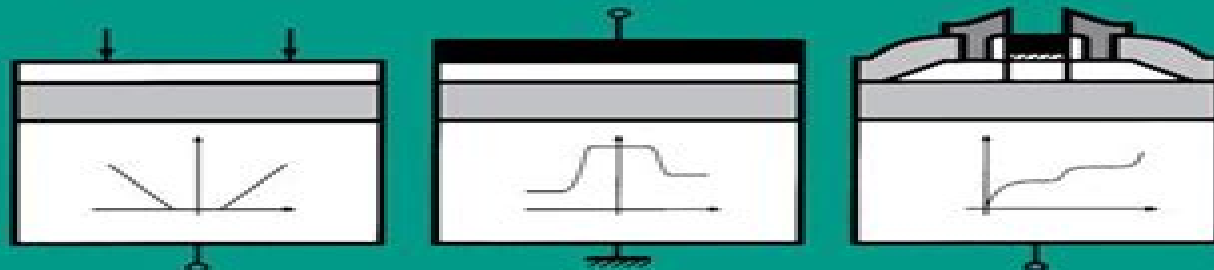

Electrical Characterization of Silicon-On-Insulator Materials and Devices

Sorin Cristoloveanu
Sheng S. Li



Kluwer Academic Publishers

Electrical Characterization Of Silicon On Insulator Materials And Devices

**J.-P. Colinge, Vladimir S.
Lysenko, Alexei N. Nazarov**



Electrical Characterization Of Silicon On Insulator Materials And Devices:

Electrical Characterization of Silicon-on-Insulator Materials and Devices Sorin Cristoloveanu, Sheng Li, 2013-11-27 Silicon on Insulator is more than a technology more than a job and more than a venture in microelectronics it is something different and refreshing in device physics This book recalls the activity and enthusiasm of our SOI groups Many contributing students have since then disappeared from the SOI horizon Some of them believed that SOI was the great love of their scientific lives others just considered SOI as a fantastic LEGO game for adults We thank them all for kindly letting us imagine that we were guiding them This book was very necessary to many people SOI engineers will certainly be happy indeed if the performance of their SOI components is not always outstanding they can now safely incriminate the relations given in the book rather than their process Martine Gunter and Y S Chang can contemplate at last the amount of work they did with the figures Our SOI accomplices already know how much we borrowed from their expertise and would find it indecent to have their detailed contributions listed Jean Pierre and Dimitris incited the book while sharing their experience in the reliability of floating bodies Our families and friends now realize the SOI capability of dielectrically isolating us for about two years in a BOX Our kids encouraged us to start writing Our wives definitely gave us the courage to stop writing They had a hard time fighting the symptoms of a rapidly developing SOI allergy Defects and Electrical Characterization of Silicon-on-insulator Materials and Devices Hung-Sheng Chen, 1988 *Nanoelectronics: Physics, Materials and Devices* Angsuman Sarkar, Chandan Kumar Sarkar, Arpan Deyasi, Debashis De, Arezki Benfdila, 2023-01-03 Approx 528 pages Approx 528 pages *Silicon-on-insulator Technology and Devices XI* Electrochemical Society. Meeting, 2003 *Silicon-on-Insulator Technology: Materials to VLSI* J.-P. Colinge, 2012-12-06 Silicon on Insulator Technology Materials to VLSI Third Edition retraces the evolution of SOI materials devices and circuits over a period of roughly twenty years Twenty years of progress research and development during which SOI material fabrication techniques have been born and abandoned devices have been invented and forgotten but most importantly twenty years during which SOI Technology has little by little proven it could outperform bulk silicon in every possible way The turn of the century turned out to be a milestone for the semiconductor industry as high quality SOI wafers suddenly became available in large quantities From then on it took only a few years to witness the use of SOI technology in a wealth of applications ranging from audio amplifiers and wristwatches to 64 bit microprocessors This book presents a complete and state of the art review of SOI materials devices and circuits SOI fabrication and characterization techniques SOI CMOS processing and the physics of the SOI MOSFET receive an in depth analysis **Perspectives, Science and Technologies for Novel Silicon on Insulator Devices** Peter L.F. Hemment, Vladimir S. Lysenko, Alexei N. Nazarov, 2012-12-06 This proceedings volume contains the contributions of the speakers who attended the NATO Advanced Research Workshop on Perspectives Science and Technologies for Novel Silicon on Insulator Devices held at the Sanatorium Pushcha Oleha Kyiv th Ukraine from 10 to 15 October 1998 This meeting was

the second NATO Silicon on Insulator SOI Workshop to be held in st the Ukraine where the first meeting Gurzuf Crimea 1 to 4th November 1994 focussed upon the physical and technical problems to be addressed in order to exploit the advantages of incorporating SOI materials in device and sensor technologies On this occasion emphasis was placed upon firstly promoting the use of SOI substrates for a range of novel device and circuit applications and secondly addressing the economic issues of incorporating SOI processing technologies and device technologies within the framework of the resources available within the laboratories and factories of the Newly Independent States NIS The primary goal of both workshops has been the breaking of the barriers that inhibit closer collaboration between scientists and engineers in the NATO countries and the NIS Indeed it was a pleasure for attendees at the first meeting to renew acquaintances and for the first time attendees to make new contacts and enjoy the warm hospitality offered by our hosts in Kyiv An outcome was the forging of new links and concrete proposals for future collaborations

Silicon-on-insulator Technology and Devices 13 George K. Celler, Sorin Cristoloveanu, 2007 This issue of ESC Transactions covers recent significant advances in SOI technologies It will be of interest to materials and device scientists as well as to process and applications oriented engineers Several keynote papers introduce and review the main topics This is followed by contributed papers covering the latest research and implementation results

Silicon-on-insulator Technology and Devices XII George K. Celler, Sorin Cristoloveanu, Electrochemical Society. Meeting, 2005

Silicon-On-Insulator (SOI) Technology O. Kononchuk, B.-Y. Nguyen, 2014-06-19 Silicon On Insulator SOI Technology Manufacture and Applications covers SOI transistors and circuits manufacture and reliability The book also looks at applications such as memory power devices and photonics The book is divided into two parts part one covers SOI materials and manufacture while part two covers SOI devices and applications The book begins with chapters that introduce techniques for manufacturing SOI wafer technology the electrical properties of advanced SOI materials and modeling short channel SOI semiconductor transistors Both partially depleted and fully depleted SOI technologies are considered Chapters 6 and 7 concern junctionless and fin on oxide field effect transistors The challenges of variability and electrostatic discharge in CMOS devices are also addressed Part two covers recent and established technologies These include SOI transistors for radio frequency applications SOI CMOS circuits for ultralow power applications and improving device performance by using 3D integration of SOI integrated circuits Finally chapters 13 and 14 consider SOI technology for photonic integrated circuits and for micro electromechanical systems and nano electromechanical sensors The extensive coverage provided by Silicon On Insulator SOI Technology makes the book a central resource for those working in the semiconductor industry for circuit design engineers and for academics It is also important for electrical engineers in the automotive and consumer electronics sectors Covers SOI transistors and circuits as well as manufacturing processes and reliability Looks at applications such as memory power devices and photonics

Fully Depleted Silicon-On-Insulator Sorin Cristoloveanu, 2021-08-04 Fully Depleted Silicon On Insulator provides an in depth presentation of the fundamental and pragmatic concepts of this

increasingly important technology There are two main technologies in the marketplace of advanced CMOS circuits FinFETs and fully depleted silicon on insulators FD SOI The latter is unchallenged in the field of low power high frequency and Internet of Things IOT circuits The topic is very timely at research and development levels Compared to existing books on SOI materials and devices this book covers exhaustively the FD SOI domain Fully Depleted Silicon On Insulator is based on the expertise of one of the most eminent individuals in the community Dr Sorin Cristoloveanu an IEEE Andrew Grove 2017 award recipient For contributions to silicon on insulator technology and thin body devices In the book he shares key insights on the technological aspects operation mechanisms characterization techniques and most promising emerging applications Early praise for Fully Depleted Silicon On Insulator It is an excellent written guide for everyone who would like to study SOI deeply specially focusing on FD SOI Dr Katsu Izumi Formerly at NTT Laboratories and then at Osaka Prefecture University Japan FDSOI technology is poised to catch an increasingly large portion of the semiconductor market This book fits perfectly in this new paradigm It covers many SOI topics which have never been described in a book before Professor Jean Pierre Colinge Formerly at TSMC and then at CEA LETI Grenoble France This book written by one of the true experts and pioneers in the silicon on insulator field is extremely timely because of the growing footprint of FD SOI in modern silicon technology especially in IoT applications Written in a delightfully informal style yet comprehensive in its coverage the book describes both the device physics underpinning FD SOI technology and the cutting edge perhaps even futuristic devices enabled by it Professor Alexander Zaslavsky Brown University USA A superbly written book on SOI technology by a master in the field Professor Yuan Taur University of California San Diego USA The author is a world top researcher of SOI device process technology This book is his masterpiece and important for the FD SOI archive The reader will learn much from the book Professor Hiroshi Iwai National Yang Ming Chiao Tung University Taiwan From the author It is during our global war against the terrifying coalition of corona and insidious computer viruses that this book has been put together Continuous enlightenment from FD SOI helped me cross this black and gray period I shared a lot of myself in this book The rule of the game was to keep the text light despite the heavy technical content There are even tentative FD SOI hieroglyphs on the front cover composed of curves discussed in the book Written by a top expert in the silicon on insulator community and IEEE Andrew Grove 2017 award recipient Comprehensively addresses the technology aspects operation mechanisms and electrical characterization techniques for FD SOI devices Discusses FD SOI s most promising device structures for memory sensing and emerging applications *Device Physics, Modeling, Technology, and Analysis for Silicon MESFET* Iraj Sadegh Amiri, Hossein Mohammadi, Mahdiar Hosseinghadiry, 2018-12-13 This book provides detailed and accurate information on the history structure operation benefits and advanced structures of silicon MESFET along with modeling and analysis of the device The authors explain the detailed physics that are important in modeling of SOI MESFETs and present the derivations of compact model expressions so that users can recognize the physical meaning of the model equations and parameters The

discussion also includes advanced structures for SOI MESFET for submicron applications

Silicon-on-insulator Technology and Devices Peter L. F. Hemment, Sorin Cristoloveanu, 1999

Transient Floating-Body Effects for Memory Applications in Fully-Depleted SOI MOSFETs Maryline Bawedin, 2007

Memory devices based on floating body effects FBE in Silicon on Insulator SOI technology are among the most promising candidates for sub 100nm and low power Dynamic Random Access Memory DRAM This new type of DRAMs called Zero Capacitor RAM Z RAM uses only one transistor in partially depleted PD SOI technology and takes advantage of FBE which have been considered as parasitic phenomena until now The Z RAM programming principles are based on the threshold voltage V_{TH} variations induced by the excess or lack of majority carriers in the floating body In this dissertation a new floating body effect the Transient Floating Body Potential Effect TFBPE based on the body majority carriers non equilibrium and on the dual dynamic gate coupling in standard fully depleted FD SOI MOSFETs is presented for the first time The TFBPE occurs in a specific gate bias range and can induce strong hysteresis of the gate and drain current characteristics although the FD SOI transistors are usually known to be immune against the FBE and their aftermaths Adapted from the same physics principles as in the drain current hysteresis that we called the Meta Stable Dip MSD effect a new concept of one transistor capacitor less memory was also proposed the Meta Stable DRAM MSDRAM which is dedicated for double gate operations All the experimental results and physics interpretations were supported by 2D numerical simulations A 1D semi analytical model of the body potential for non equilibrium states was also proposed For the first time this original body potential model takes into account the majority carriers density variations i.e the quasi Fermi level non equilibrium versus a transient gate voltage scan in a FD MOS device

Semiconductor-On-Insulator Materials for Nanoelectronics Applications Alexei Nazarov, J.-P. Colinge, Francis Balestra, Jean-Pierre Raskin, Francisco Gamiz, V.S. Lysenko, 2011-03-03

Semiconductor On Insulator Materials for NanoElectronics Applications is devoted to the fast evolving field of modern nanoelectronics and more particularly to the physics and technology of nanoelectronic devices built on semiconductor on insulator SemOI systems The book contains the achievements in this field from leading companies and universities in Europe USA Brazil and Russia It is articulated around four main topics 1 New semiconductor on insulator materials 2 Physics of modern SemOI devices 3 Advanced characterization of SemOI devices 4 Sensors and MEMS on SOI Semiconductor On Insulator Materials for NanoElectronics Applications is useful not only to specialists in nano and microelectronics but also to students and to the wider audience of readers who are interested in new directions in modern electronics and optoelectronics

Silicon-on-Insulator Technology J.-P. Colinge, 2013-03-09

Silicon on Insulator Technology Materials to VLSI 2nd Edition describes the different facets of SOI technology SOI chips are now commercially available and SOI wafer manufacturers have gone public SOI has finally made it out of the academic world and is now a big concern for every major semiconductor company SOI technology has indeed deserved serious recognition high temperature 400 C extremely rad hard 500 Mrad Si high density 16 Mb 0.9 volt DRAM

high speed several GHz and low voltage 0.5 V SOI circuits have been demonstrated Strategic choices in favor of the use of SOI for low voltage low power portable systems have been made by several major semiconductor manufacturers Silicon on Insulator Technology Materials to VLSI 2nd Edition presents a complete and state of the art review of SOI materials devices and circuits SOI fabrication and characterization techniques SOI device processing the physics of the SOI MOSFET as well as that of SOI other devices and the performances of SOI circuits are discussed in detail The SOI specialist will find this book invaluable as a source of compiled references covering the different aspects of SOI technology For the non specialist the book serves as an excellent introduction to the topic with detailed yet simple and clear explanations Silicon on Insulator Technology Materials to VLSI 2nd Edition is recommended for use as a textbook for classes on semiconductor device processing and physics The level of the book is appropriate for teaching at both the undergraduate and graduate levels Silicon on Insulator Technology Materials to VLSI 2nd Edition includes the new materials devices and circuit concepts which have been devised since the publication of the first edition The circuit sections in particular have been updated to present the performances of SOI devices for low voltage low power applications as well as for high temperature smart power and DRAM applications The other sections such as those describing SOI materials the physics of the SOI MOSFET and other devices have been updated to present the state of the art in SOI technology

Physical and Technical Problems of SOI

Structures and Devices J.-P. Colinge, Vladimir S. Lysenko, Alexei N. Nazarov, 2012-12-06 In Physical and Technical Problems of SOI Structures and Devices specialists in silicon on insulator technology from both East and West meet for the first time giving the reader the chance to become acquainted with work from the former Soviet Union hitherto only available in Russian and barely available to western scientists Keynote lectures and state of the art presentations give a wide ranging panorama of the challenges posed by SOI materials and devices material fabrication techniques characterisation device and circuit issues

Nanoscaled Semiconductor-on-Insulator Structures and Devices S. Hall, A.N. Nazarov, V.S.

Lysenko, 2007-09-04 This proceedings volume constitutes an archive of the contributions of the key speakers who attended the NATO Advanced Research Workshop on Nanoscaled Semiconductor On Insulator Structures and devices held in the Tourist and Recreation Centre Sudak Crimea Ukraine from 15 to 19 October 2006 The semiconductor industry has sustained a very rapid growth during the last three decades through impressive technological developments which have resulted in products with higher performance and lower cost per function After many years of development it is now confidently predicted that semiconductor on insulator materials will enter and increasingly be used by manufacturing industry The wider use of semiconductor especially silicon on insulator materials will not only enable the benefits of these materials to be demonstrated but also will drive down the cost of substrates which in turn will stimulate the development of other novel devices and applications Thus the semiconductor on insulator materials of today are not only the basis for modern microelectronics but also for future nanoscale devices and ICs In itself this trend will encourage the promotion of the skills

and ideas generated by researchers in the Former Soviet Union and Eastern Europe. Indeed, one of the goals of this Workshop is to promote the development of SOI technologies worldwide.

The VLSI Handbook Wai-Kai Chen, 2018-10-03. For the new millennium, Wai Kai Chen introduced a monumental reference for the design analysis and prediction of VLSI circuits. The VLSI Handbook is still a valuable tool for dealing with the most dynamic field in engineering. This second edition includes 13 sections comprising nearly 100 chapters focused on the key concepts, models, and equations. Written by a stellar international panel of expert contributors, this handbook is a reliable, comprehensive resource for real answers to practical problems. It emphasizes fundamental theory underlying professional applications and also reflects key areas of industrial and research focus.

WHAT'S IN THE SECOND EDITION: Sections on Low power electronics and design, VLSI signal processing, Chapters on CMOS fabrication, Content addressable memory, Compound semiconductor, RF circuits, High speed circuit design principles, SiGe HBT technology, Bipolar junction transistor amplifiers, Performance modeling and analysis using SystemC, Design languages expanded from two chapters to twelve, Testing of digital systems. Structured for convenient navigation and loaded with practical solutions, The VLSI Handbook, Second Edition remains the first choice for answers to the problems and challenges faced daily in engineering practice.

Device and Circuit Cryogenic Operation for Low Temperature Electronics Francis Balestra, G. Ghibaudo, 2013-11-11. *Device and Circuit Cryogenic Operation for Low Temperature Electronics* is a first in reviewing the performance and physical mechanisms of advanced devices and circuits at cryogenic temperatures that can be used for many applications. The first two chapters cover bulk silicon and SOI MOSFETs. The electronic transport in the inversion layer, the influence of impurity freeze-out, the special electrical properties of SOI structures, the device reliability, and the interest of a low temperature operation for the ultimate integration of silicon down to nanometer dimensions are described. The next two chapters deal with Silicon Germanium and III-V Heterojunction Bipolar Transistors as well as III-V High Electron Mobility Transistors (HEMT). The basic physics of the SiGe HBT and its unique cryogenic capabilities, the optimization of such bipolar devices, and the performance of SiGe HBT BiCMOS technology at liquid nitrogen temperature are examined. The physical effects in III-V semiconductors at low temperature, the HEMT and HBT static high frequency and noise properties, and the comparison of various cooled III-V devices are also addressed. The next chapter treats quantum effect devices made of silicon materials. The major quantum effects at low temperature, quantum wires, quantum dots, as well as single electron devices and applications are investigated. The last chapter overviews the performances of cryogenic circuits and their applications. The low temperature properties and performance of inverters, multipliers, adders, operational amplifiers, memories, microprocessors, imaging devices, circuits, and systems, sensors, and read-out circuits are analyzed.

Device and Circuit Cryogenic Operation for Low Temperature Electronics is useful for researchers, engineers, Ph.D. and M.S. students working in the field of advanced electron devices and circuits, new semiconductor materials, and low temperature electronics and physics.

75th Anniversary of the Transistor Arokia Nathan, Samar K. Saha, Ravi M. Todi, 2023-07-11. 75th

Anniversary of the Transistor 75th anniversary commemorative volume reflecting the transistor's development since inception to current state of the art 75th Anniversary of the Transistor is a commemorative anniversary volume to celebrate the invention of the transistor The anniversary volume was conceived by the IEEE Electron Devices Society EDS to provide comprehensive yet compact coverage of the historical perspectives underlying the invention of the transistor and its subsequent evolution into a multitude of integration and manufacturing technologies and applications The book reflects the transistor's development since inception to the current state of the art that continues to enable scaling to very large scale integrated circuits of higher functionality and speed The stages in this evolution covered are in chronological order to reflect historical developments Narratives and experiences are provided by a select number of venerated industry and academic leaders and retired veterans of the semiconductor industry 75th Anniversary of the Transistor highlights Historical perspectives of the state of the art pre solid state transistor world pre 1947 leading to the invention of the transistor Invention of the bipolar junction transistor BJT and analytical formulations by Shockley 1948 and their impact on the semiconductor industry Large scale integration Moore's Law 1965 and transistor scaling 1974 and MOS LSI including flash memories SRAMs DRAMs 1963 and the Toshiba NAND flash memory 1989 Image sensors 1986 including charge coupled devices and related microsensor applications With comprehensive yet succinct and accessible coverage of one of the cornerstones of modern technology 75th Anniversary of the Transistor is an essential reference for engineers researchers and undergraduate students looking for historical perspective from leaders in the field

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