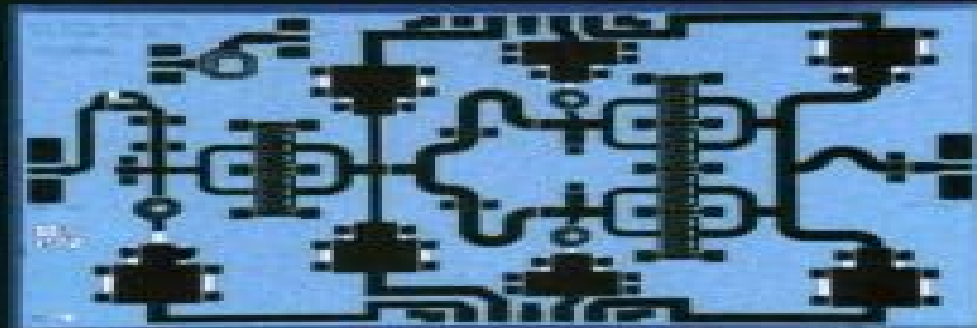


Gallium Nitride (GaN)

Physics, Devices, and Technology



Edited by **Farid Medjdoub**



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Gallium Nitride (GaN) Farid Medjdoub, 2017-12-19 Addresses a Growing Need for High Power and High Frequency Transistors Gallium Nitride GaN Physics Devices and Technology offers a balanced perspective on the state of the art in gallium nitride technology A semiconductor commonly used in bright light emitting diodes GaN can serve as a great alternative to existing devices used in microelectronics It has a wide band gap and high electron mobility that gives it special properties for applications in optoelectronic high power and high frequency devices and because of its high off state breakdown strength combined with excellent on state channel conductivity GaN is an ideal candidate for switching power transistors Explores Recent Progress in High Frequency GaN Technology Written by a panel of academic and industry experts from around the globe this book reviews the advantages of GaN based material systems suitable for high frequency high power applications It provides an overview of the semiconductor environment outlines the fundamental device physics of GaN and describes GaN materials and device structures that are needed for the next stage of microelectronics and optoelectronics The book details the development of radio frequency RF semiconductor devices and circuits considers the current challenges that the industry now faces and examines future trends In addition the authors Propose a design in which multiple LED stacks can be connected in a series using interband tunnel junction TJ interconnects Examine GaN technology while in its early stages of high volume deployment in commercial and military products Consider the potential use of both sunlight and hydrogen as promising and prominent energy sources for this technology Introduce two unique methods PEC oxidation and vapor cooling condensation methods for the deposition of high quality oxide layers A single source reference for students and professionals Gallium Nitride GaN Physics Devices and Technology provides an overall assessment of the semiconductor environment discusses the potential use of GaN based technology for RF semiconductor devices and highlights the current and emerging applications of GaN

CMOS Angelo Rivetti, 2018-09-03 CMOS Front End Electronics for Radiation Sensors offers a comprehensive introduction to integrated front end electronics for radiation detectors focusing on devices that capture individual particles or photons and are used in nuclear and high energy physics space instrumentation medical physics homeland security and related fields Emphasizing practical design and implementation this book Covers the fundamental principles of signal processing for radiation detectors Discusses the relevant analog building blocks used in the front end electronics Employs systematically weak and moderate inversion regimes in circuit analysis Makes complex topics such as noise and circuit weighting functions more accessible Includes numerical examples where appropriate CMOS Front End Electronics for Radiation Sensors provides specialized knowledge previously obtained only through the study of multiple technical and scientific papers It is an ideal text for students of physics and electronics engineering as well as a useful reference for experienced practitioners

Circuits and Systems for Security and Privacy Farhana Sheikh, Leonel Sousa, 2017-12-19 Circuits and Systems for Security and Privacy begins by introducing the basic

theoretical concepts and arithmetic used in algorithms for security and cryptography and by reviewing the fundamental building blocks of cryptographic systems It then analyzes the advantages and disadvantages of real world implementations that not only optimize power area and throughput but also resist side channel attacks Merging the perspectives of experts from industry and academia the book provides valuable insight and necessary background for the design of security aware circuits and systems as well as efficient accelerators used in security applications Wireless Transceiver Circuits Woogeun Rhee,2018-09-03 Modern transceiver systems require diversified design aspects as various radio and sensor applications have emerged Choosing the right architecture and understanding interference and linearity issues are important for multi standard cellular transceivers and software defined radios A millimeter wave complementary metal oxide semiconductor CMOS transceiver design for multi Gb s data transmission is another challenging area Energy efficient short range radios for body area networks and sensor networks have recently received great attention To meet different design requirements gaining good system perspectives is important Wireless Transceiver Circuits System Perspectives and Design Aspects offers an in depth look at integrated circuit IC design for modern transceiver circuits and wireless systems Ranging in scope from system perspectives to practical circuit design for emerging wireless applications this cutting edge book Provides system design considerations in modern transceiver design Covers both systems and circuits for the millimeter wave transceiver design Introduces four energy efficient short range radios for biomedical and wireless connectivity applications Emphasizes key building blocks in modern transceivers and transmitters including frequency synthesizers and digital intensive phase modulators Featuring contributions from renowned international experts in industry and academia Wireless Transceiver Circuits System Perspectives and Design Aspects makes an ideal reference for engineers and researchers in the area of wireless systems and circuits

Design of 3D Integrated Circuits and Systems Rohit Sharma,2018-09-03 Three dimensional 3D integration of microsystems and subsystems has become essential to the future of semiconductor technology development 3D integration requires a greater understanding of several interconnected systems stacked over each other While this vertical growth profoundly increases the system functionality it also exponentially increases the design complexity Design of 3D Integrated Circuits and Systems tackles all aspects of 3D integration including 3D circuit and system design new processes and simulation techniques alternative communication schemes for 3D circuits and systems application of novel materials for 3D systems and the thermal challenges to restrict power dissipation and improve performance of 3D systems Containing contributions from experts in industry as well as academia this authoritative text Illustrates different 3D integration approaches such as die to die die to wafer and wafer to wafer Discusses the use of interposer technology and the role of Through Silicon Vias TSVs Presents the latest improvements in three major fields of thermal management for multiprocessor systems on chip MPSoCs Explores ThruChip Interface TCI NAND flash memory stacking and emerging applications Describes large scale integration testing and state of the art low power testing solutions Complete with

experimental results of chip level 3D integration schemes tested at IBM and case studies on advanced complementary metal oxide semiconductor CMOS integration for 3D integrated circuits ICs Design of 3D Integrated Circuits and Systems is a practical reference that not only covers a wealth of design issues encountered in 3D integration but also demonstrates their impact on the efficiency of 3D systems *High-Speed Devices and Circuits with THz Applications* Jung Han Choi, 2017-09-19 Presenting the cutting edge results of new device developments and circuit implementations High Speed Devices and Circuits with THz Applications covers the recent advancements of nano devices for terahertz THz applications and the latest high speed data rate connectivity technologies from system design to integrated circuit IC design providing relevant standard activities and technical specifications Featuring the contributions of leading experts from industry and academia this pivotal work Discusses THz sensing and imaging devices based on nano devices and materials Describes silicon on insulator SOI multigate nanowire field effect transistors FETs Explains the theory underpinning nanoscale nanowire metal oxide semiconductor field effect transistors MOSFETs simulation methods and their results Explores the physics of the silicon germanium SiGe heterojunction bipolar transistor HBT as well as commercially available SiGe HBT devices and their applications Details aspects of THz IC design using standard silicon Si complementary metal oxide semiconductor CMOS devices including experimental setups for measurements detection methods and more An essential text for the future of high frequency engineering High Speed Devices and Circuits with THz Applications offers valuable insight into emerging technologies and product possibilities that are attractive in terms of mass production and compatibility with current manufacturing facilities *Low Power Circuits for Emerging Applications in Communications, Computing, and Sensing* Fei Yuan, 2018-12-07 The book addresses the need to investigate new approaches to lower energy requirement in multiple application areas and serves as a guide into emerging circuit technologies It explores revolutionary device concepts sensors and associated circuits and architectures that will greatly extend the practical engineering limits of energy efficient computation The book responds to the need to develop disruptive new system architectures circuit microarchitectures and attendant device and interconnect technology aimed at achieving the highest level of computational energy efficiency for general purpose computing systems Features Discusses unique technologies and material only available in specialized journal and conferences Covers emerging applications areas such as ultra low power communications emerging bio electronics and operation in extreme environments Explores broad circuit operation ex analog RF memory and digital circuits Contains practical applications in the engineering field as well as graduate studies Written by international experts from both academia and industry **MIMO Power Line Communications** Lars Torsten Berger, Andreas Schwager, Pascal Pagani, Daniel Schneider, 2017-12-19 One of the first publications of its kind in the exciting field of multiple input multiple output MIMO power line communications PLC MIMO Power Line Communications Narrow and Broadband Standards EMC and Advanced Processing contains contributions from experts in industry and academia making it practical enough to provide

a solid understanding of how PLC technologies work yet scientific enough to form a base for ongoing R D activities This book is subdivided into five thematic parts Part I looks at narrow and broadband channel characterization based on measurements from around the globe Taking into account current regulations and electromagnetic compatibility EMC part II describes MIMO signal processing strategies and related capacity and throughput estimates Current narrow and broadband PLC standards and specifications are described in the various chapters of part III Advanced PLC processing options are treated in part IV drawing from a wide variety of research areas such as beamforming precoding time reversal multi user processing and relaying Lastly part V contains case studies and field trials where the advanced technologies of tomorrow are put into practice today Suitable as a reference or a handbook MIMO Power Line Communications Narrow and Broadband Standards EMC and Advanced Processing features self contained chapters with extensive cross referencing to allow for a flexible reading path

Microfluidics and Nanotechnology Eric Lagally, 2017-12-19 An increasing number of technologies are being used to detect minute quantities of biomolecules and cells However it can be difficult to determine which technologies show the most promise for high sensitivity and low limit detection in different applications Microfluidics and Nanotechnology Biosensing to the Single Molecule Limit details proven approaches for the detection of single cells and even single molecules approaches employed by the world s foremost microfluidics and nanotechnology laboratories While similar books concentrate only on microfluidics or nanotechnology this book focuses on the combination of soft materials elastomers and other polymers with hard materials semiconductors metals and glass to form integrated detection systems for biological and chemical targets It explores physical and chemical as well as contact and noncontact detection methods using case studies to demonstrate system capabilities Presenting a snapshot of the current state of the art the text Explains the theory behind different detection techniques from mechanical resonators for detecting cell density to fiber optic methods for detecting DNA hybridization and beyond Examines microfluidic advances including droplet microfluidics digital microfluidics for manipulating droplets on the microscale and more Highlights an array of technologies to allow for a comparison of the fundamental advantages and challenges of each as well as an appreciation of the power of leveraging scalability and integration to achieve sensitivity at low cost Microfluidics and Nanotechnology Biosensing to the Single Molecule Limit not only serves as a quick reference for the latest achievements in biochemical detection at the single cell and single molecule levels but also provides researchers with inspiration for further innovation and expansion of the field

Technologies for Smart Sensors and Sensor Fusion Kevin Yallup, Krzysztof Iniewski, 2017-12-19 Exciting new developments are enabling sensors to go beyond the realm of simple sensing of movement or capture of images to deliver information such as location in a built environment the sense of touch and the presence of chemicals These sensors unlock the potential for smarter systems allowing machines to interact with the world around them in more intelligent and sophisticated ways Featuring contributions from authors working at the leading edge of sensor technology Technologies for Smart Sensors and Sensor Fusion showcases

the latest advancements in sensors with biotechnology medical science chemical detection environmental monitoring automotive and industrial applications This valuable reference describes the increasingly varied number of sensors that can be integrated into arrays and examines the growing availability and computational power of communication devices that support the algorithms needed to reduce the raw sensor data from multiple sensors and convert it into the information needed by the sensor array to enable rapid transmission of the results to the required point Using both SI and US units the text Provides a fundamental and analytical understanding of the underlying technology for smart sensors Discusses groundbreaking software and sensor systems as well as key issues surrounding sensor fusion Exemplifies the richness and diversity of development work in the world of smart sensors and sensor fusion Offering fresh insight into the sensors of the future Technologies for Smart Sensors and Sensor Fusion not only exposes readers to trends but also inspires innovation in smart sensor and sensor system development

Nanoscale Semiconductor Memories Santosh K. Kurinec, Krzysztof Iniewski, 2017-07-28 Nanoscale memories are used everywhere From your iPhone to a supercomputer every electronic device contains at least one such type With coverage of current and prototypical technologies *Nanoscale Semiconductor Memories Technology and Applications* presents the latest research in the field of nanoscale memories technology in one place It also covers a myriad of applications that nanoscale memories technology has enabled The book begins with coverage of SRAM addressing the design challenges as the technology scales then provides design strategies to mitigate radiation induced upsets in SRAM It discusses the current state of the art DRAM technology and the need to develop high performance sense amplifier circuitry The text then covers the novel concept of capacitorless 1T DRAM termed as Advanced RAM or A RAM and presents a discussion on quantum dot QD based flash memory Building on this foundation the coverage turns to STT RAM emphasizing scalable embedded STT RAM and the physics and engineering of magnetic domain wall racetrack memory The book also discusses state of the art modeling applied to phase change memory devices and includes an extensive review of RRAM highlighting the physics of operation and analyzing different materials systems currently under investigation The hunt is still on for universal memory that fits all the requirements of an ideal memory capable of high density storage low power operation unparalleled speed high endurance and low cost Taking an interdisciplinary approach this book bridges technological and application issues to provide the groundwork for developing custom designed memory systems

MRI Angshul Majumdar, Rabab Ward, 2018-09-03 The field of magnetic resonance imaging MRI has developed rapidly over the past decade benefiting greatly from the newly developed framework of compressed sensing and its ability to drastically reduce MRI scan times *MRI Physics Image Reconstruction and Analysis* presents the latest research in MRI technology emphasizing compressed sensing based image reconstruction techniques The book begins with a succinct introduction to the principles of MRI and then Discusses the technology and applications of T1rho MRI Details the recovery of highly sampled functional MRIs Explains sparsity based techniques for quantitative MRIs Describes multi coil parallel MRI reconstruction

techniques Examines off line techniques in dynamic MRI reconstruction Explores advances in brain connectivity analysis using diffusion and functional MRIs Featuring chapters authored by field experts MRI Physics Image Reconstruction and Analysis delivers an authoritative and cutting edge treatment of MRI reconstruction techniques The book provides engineers physicists and graduate students with a comprehensive look at the state of the art of MRI **Solid-State Radiation**

Detectors Salah Awadalla, 2017-12-19 Integrating aspects of engineering application physics and medical science Solid State Radiation Detectors Technology and Applications offers a comprehensive review of new and emerging solid state materials based technologies for radiation detection Each chapter is structured to address the current advantages and challenges of each material and technology presented as well as to discuss novel research and applications Featuring contributions from leading experts in industry and academia this authoritative text Covers modern semiconductors used for radiation monitoring Examines CdZnTe and CdTe technology for imaging applications including three dimensional capability detectors Highlights interconnect technology for current pixel detectors Describes hybrid pixel detectors and their characterizations Tackles the integrated analog signal processing read out front ends for particle detectors Considers new organic materials with direct bandgap for direct energy detection Summarizes recent developments involving lanthanum halide and cerium bromide scintillators Analyzes the potential of recent progress in the field of crystallogenes quantum dots and photonics crystals toward a new concept of x and gamma ray detectors based on metamaterials Explores position sensitivity photomultipliers and silicon photomultipliers for scintillation crystals Solid State Radiation Detectors Technology and Applications provides a valuable reference for engineers and scientists looking to enhance the performance of radiation detector technology for medical imaging and other applications Mixed-Signal Circuits Thomas Noulis, 2018-09-03 Mixed Signal Circuits offers a

thoroughly modern treatment of integrated circuit design in the context of mixed signal applications Featuring chapters authored by leading experts from industry and academia this book Discusses signal integrity and large scale simulation verification and testing Demonstrates advanced design techniques that enable digital circuits and sensitive analog circuits to coexist without any compromise Describes the process technology needed to address the performance challenges associated with developing complex mixed signal circuits Deals with modeling topics such as reliability variability and crosstalk that define pre silicon design methodology and trends and are the focus of companies involved in wireless applications Develops methods to move analog into the digital domain quickly minimizing and eliminating common trade offs between performance power consumption simulation time verification size and cost Details approaches for very low power performances high speed interfaces phase locked loops PLLs voltage controlled oscillators VCOs analog to digital converters ADCs and biomedical filters Delineates the respective parts of a full system on chip SoC from the digital parts to the baseband blocks radio frequency RF circuitries electrostatic discharge ESD structures and built in self test BIST architectures Mixed Signal Circuits explores exciting opportunities in wireless communications and beyond The book is a must for anyone involved in

mixed signal circuit design for future technologies

Semiconductor Devices in Harsh Conditions Kirsten

Weide-Zaage, Malgorzata Chrzanowska-Jeske, 2016-11-25 This book introduces the reader to a number of challenges for the operation of electronic devices in various harsh environmental conditions While some chapters focus on measuring and understanding the effects of these environments on electronic components many also propose design solutions whether in choice of material innovative structures or strategies for amelioration and repair Many applications need electronics designed to operate in harsh environments Readers will find in this collection of topics tools and ideas useful in their own pursuits and of interest to their intellectual curiosity With a focus on radiation operating conditions sensor systems package and system design the book is divided into three parts The first part deals with sensing devices designed for operating in the presence of radiation commercials of the shelf COTS products for space computing and influences of single event upset The second covers system and package design for harsh operating conditions The third presents devices for biomedical applications under moisture and temperature loads in the frame of sensor systems and operating conditions

Wireless Medical Systems and Algorithms Pietro Salvo, Miguel Hernandez-Silveira, 2017-11-22 Wireless Medical Systems and Algorithms Design and Applications provides a state of the art overview of the key steps in the development of wireless medical systems from biochips to brain computer interfaces and beyond The book also examines some of the most advanced algorithms and data processing in the field Addressing the latest challenges and solutions related to the medical needs electronic design advanced materials chemistry wireless body sensor networks and technologies suitable for wireless medical devices the text Investigates the technological and manufacturing issues associated with the development of wireless medical devices Introduces the techniques and strategies that can optimize the performances of algorithms for medical applications and provide robust results in terms of data reliability Includes a variety of practical examples and case studies relevant to engineers medical doctors chemists and biologists Wireless Medical Systems and Algorithms Design and Applications not only highlights new technologies for the continuous surveillance of patient health conditions but also shows how disciplines such as chemistry biology engineering and medicine are merging to produce a new class of smart devices capable of managing and monitoring a wide range of cognitive and physical disabilities

Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion Gaudenzio Meneghesso, Matteo Meneghini, Enrico Zanoni, 2018-05-12 This book demonstrates to readers why Gallium Nitride GaN transistors have a superior performance as compared to the already mature Silicon technology The new GaN based transistors here described enable both high frequency and high efficiency power conversion leading to smaller and more efficient power systems Coverage includes i GaN substrates and device physics ii innovative GaN transistors structure lateral and vertical iii reliability and robustness of GaN power transistors iv impact of parasitic on GaN based power conversion v new power converter architectures and vi GaN in switched mode power conversion Provides single source reference to Gallium Nitride GaN based technologies from the material level to circuit

level both for power conversions architectures and switched mode power amplifiers Demonstrates how GaN is a superior technology for switching devices enabling both high frequency high efficiency and lower cost power conversion Enables design of smaller cheaper and more efficient power supplies

Physical Design for 3D Integrated Circuits Aida Todri-Sanial, Chuan Seng Tan, 2017-12-19 Physical Design for 3D Integrated Circuits reveals how to effectively and optimally design 3D integrated circuits ICs It also analyzes the design tools for 3D circuits while exploiting the benefits of 3D technology The book begins by offering an overview of physical design challenges with respect to conventional 2D circuits and then each chapter delivers an in depth look at a specific physical design topic This comprehensive reference Contains extensive coverage of the physical design of 2 5D 3D ICs and monolithic 3D ICs Supplies state of the art solutions for challenges unique to 3D circuit design Features contributions from renowned experts in their respective fields Physical Design for 3D Integrated Circuits provides a single convenient source of cutting edge information for those pursuing 2 5D 3D technology

Flexible, Wearable, and Stretchable Electronics Katsuyuki Sakuma, 2020-11-19 Remarkable progress has been achieved within recent years in developing flexible wearable and stretchable FWS electronics These electronics will play an increasingly significant role in the future of electronics and will open new product paradigms that conventional semiconductors are not capable of This is because flexible electronics will allow us to build flexible circuits and devices on a substrate that can be bent stretched or folded without losing functionality This revolutionary change will impact how we interact with the world around us Future electronic devices will use flexible electronics as part of ambient intelligence and ubiquitous computing for many different applications such as consumer electronics medical healthcare and security devices Thus these devices have the potential to create a huge market all over the world Flexible Wearable and Stretchable Electronics provide a comprehensive technological review of the state of the art developments in FWS electronics This book offers the reader a taste of what is possible with FWS electronics and describes how these electronics can provide unique solutions for a wide variety of applications Furthermore the book introduces and explains new applications of flexible technology that has opened up the future of FWS electronics

Cell and Material Interface Nihal Engin Vrana, 2018-09-03 A significant portion of biomedical applications necessitates the establishment of an interface between the cells of the patient and the components of the device In many cases such as in implants and engineered tissues the interaction of the cells with the biomaterial is one of the main determinants of the success of the system Cell and Material Interface Advances in Tissue Engineering Biosensor Implant and Imaging Technologies explores this interaction and its control at length scales ranging from the nano to the macro Featuring contributions from leading molecular biologists chemists and material scientists this authoritative reference Presents practical examples of cell and material interface based applications Reflects the interdisciplinary nature of bioengineering covering topics such as biosensing immunology and controlled delivery Explains the role of the cell and material interface in the context of cardiac and skin tissue engineering

nanoparticles natural polymers and more Cell and Material Interface Advances in Tissue Engineering Biosensor Implant and Imaging Technologies addresses concepts essential to biomaterial production methods and cell and material interactions The book provides a solid starting point for elucidating and exploiting the different aspects of cellular interactions with materials for biomedical engineering

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