

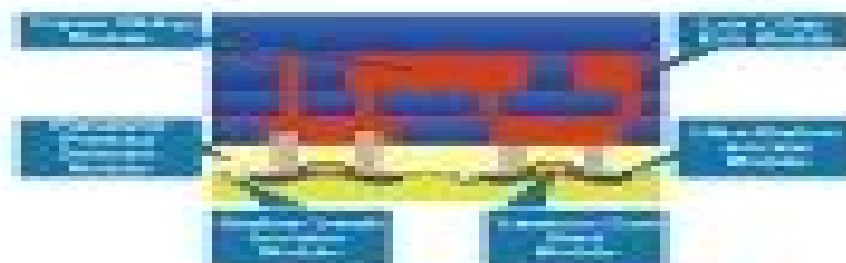


# Interlayer Dielectrics

in Semiconductor Technologies



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# Interlayer Dielectrics For Semiconductor Technologies

**Chih-Hang Tung, George T. T.  
Sheng, Chih-Yuan Lu**



## **Interlayer Dielectrics For Semiconductor Technologies:**

**Interlayer Dielectrics for Semiconductor Technologies** Shyam P Muraka, Moshe Eizenberg, Ashok K Sinha, 2003-10-13 Semiconductor technologies are moving at such a fast pace that new materials are needed in all types of application Manipulating the materials and their properties at atomic dimensions has become a must This book presents the case of interlayer dielectrics materials whilst considering these challenges Interlayer Dielectrics for Semiconductor Technologies cover the science properties and applications of dielectrics their preparation patterning reliability and characterisation followed by the discussion of different materials including those with high dielectric constants and those useful for waveguide applications in optical communications on the chip and the package Brings together for the FIRST time the science and technology of interlayer dielectrics materials in one volume written by renowned experts in the field Provides an up to date starting point in this young research field **Semiconductor Technology (ISTC2001)** Ming Yang, 2001

**Emerging Semiconductor Technology** Dinesh C. Gupta, Paul H. Langer, 1987 **ULSI Semiconductor Technology Atlas** Chih-Hang Tung, George T. T. Sheng, Chih-Yuan Lu, 2003-10-06 More than 1 100 TEM images illustrate the science of ULSI The natural outgrowth of VLSI Very Large Scale Integration Ultra Large Scale Integration ULSI refers to semiconductor chips with more than 10 million devices per chip Written by three renowned pioneers in their field ULSI Semiconductor Technology Atlas uses examples and TEM Transmission Electron Microscopy micrographs to explain and illustrate ULSI process technologies and their associated problems The first book available on the subject to be illustrated using TEM images ULSI Semiconductor Technology Atlas is logically divided into four parts Part I includes basic introductions to the ULSI process device construction analysis and TEM sample preparation Part II focuses on key ULSI modules ion implantation and defects dielectrics and isolation structures silicides salicides and metallization Part III examines integrated devices including complete planar DRAM stacked cell DRAM and trench cell DRAM as well as SRAM as examples for process integration and development Part IV emphasizes special applications including TEM in advanced failure analysis TEM in advanced packaging development and UBM Under Bump Metallization studies and high resolution TEM in microelectronics This innovative guide also provides engineers and managers in the microelectronics industry as well as graduate students with More than 1 100 TEM images to illustrate the science of ULSI A historical introduction to the technology as well as coverage of the evolution of basic ULSI process problems and issues Discussion of TEM in other advanced microelectronics devices and materials such as flash memories SOI SiGe devices MEMS and CD ROMs High-k Gate Dielectric Materials Niladri Pratap Maity, Reshmi Maity, Srimanta Baishya, 2020-12-18 This volume explores and addresses the challenges of high k gate dielectric materials one of the major concerns in the evolving semiconductor industry and the International Technology Roadmap for Semiconductors ITRS The application of high k gate dielectric materials is a promising strategy that allows further miniaturization of microelectronic components This book presents a broad review of

SiO<sub>2</sub> materials including a brief historical note of Moore's law followed by reliability issues of the SiO<sub>2</sub> based MOS transistor. It goes on to discuss the transition of gate dielectrics with an EOT 1 nm and a selection of high k materials. A review of the various deposition techniques of different high k films is also discussed. High k dielectrics theories, quantum tunneling effects and interface engineering theory and applications of different novel MOSFET structures like tunneling FET are also covered in this book. The volume also looks at the important issues in the future of CMOS technology and presents an analysis of interface charge densities with the high k material tantalum pentoxide. The issue of CMOS VLSI technology with the high k gate dielectric materials is covered as is the advanced MOSFET structure with its working structure and modeling. This timely volume will prove to be a valuable resource on both the fundamentals and the successful integration of high k dielectric materials in future IC technology.

*Dielectric Films for Advanced Microelectronics* Mikhail Baklanov, Karen Maex, Martin Green, 2007-04-04. The topic of thin films is an area of increasing importance in materials science, electrical engineering and applied solid state physics with both research and industrial applications in microelectronics, computer manufacturing and physical devices. Advanced high performance computers, high definition TV, broadband imaging systems, flat panel displays, robotic systems and medical electronics and diagnostics are a few examples of the miniaturized device technologies that depend on the utilization of thin film materials. This book presents an in depth overview of the novel developments made by the scientific leaders in the area of modern dielectric films for advanced microelectronic applications. It contains clear, concise explanations of material science of dielectric films and their problem for device operation including high k, low k, medium k dielectric films and also specific features and requirements for dielectric films used in the packaging technology. A broad range of related topics are covered from physical principles to design, fabrication, characterization and applications of novel dielectric films.

**Semiconductor Technology (ISTC 2001)** Ming Yang, 2001

**Copper Interconnect Technology** Tapan Gupta, 2010-01-22. Since overall circuit performance has depended primarily on transistor properties, previous efforts to enhance circuit and system speed were focused on transistors as well. During the last decade, however, the parasitic resistance, capacitance and inductance associated with interconnections began to influence circuit performance and will be the primary factors in the evolution of nanoscale ULSI technology. Because metallic conductivity and resistance to electromigration of bulk copper (Cu) are better than aluminum, use of copper and low k materials is now prevalent in the international microelectronics industry. As the feature size of the Cu lines forming interconnects is scaled, resistivity of the lines increases. At the same time, electromigration and stress induced voids due to increased current density become significant reliability issues. Although copper low k technology has become fairly mature, there is no single book available on the promise and challenges of these next generation technologies. In this book, a leader in the field describes advanced laser systems with lower radiation wavelengths, photolithography materials and mathematical modeling approaches to address the challenges of Cu interconnect technology.

Physics of Semiconductors Aditya Saxena, 2025-02-20. Physics of

Semiconductors Core Principles is a comprehensive guide that demystifies how semiconductors function from the fundamental physics to the devices we use daily We cater to a general audience with a focus on readers in the United States We begin with the basics of quantum mechanics and solid state physics before diving into how these principles apply to semiconductors like silicon and gallium arsenide We explain crucial concepts such as band theory the flow of electricity through semiconductors and their use in devices like transistors and solar cells Additionally we discuss the manufacturing processes of semiconductors and highlight the advancements scientists are making in developing new and improved semiconductors Physics of Semiconductors Core Principles is an excellent resource for anyone eager to understand the intricacies of this essential technology

**Semiconductors, Dielectrics, and Metals for Nanoelectronics 13** S. Kar,Koji Kita,Dolf Landheer,D. Misra,2015

**Silicon Carbide, Volume 2** Peter Friedrichs,Tsunenobu Kimoto,Lothar Ley,Gerhard Pensl,2011-04-08 Silicon Carbide this easy to manufacture compound of silicon and carbon is said to be THE emerging material for applications in electronics High thermal conductivity high electric field breakdown strength and high maximum current density make it most promising for high powered semiconductor devices Apart from applications in power electronics sensors and NEMS SiC has recently gained new interest as a substrate material for the manufacture of controlled graphene SiC and graphene research is oriented towards end markets and has high impact on areas of rapidly growing interest like electric vehicles This volume is devoted to high power devices products and their challenges in industrial application Readers will benefit from reports on development and reliability aspects of Schottky barrier diodes advantages of SiC power MOSFETs or SiC sensors The authors discuss MEMS and NEMS as SiC based electronics for automotive industry as well as SiC based circuit elements for high temperature applications and the application of transistors in PV inverters The list of contributors reads like a Who s Who of the SiC community strongly benefiting from collaborations between research institutions and enterprises active in SiC crystal growth and device development Among the former are CREE Inc and Fraunhofer ISE while the industry is represented by Toshiba Nissan Infineon NASA Naval Research Lab and Rensselaer Polytechnic Institute to name but a few

**Laser Annealing Processes in Semiconductor Technology** Fuccio Cristiano,Antonino La Magna,2021-04-21 Laser Annealing Processes in Semiconductor Technology Theory Modeling and Applications in Nanoelectronics synthesizes the scientific and technological advances of laser annealing processes for current and emerging nanotechnologies The book provides an overview of the laser matter interactions of materials and recent advances in modeling of laser related phenomena with the bulk of the book focusing on current and emerging beyond CMOS applications Reviewed applications include laser annealing of CMOS group IV semiconductors superconducting materials photonic materials 2D materials This comprehensive book is ideal for post graduate students new entrants and experienced researchers in academia research and development in materials science physics and engineering Introduces the fundamentals of laser materials and device fabrication methods including laser matter interactions and laser related

phenomena Addresses advances in physical modeling and in predictive simulations of laser annealing processes such as atomistic modeling and TCAD simulations Reviews current and emerging applications of laser annealing processes such as CMOS technology and group IV semiconductors

**Advanced Interconnects for ULSI Technology** Mikhail Baklanov, Paul S. Ho, Ehrenfried Zschech, 2012-02-17 Finding new materials for copper low k interconnects is critical to the continuing development of computer chips While copper low k interconnects have served well allowing for the creation of Ultra Large Scale Integration ULSI devices which combine over a billion transistors onto a single chip the increased resistance and RC delay at the smaller scale has become a significant factor affecting chip performance Advanced Interconnects for ULSI Technology is dedicated to the materials and methods which might be suitable replacements It covers a broad range of topics from physical principles to design fabrication characterization and application of new materials for nano interconnects and discusses Interconnect functions characterisations electrical properties and wiring requirements Low k materials fundamentals advances and mechanical properties Conductive layers and barriers Integration and reliability including mechanical reliability electromigration and electrical breakdown New approaches including 3D optical wireless interchip and carbon based interconnects Intended for postgraduate students and researchers in academia and industry this book provides a critical overview of the enabling technology at the heart of the future development of computer chips

**X-Ray Metrology in Semiconductor Manufacturing** D. Keith Bowen, Brian K. Tanner, 2018-10-03 The scales involved in modern semiconductor manufacturing and microelectronics continue to plunge downward Effective and accurate characterization of materials with thicknesses below a few nanometers can be achieved using x rays While many books are available on the theory behind x ray metrology XRM X Ray Metrology in Semiconductor Manufacturing is the first book to focus on the practical aspects of the technology and its application in device fabrication and solving new materials problems Following a general overview of the field the first section of the book is organized by application and outlines the techniques that are best suited to each The next section delves into the techniques and theory behind the applications such as specular x ray reflectivity diffraction imaging and defect mapping Finally the third section provides technological details of each technique answering questions commonly encountered in practice The authors supply real examples from the semiconductor and magnetic recording industries as well as more than 150 clearly drawn figures to illustrate the discussion They also summarize the principles and key information about each method with inset boxes found throughout the text Written by world leaders in the field X Ray Metrology in Semiconductor Manufacturing provides real solutions with a focus on accuracy repeatability and throughput

**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

### **Nanomaterials for Sustainable Energy**

Quan Li, 2016-05-12 This book presents the unique mechanical electrical and optical properties of nanomaterials which play an important role in the recent advances of energy related applications Different nanomaterials have been employed in energy saving generation harvest conversion storage and transport processes very effectively and efficiently Recent progress in the preparation characterization and usage of 1D 2D nanomaterials and hybrid architectures for energy related applications and relevant technologies and devices such as solar cells thermoelectronics piezoelectronics solar water splitting hydrogen production storage fuel cells batteries and supercapacitors is covered Moreover the book also highlights novel approaches in nanomaterials design and synthesis and evaluating materials sustainability issues Contributions from active and leading experts regarding important aspects like the synthesis assembly and properties of nanomaterials for energy related applications are compiled into a reference book As evident from the diverse topics the book will be very valuable to researchers working in the intersection of physics chemistry biology materials science and engineering It may set the standard and stimulates future developments in this rapidly emerging fertile frontier of nanomaterials for energy

**Gaseous Dielectrics VIII** Loucas G. Christophorou, James K. Olthoff, 2012-12-06 Gaseous Dielectrics VIII covers recent advances and developments in a wide range of basic applied and industrial areas of gaseous dielectrics

**Proceedings of the Symposium on Packaging of Electronic Devices** P. Bindra, Robin A. Susko, 1989

**Physics and Technology of High-k Gate Dielectrics II** Samares Kar, 2004 This volume is the proceedings of The Second International Symposium on High Dielectric Constant Materials Materials Science Processing Reliability and Manufacturing Issues and was held during the 204th Meeting of the Electrochemical Society P v Handbook of Thin Film Deposition Techniques Principles, Methods, Equipment and Applications, Second Edition Krishna Seshan, 2002-02-01 The Handbook of Thin Film Deposition Techniques Principles Methods Equipment and Applications Second Edition explores the technology behind the spectacular growth in the

silicon semiconductor industry and the continued trend in miniaturization over the last 20 years. This growth has been fueled in large part by improved thin film deposition tec



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