

Copper—Fundamental Mechanisms for Microelectronic Applications



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Copper Fundamental Mechanisms For Microelectronic Applications

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Copper Fundamental Mechanisms For Microelectronic Applications:

Microelectronic Applications of Chemical Mechanical Planarization Yuzhuo Li, 2008 An authoritative systematic and comprehensive description of current CMP technology Chemical Mechanical Planarization CMP provides the greatest degree of planarization of any known technique The current standard for integrated circuit IC planarization CMP is playing an increasingly important role in other related applications such as microelectromechanical systems MEMS and computer hard drive manufacturing This reference focuses on the chemical aspects of the technology and includes contributions from the foremost experts on specific applications After a detailed overview of the fundamentals and basic science of CMP Microelectronic Applications of Chemical Mechanical Planarization Provides in depth coverage of a wide range of state of the art technologies and applications Presents information on new designs capabilities and emerging technologies including topics like CMP with nanomaterials and 3D chips Discusses different types of CMP tools pads for IC CMP modeling and the applicability of tribometry to various aspects of CMP Covers nanotopography CMP performance and defect profiles CMP waste treatment and the chemistry and colloidal properties of the slurries used in CMP Provides a perspective on the opportunities and challenges of the next fifteen years Complete with case studies this is a valuable hands on resource for professionals including process engineers equipment engineers formulation chemists IC manufacturers and others With systematic organization and questions at the end of each chapter to facilitate learning it is an ideal introduction to CMP and an excellent text for students in advanced graduate courses that cover CMP or related semiconductor manufacturing processes

Advanced Nanoscale ULSI Interconnects: Fundamentals and Applications Yosi

Shacham-Diamand, Tetsuya Osaka, Madhav Datta, Takayuki Ohba, 2009-09-19 In Advanced ULSI interconnects fundamentals and applications we bring a comprehensive description of copper based interconnect technology for ultra lar scale integration ULSI technology for integrated circuit IC application In grated circuit technology is the base for all modern electronics systems You can nd electronics systems today everywhere from toys and home appliances to a planes and space shuttles Electronics systems form the hardware that together with software are the bases of the modern information society The rapid growth and vast exploitation of modern electronics system create a strong demand for new and improved electronic circuits as demonstrated by the amazing progress in the eld of ULSI technology This progress is well described by the famous Moore s law which states in its most general form that all the metrics that describe integrated circuit performance e g speed number of devices chip area improve expon tially as a function of time For example the number of components per chip d bles every 18 months and the critical dimension on a chip has shrunk by 50% every 2 years on average in the last 30 years This rapid growth in integrated circuits te nology results in highly complex integrated circuits with an increasing number of interconnects on chips and between the chip and its package The complexity of the interconnect network on chips involves an increasing number of metal lines per interconnect level more interconnect levels

and at the same time a reduction in the interconnect line critical dimensions

Copper -- Fundamental Mechanisms for Microelectronic Applications Shyam P. Murarka, Igor V. Verner, Ronald J. Gutmann, 2000-04-06 A complete guide to the state of the art and future direction of copper interconnect technology Owing to its performance advantages copper metallization for IC interconnect is attracting tremendous interest in the semiconductor community worldwide This timely book provides scientists and engineers with a much needed comprehensive reference on the fundamentals and applications of this emerging technology The authors draw on more than a decade of intimate involvement with copper interconnect research integrating the vast amounts of available knowledge and making clear the connection between mechanistic principles and relevant technologies In depth cutting edge discussions include The effects of copper in semiconductor materials especially silicon The fundamental chemistry and electro chemistry of copper The effects of copper on insulating materials such as glass and polymers Intermetallic and interfacial reactions of copper in layered structures Current and projected applications of copper in integrated circuits Copper Fundamental Mechanisms for Microelectronic Applications also features extensive references tables and over 100 illustrations including dual Damascene patterning necessary for copper interconnects It is an excellent resource for anyone seeking to explore the current literature and gain insight into opportunities opening in the field

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

Thin Film Materials, Processes, and Reliability G. S. Mathad, 2003

Copper in the Automotive Industry Hansjörg Lipowsky, Emin Arpacı, 2008-01-08 A comprehensive and substantial source of information on the properties production processing and applications of copper and copper alloys of interest to metallurgical development design and testing engineers in the automotive and other industries using copper The authority behind this book the German Copper Institute was founded in 1927 and is the technical scientific advisory center for all questions concerning applications and the processing of copper and copper alloys in Germany For more than 75 years the technical scientific advisory and information

service of the institute has been providing expert help free of charge It is supported by the copper industry the European Copper Institute ECI and The International Copper Association It is competent and active in matters concerning the use of copper not only in automotive but also in all kind of industrial applications in building construction in electrical engineering and in questions concerning copper s importance for health

Metal-Dielectric Interfaces in Gigascale Electronics

Ming He, Toh-Ming Lu, 2012-02-02 Metal dielectric interfaces are ubiquitous in modern electronics As advanced gigascale electronic devices continue to shrink the stability of these interfaces is becoming an increasingly important issue that has a profound impact on the operational reliability of these devices In this book the authors present the basic science underlying the thermal and electrical stability of metal dielectric interfaces and its relationship to the operation of advanced interconnect systems in gigascale electronics Interface phenomena including chemical reactions between metals and dielectrics metallic atom diffusion and ion drift are discussed based on fundamental physical and chemical principles Schematic diagrams are provided throughout the book to illustrate interface phenomena and the principles that govern them Metal Dielectric Interfaces in Gigascale Electronics provides a unifying approach to the diverse and sometimes contradictory test results that are reported in the literature on metal dielectric interfaces The goal is to provide readers with a clear account of the relationship between interface science and its applications in interconnect structures The material presented here will also be of interest to those engaged in field effect transistor and memristor device research as well as university researchers and industrial scientists working in the areas of electronic materials processing semiconductor manufacturing memory chips and IC design

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

Diffusion Processes in Advanced

Technological Materials Devendra Gupta, 2010-06-01 My 12 year old granddaughter Nina Alesi once asked me Grandpa you are a scientist at IBM so what do you do I tried to reply Oh I watch atoms move But before I could finish this sentence my 7 year old grandson Vinnie interjected Grandpa do atoms play soccer This book is about the games atoms play in diffusion and various other properties of materials While diffusion has been studied for more than 100 years in solids its importance excitement and intellectual challenges remain undiminished with time It is central to understanding the relationship

between the structure and properties of naturally occurring and synthetic materials which is at the root of current technological development and innovations The diversity of material has led to spectacular progress in functional inorganics polymers granular materials photonics complex oxides metallic glasses quasi crystals and strongly correlated electronic materials The integrity of complex materials packages is determined by diffusion a highly interactive and synergic phenomenon that interrelates to the microstructure the microchemistry and the superimposed physical fields While the various physico chemical properties of the materials are affected by diffusion they determine diffusion itself This book which is intended to document the diffusive processes operative in advanced technological materials has been written by pioneers in industry and academia *Nanodevices and Nanomaterials for Ecological Security* Yuri N. Shunin, Arnold E. Kiv, 2012-06-05

This book is devoted to a wide range of problems concerning applications of nanomaterials and nanodevices as effective solutions to modern ecological problems Leading experts in nanoscience and nanotechnology present the key theoretical experimental and implementation issues related to the creation and utilization of novel nanoscale devices to help ensure ecological security The authors discuss appropriate nanotechnologies for minimizing various types of risk to human life technogenic risk or indeed terrorist threats Particular emphasis is placed on defining and studying the required materials properties and in the field on nanoscale devices for sensors and monitoring **High Purity Silicon VII** Cor L. Claeys, 2002

Dielectric Breakdown in Gigascale Electronics Juan Pablo Borja, Toh-Ming Lu, Joel Plawsky, 2016-09-16 This book focuses on the experimental and theoretical aspects of the time dependent breakdown of advanced dielectric films used in gigascale electronics Coverage includes the most important failure mechanisms for thin low k films new and established experimental techniques recent advances in the area of dielectric failure and advanced simulations models to resolve and predict dielectric breakdown all of which are of considerable importance for engineers and scientists working on developing and integrating present and future chip architectures The book is specifically designed to aid scientists in assessing the reliability and robustness of electronic systems employing low k dielectric materials such as nano porous films Similarly the models presented here will help to improve current methodologies for estimating the failure of gigascale electronics at device operating conditions from accelerated lab test conditions Numerous graphs tables and illustrations are included to facilitate understanding of the topics Readers will be able to understand dielectric breakdown in thin films along with the main failure modes and characterization techniques In addition they will gain expertise on conventional as well as new field acceleration test models for predicting long term dielectric degradation *The International Handbook on Innovation* Larisa V

Shavinina, 2003-10-16 The breadth of this work will allow the reader to acquire a comprehensive and panoramic picture of the nature of innovation within a single handbook **ULSI Process Integration II** Cor L. Claeys, Electrochemical Society. Meeting, 2001

High Purity Silicon VIII Cor L. Claeys, 2004 This Proceedings Volume includes papers that were presented at the Eighth Symposium on High Purity Silicon held in Honolulu Hawaii at the 206th Meeting of the Electrochemical Society

October 3 8 2004 Pref **ISTFA 2007 Proceedings of the 33rd International Symposium for Testing and Failure Analysis** ASM International,2007-01-01 Printbegr nsninger Der kan printes 10 sider ad gangen og max 40 sider pr session

Handbook of Thick- and Thin-Film Hybrid Microelectronics Tapan Gupta,2003-04-17 This handbook is meant to be an introduction to the design layout and fabrication of hybrid microelectronic circuits for electrical engineering students as well as a reference book for practitioners in this discipline The text has grown out of notes prepared for a one semester graduate level course in the Electrical Engineering Department of Tufts university preface *Chemical Mechanical Planarization of Microelectronic Materials* Joseph M. Steigerwald,Shyam P. Murarka,Ronald J. Gutmann,1997 The concluding chapter describes post CMP cleaning techniques and most chapters feature problem sets to assist readers in developing a more practical understanding of CMP The only comprehensive reference to one of the fastest growing integrated circuit manufacturing technologies Chemical Mechanical Planarization of Microelectronic Materials is an important resource for research scientists and engineers working in the microelectronics industry Semiconductor Manufacturing Handbook Hwaiyu Geng,2005-05-18 This handbook will provide engineers with the principles applications and solutions needed to design and manage semiconductor manufacturing operations Consolidating the many complex fields of semiconductor fundamentals and manufacturing into one volume by deploying a team of world class specialists it allows the quick look up of specific manufacturing reference data across many subdisciplines **Device and Process Technologies for MEMS and Microelectronics** ,2005

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