general, and to come to a solution for the above mentioned specific issues arising from 1-bit sigma-delta modulation for SA-CD. In

order to achieve this objective an analysis is made of the possibilities for improving the performance of digital noise-shaping look-ahead solutions. On the basis of the insights obtained from the analysis, several novel generic 1-bit look-ahead solutions that improve upon the state-of-the-art will be derived and their performance will be evaluated and compared. Finally, all the insights are combined with the knowledge of the SA-CD lossless data compression algorithm to come to a specifically for SA-CD optimized look-ahead design.
Abstract: The huge increments in data traffic and communication over the past few decades have pushed the conventional electronic communication systems to their physical limits in terms of data rate, bandwidth and capacity. The continuous shrinking of feature sizes, the increase in the microelectronic integrated circuits complexity, and the increasing demand for higher speeds and data rates have all stimulated seeking new technology to replace the currently present microelectronics industry rather than improving it. Photonics is one of the most likely candidates to answer this pursuit for its compatibility with the fiber optic industry, which has shown a great success in large-scale communication since around 50 years ago. Silicon photonics, in particular, is very interesting for the scientific community for its compatibility with the foundries which are the bases for microelectronic

industries around the globe. Advancements in silicon photonic would rather enable the integration of both electronic and optical system components on the same chip, which is a very important step in the transition towards all-optical on-chip systems. The huge interest in silicon photonics over the past two decades has brought forth a number of applications in various fields, such as biosensing, displays, on- and off-chip interconnection, artificial intelligence, internet of things, big data centres, and telecommunications. In practice, there are many ways of realizing and fabricating on-chip silicon waveguides. Ion exchange process is one of the most commonly used techniques in fabricating glass waveguides as it offers ease of application, low cost, and low equipment requirements. Unfortunately, numerical constraints render the modelling of this process challenging due to the presence of computational instabilities at certain conditions. In the first part of this thesis, this issue is worked out by introducing a novel numerical model based on finite element method formulation. In the second part of the thesis, we concentrate on one of the promising applications of silicon photonics, which is the telecommunications. Optical communication systems include many components such as, light sources, photodetectors, multiplexers, filters, resonators, optical interconnects, switches, couplers, splitters, and modulators. The optical

modulator is considered the most essential component in an optical communication system as it converts the incoming electric digital data into an optical data stream. Its acts as a binding link between both the optical and electronic domains on the chip. Therefore, electro-optical modulators have gained enormous attention during the past few years. Weak electro-optical effects in intrinsic silicon have stimulated the search for novel materials to be responsible for the modulation of the light beam. Surface plasmon polaritons, which propagate at a metal-dielectric interface, allow the confinement of light in subwavelength dimensions. However, they introduce large losses to the system. Transparent conducting oxides, especially indium tin oxide (ITO), provide metal-like response when exposed to a gating voltage while maintaining lower losses than noble metals. In the second part of the thesis, we propose two novel electro-optical on-chip integrated modulators based on the utilization of ITO as the active material. Electro-optic (EO) polymers have proved to be promising for use in optical modulators due to their broad bandwidth and higher electro-optic coefficient compared to conventional inorganic ceramics, while maintaining compatibility with Si-Photonics hence lowering the manufacturing cost. While modulator designs using EO polymers have been explored previously, these designs

require a long length (>1cm) to obtain a phase shift of 180o at reasonable voltage levels. In order to produce a modulator with a smaller footprint, the device must have a low figure of merit of VÏ0xL. Conventional EO polymer-based modulators offer decent bandwidth characteristics (>50GHz), however, the length - half wave voltage tradeoff limits the size and the practicality. In recent years, the use of slow-wave photonic crystal (PhC) structures has been shown to enhance the half wave voltage without increasing the modulator length. The goal of this work is to enhance phase sensitivity performance of an electro-optic (EO) polymer based phase modulator (PM) design by utilizing PhC structures. The addition of a PhC structure produces a slow-wave effect, which allows for control of the group velocity of the optical wave in the core of the integrated optic channel. PhC structures consist of a base substrate with a second material added along periodic lattice, in close proximity to the core of the optical waveguide. Analysis and numerical calculation group velocity in 1D and 2D PhC structures showed an increase in the effective group index of refraction, indicating a slowed group velocity of the lightwave. These structures were modeled using MATLAB by considering periodic structures to obtain the sensitivity of the group index of refraction in relation to cell size and periodicity. The PhC structure was analytically modeled and then

verified using periodic boundaries utilizing finite element method (FEM). The FEM based HFSS simulation has included 1D and 2D PhC topologies using material combinations of PMMA/Air or PMMA/Si3N4 structures. The primary goal of this thesis is then achieved by adding the modeled slow wave structure to a traveling-wave EO polymer-based phase modulator as either a substrate or superstrate to the optical core. To quantify the phase modulation sensitivity improvement, the traveling wave phase modulator was modeled first using FEM and beam propagation methods (BPM) to model RF and optical characteristics. Then, both substrate and superstrate topologies are introduced to the PM design. Utilizing both techniques, the EO polymer based PM design with an added PhC structure reduces the length voltage product required to achieve optical phase of 180o. Phase improvement due to the added structure was achieved through modulator simulation, yielding an improved effective EO coefficient of 162.2 pm/V compared to 67.9pm/V from the original modulator. The optimal topology a high phase improvement was chosen to be the superstrate design using a 2D PMMA/Air topology, whereas the most practical manufacturing challenge was chosen to be the 2D PMMA/Si3N4 topology with a superstrate design. "The continually increasing speed of microprocessors over the past forty years has been due in large part to

miniaturization. The smaller a transistor is made, the faster it can run, and the more can be packed onto a chip. More recently, the performance of the electrical interconnects, which are responsible for transporting data within the microprocessor and between the microprocessor and memory, has been unable to keep pace. As the interconnect is scaled down along with the transistors, its bandwidth decreases and its latency and power consumption increase. This not only decreases the bandwidth of the interconnect, but also increases both its latency and power consumption. Optical interconnects can directly address these problems by replacing electrical interconnects at the system level. In this work we outline the requirements for a successful optical interconnect, and show that the photonic crystal platform is ideal for optical interconnects. Specifically, we show how photonic crystals can be used to build one of the most basic components of an optical interconnect: the electro-optic modulator, which converts an electrical signal into the optical domain. We will first discuss the potential of photonic crystal slow light for modulation, and then introduce a new multi-channel slow light platform for improved bandwidth. Next we describe the design of a photonic crystal resonator that is embedded entirely in silicon dioxide, which is a fundamental requirement for chip compatibility. This resonator uses a graded cavity

design and has a quality factor as high as 300,000. It can be coupled to standard strip waveguides, facilitating the integration of photonic crystal devices with other photonic devices. We will also describe a simplified model of photonic crystal line-defect cavities that can aid in their design. Finally, we propose a design for a low-energy electro-optic modulator based on this graded cavity. Due to the extremely small mode volume possible with photonic crystal resonators, the active region can be on the order of a single cubic wavelength in size. By optimizing a number of parameters, a theoretical switching energy as low as 1 fJ/ bit is possible using this design."--Leaves viii-ix. This textbook provides comprehensive and detailed information on electro-optic modulation, which plays important roles in lightwave networks including optical fiber links, visible ray communications, fiber-wireless, etc. The first part of this book describes roles and basic functions of optical modulators as well as various modulation schemes. The second part is on mathematical expressions dedicated to optical modulation, where sideband generation are clearly described. In conclusion, this book provides useful information for device and system technologies, and helps in understanding fundamental issues on telecommunication systems as well as electro-optic devices. Contents in this book provide valuable information for engineering students in

telecommunications. It also gives useful examples of applied mathematics using Bessel functions. It is ideal for upper undergraduate and graduate level classes. Provides comprehensive mathematical expressions dedicated to optical phase modulation based electro-optic effect; Presents practical knowledge of optical modulators as well as basic theory on modulator operation; Includes classroom materials including software and PowerPoint slides for easy integration into curriculum. Abstract: An all-fiber optical modulator, which is composed of a piece of no-core fiber spliced between two sections of single-mode fibers and uses magnetic fluid (MF) as the cladding of the no-core fiber section, is proposed and investigated experimentally. Due to the tunable refractive index and absorption coefficient of MF, the output intensity can be modulated by controlling an applied magnetic field. The dependences of the modulator's temporal response on the working wavelength, the magnetic field strength (H), and the MF's concentration are investigated experimentally. The results are explained qualitatively by the dynamic response process of MF under the action of a magnetic field. The findings are helpful for optimizing this kind of modulator. A unidirectional electro-optic modulator based on polymeric highly multi-mode waveguides was constructed using the standard VLSI techniques. A high unidirectional coupling

efficiency of 100% Was achieved. A high modulation depth of 99% was also experimentally achieved at 633nm wavelength. The modulator was packaging enhanced by vertically configuring the guiding multi-mode waveguide and the dumping planar waveguide. The device packing density improved by a factor of two. Based on the same configuration, a packaging enhanced polarization-insensitive thermo-optic was also built. The switch operating at wavelengths of 632.8nm and 1.3 micrometers has been demonstrated experimentally with extinction ratios of 21dB and 22dB, respectively. Such devices have an intrinsic wide optical bandwidth due to the large dynamic range of the phase-matching condition implied by the multi-mode waveguides. These devices can be used in optoelectronic interconnects for data communications. Electro-optical traveling wave modulators (EO-TWM) are basic building blocks of the optical communications industry which is leading a revolution in the way we communicate, work and live. As a result, the demand for high-speed data transmission with low driving voltage is continuously growing up with costs that should be kept below a minimum. Besides communications, a growing number of applications for EO-TWM is continuously emerging with equally stringent requirements. This Thesis is concerned with advances in the eld of systematic design and optimization of EO-TWM for coping inverse of the

velocity matching constant has been shown to govern the low-loss limit (LL), while in the velocity matching limit (VM), a constant bandwidth times squared-length rule proportional to the inverse of the squared loss constant has been found more appropriate. In this work we provide insights into the trade-o issue in EO-TWM, and a complete picture of the applicable gures of merit for every operative range. Besides the known LL and VM gures of merit, two intermediate ranges, the quasi-low loss (QLL) and the quasi-velocity matching (QVM), have been identi ed. Also novel closed-forms expressions fully accounting for the e ffects of the skin-e ffect electrode loss and optical-electrical wave velocity mismatch, explicitly relating the operative bandwidth and the electrode length in EO-TWM, have been found. Novel bandwidth and electrode-length charts have been created, which constitute a useful tool for the optimization and design of this modulators. A graphical interface tool called MZM-GIT has been built integrating the analytical optimization and design strategies developed throughout the Thesis. With the aid of the MZM-GIT, several proposals of optimized MZM designs based on practical structures described in literature, and also based on the industry trends, are made and analyzed. with the industrial demands. In EO-TWM, the accumulated electro-optic e ect over the optical wave grows with the co-propagated traveling wave (TW)

length, allowing to reduce the required RF driving power. However, in typical electro-optic materials for modulators, among which LiNbO3 stands up, due to the natural mismatch between the velocity of the RF and the optical waves, the modulation bandwidth decreases with the TW length, giving place to a well-known trade-o ff. In typical LiNbO3 substrates, in which this Thesis is focused, this trade-off is seen to mainly depend on the values of the electrical loss constant and the e ective wave velocity mismatch in the TW structure that forms the electrodes, usually a coplanar waveguide (CPW). Special emphasis has historically been placed on the optimized design of the CPW in EO-TWM. In this Thesis the study of closed-form expressions for the propagation parameters of CPW as a function of the geometry, has proven useful for the design and optimization procedures sought. Although some interesting approaches to closed-form formulations have been found in literature, none of them completely ful lls the desired requirements of providing a reliable yet simple description of propagation in CPW, appropriate to systematic and easy to follow design rules for EO-TWM, and therefore new simpli ed closed-form expressions for the CPW transmission parameters have been developed. In a second part of the Thesis, the bandwidth-length trade-off has been examined. To date, two bandwidth-length rules have been proposed: a

constant bandwidth-length product proportional to the inverse of the velocity matching constant has been shown to govern the low-loss limit (LL), while in the velocity matching limit (VM), a constant bandwidth times squared-length rule proportional to the inverse of the squared loss constant has been found more appropriate. In this work we provide insights into the trade-off issue in EO-TWM, and a complete picture of the applicable fi gures of merit for every operative range. Besides the known LL and VM gures of merit, two intermediate ranges, the quasi-low loss (QLL) and the quasi-velocity matching (QVM), have been identi ed. Also novel closed-forms expressions fully accounting for the e ffects of the skin-eff ect electrode loss and optical-electrical wave velocity mismatch, explicitly relating the operative bandwidth and the electrode length in EO-TWM, have been found. Novel bandwidth and electrode-length charts have been created, which constitute a useful tool for the optimization and design of this modulators. A graphical interface tool called MZM-GIT has been built integrating the analytical optimization and design strategies developed throughout the Thesis. With the aid of the MZM-GIT, several proposals of optimized MZM designs based on practical structures described in literature, and also based on the industry trends, are made and analyzed. Oversampling techniques based on sigma-delta modulation are widely

used to implement the analog/digital interfaces in CMOS VLSI technologies. This approach is relatively insensitive to imperfections in the manufacturing process and offers numerous advantages for the realization of high-resolution analog-to-digital (A/D) converters in the low-voltage environment that is increasingly demanded by advanced VLSI technologies and by portable electronic systems. In The Design of Low-Voltage, Low-Power Sigma-Delta Modulators, an analysis of power dissipation in sigma-delta modulators is presented, and a low-voltage implementation of a digital-audio performance A/D converter based on the results of this analysis is described. Although significant power savings can typically be achieved in digital circuits by reducing the power supply voltage, the power dissipation in analog circuits actually tends to increase with decreasing supply voltages. Oversampling architectures are a potentially power-efficient means of implementing high-resolution A/D converters because they reduce the number and complexity of the analog circuits in comparison with Nyquist-rate converters. In fact, it is shown that the power dissipation of a sigma-delta modulator can approach that of a single integrator with the resolution and bandwidth required for a given application. In this research the influence of various parameters on the power dissipation of the modulator has been evaluated and strategies for the design of a

power-efficient implementation have been identified. The Design of Low-Voltage, Low-Power Sigma-Delta Modulators begins with an overview of A/D conversion, emphasizing sigma-delta modulators. It includes a detailed analysis of noise in sigma-delta modulators, analyzes power dissipation in integrator circuits, and addresses practical issues in the circuit design and testing of a high-resolution modulator. The Design of Low-Voltage, Low-Power Sigma-Delta Modulators will be of interest to practicing engineers and researchers in the areas of mixed-signal and analog integrated circuit design. The theory of operation and experimental results of the Heterostructure Field Effect Optical Modulator (HFEOM) are presented. The HFEOM is a waveguide modulator that is fully compatible in both growth and processing with the inversion channel family of devices. The operation of the HFEOM is based on the blue-shift of the absorption edge due to band filling in a modulation doped quantum well. Control of this band filling is via a gate electrode as in the operation of a FET. The two dimensional waveguiding properties of the HFEOM are modeled using the Transfer Matrix Method in conjunction with the Effective Index Method. The trade-offs between loss, confinement and speed of operation are addressed. Both the dc and ac electrical operation of the HFEOM are presented showing the relationship between the blue-

shift and the applied bias on the device. The expected frequency response is also presented. A new formalism to determine the absorption coefficient of the HFEOM is presented based on the Einstein coefficients. The result includes the effects of intraband scattering and is interpreted as a partial k-selection description of absorption. An analytic approximation is made for the absorption coefficient which is used to determine the potential phase modulation capability and chirp of the HFEOM. Experimental results from HFEOMs in both the GaAs/AlGaAs and strained InGaAs/AlGaAs material systems are given. The results from inversion channel lasers and transistors produced from the same wafers are also summarized. The best result in GaAs/AlGaAs was a 15 meV blue-shift producing an 8:1 extinction ratio for a 15mu m x300mum device using a 2.5 V swing on the gate. The best result in strained InGaAs/AlGaAs was a 20 meV blue-shift producing a 35:1 extinction ratio for a 10 mu m x 300 mu m double quantum well device using a 2.0 V swing. The ac response of a 2 mu m x 400mu m InGaAs/AlGaAs device was also measured yielding a 1.6 GHz modulation bandwidth. The parasitic limitations of this result are discussed as the expected frequency for a 2mu m rib width should be as high as 23 GHz. Presents an optical modulator based on the quantum wire structures. On-chip optical interconnect is an emerging

technology with great potentials to replace traditional electrical interconnects for large-data-operation and low-power-consumption communications of integrated circuit chips. The microring resonator-based modulator has prominent advantages such as compact footprint, low loss, high quality factor (Q-factor), integrating capability, and low power consumption to be a prime component in CMOS- compatible optical interconnect systems. In this thesis, a silicon carrier-depletion mode microring modulator is designed. The design methodology and simulation process are demonstrated in detail. To achieve the highest electro-optic phase modulation efficiency, a vertical doping structure is optimized for pn junction integrated waveguide of the microring modulator. The proposed microring modulator with a small ring radius of 3.7 [mu]m yields a high Q-factor higher than 8000. The simulated electro-optic phase efficiency is as high as 58 pm/V. The microring modulator is designed to achieve a critical coupling for the highest extinction ratio. When operated at low drive voltage from 0 V to -2 V bias, the modulation extinction ratio of the microring modulator reaches 35.56 dB when insertion loss is only about 3 dB. For the fabrication process definition, a simulation of the fabrication process, including implantation, etching, and annealing, is also be provided. Furthermore, a whole design and simulation process for

a depletion-mode microdisk modulator with a vertical doping pn junction is also studied and demonstrated in Chapter 9. In the APPENDIX A, a high aspect-ratio through silicon vias fabrication process is demonstrated. Via applying a "hybrid Cu adhesion layer" deposited by E-beam system and sputtering in sequence, through silicon vias with an aspect ratio as high as 1: 15 is successfully achieved after electro-plating. In the APPENDIX B, a design and fabrication process of a 90 ° optical hybrid based on 150 nm Si3N4 platform is presented.

stacks
- Electro optic Modulation For Photonic Networks
- Electro optic Modulator Based On A Metal Ferroelectric Nanocomposite
- High Contrast Electro optic Polarization rotation Modulator Based On 110 oriented InGaAs A1GaAs Multiple Quantum Wells
- High Modulation Efficiency Electro optic Modulator
- Electro optical Modulator Based On A Layered Semiconductor Crystal Structure
- Electrooptic Modulator Based On Thin Film BaTiO3 On MgO
- Polarisation State Modulator Based On Periodic Bending
- Design Of A High Modulation Efficiency Depletion mode Silicon Microring Modulator Based On A Vertical Junction
- A 5kV 3MHz Solid State Modulator Based On The DSRD Switch For An Ultra fast Beam Kicker
- Integrated Silicon based Optical Modulators
- Polymer Based Multi Mode Coplanar Asymmetrical Unidirectional Waveguide Modulator For Multi Wavelength
- All fiber Optical Modulator Based On No core Fiber And Magnetic Fluid As CladdingProject

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- E O Polymer Based Optical Phase Modulator And Its Performance Enhancement Using Slow Wave Structures
- An Integrated optics Intensity Modulator Based On Mode Coupling
- Circuits And Systems Based On Delta Modulation
- Neuromorphic Photonics
- Analysis Of Optical Modulators For Radio Over Free Space Optical Communication Systems And Radio Over Fiber Systems
- Toward An Ultra low Energy CMOS compatible Electro optical Modulator For On chip Optical Interconnects
- Pulse Width Modulation For Power Converters
- Novel On chip Optical Modulator Designs
- Polymeric Microring Resonator Based Electro optic Modulator

- Simulation Of Electro optic Effects In InGaAs InP Quantum Wire Based Quantum Confined Stark Effet Modulators For Optical Communication
- Experimental Verification And Assessment Of An Ir Radiation Modulator Based On A Fabry Perot Etalon
- Design Rules And Optimization Of Electro optic Modulators Based On Coplanar Waveguides
- The Heterostructure Field Effect Optical Modulator
- Pulsed Ytterbium doped Fibre Laser With A Combined Modulator Based On Single wall Carbon Nanotubes
- Look Ahead Based Sigma Delta Modulation
- A Experimental Verification And Assessment Of An IR Radiation Modulator Based On A Fabry Perot Etalon
- The Design Of Low Voltage Low Power Sigma Delta Modulators
- A Synthesized Electrooptic Directional coupler Modulator At 1300 nanometer Wavelength With Low Switching Voltage
- Delta sigma Modulator Based Digital Filter
- RF Bandpass Sigma Delta Modulator Based On Integrated Transmission Lines For Digital Radios

- Electroabsorption modulator Based Clock Recovery Circuit For High speed Optical Non return to zero NRZ Signals
- Active And Passive Plasmonic Devices For Optical Communications
- Electro optic Polymer Based Mid index Phase Modulator In Silicon Nitride Waveguide Technology
- Mach Zehnder Modulator Based Electronic photonic Integrated Circuits For Optical Interconnects Applications