## **Fundamentals Of Semiconductor Manufacturing And Pr**

Gary S. May, S. M. Sze

Fundamentals of Semiconductor Manufacturing and Process Control Gary S. May, Costas J. Spanos, 2006-05-26 A practical guide to semiconductor manufacturing from processcontrol to yield modeling and experimental design Fundamentals of Semiconductor Manufacturing and Process Controlcovers all issues involved in manufacturing microelectronic devices and circuits, including fabrication sequences, process control, experimental design, process modeling, yield modeling, and CIM/CAMsystems. Readers are introduced to both the theory and practice of all basic manufacturing concepts. Following an overview of manufacturing and technology, the textexplores process monitoring methods, including those that focus onproduct wafers and those that focus on the equipment used toproduce wafers. Next, the text sets forth some fundamentals of statistics and yield modeling, which set the foundation for adetailed discussion of how statistical process control is used to analyze quality and improve yields. The discussion of statistical experimental design offers readers apowerful approach for systematically varying controllable processconditions and determining their impact on output parameters that measure quality. The authors introduce process modeling concepts, including several advanced process control topics such asrun-by-run, supervisory control, and process and equipmentdiagnosis. Critical coverage includes the following: \* Combines process control and semiconductor manufacturing \* Unique treatment of system and software technology and management of overall manufacturing systems \* Chapters include case studies, sample problems, and suggested exercises \* Instructor support includes electronic copies of the figures and an instructor's manual Graduate-level students and industrial practitioners will benefit from the detailed exami?nation of how electronic materials and supplies are converted into finished integrated circuits and electronic products in a high-volume manufacturing environment. An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorialdepartment. An Instructor Support FTP site is also available.

**Fundamentals of Semiconductor Fabrication** Gary S. May, S. M. Sze, 2004 This concise introduction to semiconductor fabrication technology covers everything professionals need to know, from crystal growth to integrated devices and circuits. Throughout, the authors address both theory and the practical aspects of each major fabrication step, including crystal growth, silicon oxidation, photolithography, etching, diffusion, ion implantation, and thin film deposition. The book integrates Computer Modeling & Simulation tools throughout. Process simulation is used as a tool for what-if analysis and discussion.

Comprehensive coverage of process sequence helps readers connect individual steps into a cohesive whole.--

Fundamentals of Semiconductor Processing Technology Badih El-Kareh, Lou N. Hutter, 2012-12-06 The drive toward new semiconductor technologies is intricately related to market demands for cheaper, smaller, faster, and more reliable circuits with lower power consumption. The development of new processing tools and technologies is aimed at optimizing one or more of these requirements. This goal can, however, only be achieved by a concerted effort between scientists, engineers, technicians, and operators in research, development, and manufac turing. It is therefore important that experts in specific disciplines, such as device and circuit design, understand the principle, capabil ities, and limitations of tools and processing technologies. It is also important that those working on specific unit processes, such as lithography or hot processes, be familiar with other unit processes used to manufacture the product. Several excellent books have been published on the subject of process technologies. These texts, however, cover subjects in too much detail, or do not cover topics important to modem tech nologies. This book is written with the need for a bridge between different disciplines in mind. It is intended to present to engineers and scientists those parts of modem processing technologies that are of greatest importance to the design and manufacture of semi conductor circuits. The material is presented with sufficient detail to understand and analyze interactions between processing and other semiconductor disciplines, such as design of devices and cir cuits, their electrical parameters, reliability, and yield.

Semiconductor Manufacturing Handbook Hwaiyu Geng, 2005-05-18 WORLD-CLASS SEMICONDUCTOR MANUFACTURING EXPERTISE AT YOUR FINGERTIPS This is a comprehensive reference to the semiconductor manufacturing process and ancillary facilities -- from raw material preparation to packaging and testing, applying basics to emerging technologies. Readers charged with optimizing the design and performance of manufacturing processes will find all the information necessary to produce the highest quality chips at the lowest price in the shortest time possible. The Semiconductor Manufacturing Handbook provides leading-edge information on semiconductor wafer processes, MEMS, nanotechnology, and FPD, plus the latest manufacturing and automation technologies, including: Yield Management Automated Material Handling System Fab and Cleanroom Design and Operation Gas Abatement and Waste Treatment Management And much more Written by 60 international experts, and peer reviewed by a seasoned advisory board, this handbook covers the fundamentals of relevant technology and its real-life application and operational considerations for planning, implementing, and controlling manufacturing processes. It includes hundreds of detailed illustrations and a list of relevant books, technical papers, and websites for further research. This inclusive, wide-ranging coverage makes the Semiconductor Manufacturing Handbook the most comprehensive single-volume reference ever published in the field. STATE-OF-THE-ART SEMICONDUCTOR TECHNOLOGIES AND MANUFACTURING PROCESSES: SEMICONDUCTOR FUNDAMENTALS How Chips Are Designed and Made \* Substrates \* Copper and Low-k Dielectrics \* Silicide Formation \*

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ESD Basics Steven H. Voldman, 2012-10-22 Electrostatic discharge (ESD) continues to impact semiconductor manufacturing, semiconductor components and systems, as technologies scale from micro- to nano electronics. This book introduces the fundamentals of ESD, electrical overstress (EOS), electromagnetic interference (EMI), electromagnetic compatibility (EMC), and latchup, as well as provides a coherent overview of the semiconductor manufacturing environment and the final system assembly. It provides an illuminating look into the integration of ESD protection networks followed by examples in specific technologies, circuits, and chips. The text is unique in covering semiconductor chip manufacturing issues, ESD semiconductor chip design, and system problems confronted today as well as the future of ESD phenomena and nano-technology. Look inside for extensive coverage on: The fundamentals of electrostatics, triboelectric charging, and how they relate to present day manufacturing environments of micro-electronics to nano-technology Semiconductor manufacturing handling and auditing processing to avoid ESD failures ESD, EOS, EMI, EMC, and latchup semiconductor component and system level testing to demonstrate product resilience from human body model (HBM), transmission line pulse (TLP), charged device model (CDM), human metal model (HMM), cable discharge events (CDE), to system level IEC 61000-4-2 tests ESD on-chip design and process manufacturing practices and solutions to improve ESD semiconductor chip solutions, also practical off-chip ESD protection and system level solutions to provide more robust systems System level concerns in servers, laptops, disk drives, cell phones, digital cameras, hand held devices, automobiles, and space applications Examples of ESD design for state-of-the-art technologies, including CMOS, BiCMOS, SOI, bipolar technology, high voltage CMOS (HVCMOS), RF CMOS, smart power, magnetic recording technology, micro-machines (MEMs) to nano-structures ESD Basics: From Semiconductor Manufacturing to Product Use complements the author's series of books on ESD protection. For those new to the field, it is an essential reference and a useful insight into the issues that confront modern technology as we enter the Nano-electronic Era.

Particle Control for Semiconductor Manufacturing Donovan,1990-01-26 There is something Alice-in-Wonderlandish about powerful and vital computer systems being shut down by a microscopic mote that a hay-feverist wouldn't sneeze at, but as computer chips get smaller, smaller and smaller particles on their surface have a larger and larger effect on their

performance. In

Handbook for Cleaning for Semiconductor Manufacturing Karen A. Reinhardt, Richard F. Reidy, 2011-04-12 Provides an In-depth discussion of surface conditioning for semiconductor applications The Handbook of Cleaning for Semiconductor Manufacturing: Fundamentals and Applications provides an in-depth discussion of surface conditioning for semiconductor applications. The fundamental physics and chemistry associated with wet processing is reviewed as well as surface and colloidal aspects of cleaning and etching. Topics covered in this new reference include: Front end line (FEOL) and back end of line (BEOL) cleaning applications such as high-k/metal gate post-etch cleaning and pore sealing, high-dose implant stripping and cleaning, and germanium, and silicon passivation Formulation development practices, methodology and a new directions are presented including chemicals used for preventing corrosion of copper lines, cleaning aluminium lines, reclaiming wafers, and water bonding, as well as the filtering and recirculating of chemicals including reuse and recycling Wetting, cleaning, and drying of features, such as high aspect ratio features and hydrophilic surface states, especially how to dry without watermarks, the abilities to wet hydrophobic surfaces and to remove liquid from deep features The chemical reactions and mechanisms of silicon dioxide etching with hydrofluoric acid, particle removal with ammonium hydroxide/hydrogen peroxide mixture, and metal removal with hydrochloric acid The Handbook of Cleaning for Semiconductor Manufacturing: Fundamentals and Applications is a valuable resource for any engineer or manager associated with using or supplying cleaning and contamination free technologies for semiconductor manufacturing. Engineers working for semiconductor manufacturing, capital equipment, chemicals, or other industries that assures cleanliness of chemicals, material, and equipment in the manufacturing area will also find this handbook an indispensible reference.

Run-to-Run Control in Semiconductor Manufacturing James Moyne, Enrique del Castillo, Arnon M. Hurwitz, 2018-10-08 Run-to-run (R2R) control is cutting-edge technology that allows modification of a product recipe between machine runs, thereby minimizing process drift, shift, and variability-and with them, costs. Its effectiveness has been demonstrated in a variety of processes, such as vapor phase epitaxy, lithography, and chemical mechanical planarization. The only barrier to the semiconductor industry's widespread adoption of this highly effective process control is a lack of understanding of the technology. Run to Run Control in Semiconductor Manufacturing overcomes that barrier by offering in-depth analyses of R2R control.

**Microchip Fabrication, 5th Ed.** Peter Van Zant,2004-06-09 The #1 book in the industry for more than 15 years! Utilizing a straightforward, math-free pathology, this is a novice-friendly guide to the semiconductor fabrication process from raw materials through shipping the finished, packaged device. Challenging quizzes and review summaries make this the perfect learning guide for technicians in training. \* NEW chapter on nanotechnology \* NEW sections on 300mm wafer

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**Microlithography Fundamentals in Semiconductor Devices and Fabrication Technology** Saburo Nonogaki, Ueno Takumi, Toshio Ito, 2018-10-08 Explores the science and technology of lithographic processes and resist materials and summarizes the most recent innovations in semiconductor manufacturing. Considers future trends in lithography and resist material technology. Reviews the interaction of light, electron beams, and X-rays with resist materials.

A History of the World Semiconductor Industry Peter Robin Morris,1990 Development of the thermionic valve. Historical survey of early research in semiconductors. Development of the transistor. Major technical processes used in semiconductor device fabrication. Review of major factors affecting the growth of the United States semiconductor industry. Review of the factors affecting the growth of the Japanese and South Korean semiconductor industries. Review of the European semiconductor industry.

<u>Fundamentals of Manufacturing For Engineers</u> T F Waters,2017-07-12 This textbook will be welcomed throughout engineering education as the one-stop teaching text for students of manufacturing. It takes the student through the fundamental principles and practices of modern manufacturing processes in a lively and informative fashion. Topics include casting, joining, cutting, metal deformation processes, surface treat

Handbook of Chemicals and Gases for the Semiconductor Industry Ashutosh Misra, Jeremiah D. Hogan, Russell A. Chorush, 2002-03-22 The first comprehensive guide to the chemicals and gases used in semiconductor manufacturing The fabrication of semiconductor devices involves a series of complex chemical processes such as photolithography, etching, cleaning, thin film deposition, and polishing. Until now, there has been no convenient source of information on the properties, applications, and health and safety considerations of the chemicals used in these processes. The Handbook of Chemicals and Gases for the Semiconductor Industry meets this need. Each of the Handbook's eight chapters is related to a specific area of semiconductor processing. The authors provide a brief overview of each step in the process, followed by tables containing physical properties, handling, safety, and other pertinent information on chemicals and gases typically used in these processes. The 270 chemical and gas entries include data on physical properties, emergency treatment procedures, waste disposal, and incompatible materials, as well as descriptions of applications, chemical mechanisms involved, and references to the literature. Appendices cross-reference entries by process, chemical name, and CAS number. The Handbook's eight chapters are: Thin Film Deposition Materials Wafer Cleaning Materials Photolithography Materials Wet and Dry Etching Materials Chemical Mechanical Planarizing Methods Carrier Gases Uncategorized Materials Semiconductor Chemicals Analysis No other single source brings together these useful and important data on chemicals and gases used in the manufacture of semiconductor devices. The Handbook of Chemicals and Gases for the Semiconductor Industry will be a

valuable reference for process engineers, scientists, suppliers to the semiconductor industry, microelectronics researchers, and students.

**Production Planning and Control for Semiconductor Wafer Fabrication Facilities** Lars Mönch, John W. Fowler, Scott J. Mason, 2012-09-14 Over the last fifty-plus years, the increased complexity and speed of integrated circuits have radically changed our world. Today, semiconductor manufacturing is perhaps the most important segment of the global manufacturing sector. As the semiconductor industry has become more competitive, improving planning and control has become a key factor for business success. This book is devoted to production planning and control problems in semiconductor wafer fabrication facilities. It is the first book that takes a comprehensive look at the role of modeling, analysis, and related information systems for such manufacturing systems. The book provides an operations research- and computer science-based introduction into this important field of semiconductor manufacturing-related research.

<u>Semiconductor Manufacturing Technology</u> Chue San Yoo,2008-03-03 This textbook contains all the materials that an engineer needs to know to start a career in the semiconductor industry. It also provides readers with essential background information for semiconductor research. It is written by a professional who has been working in the field for over two decades and teaching the material to university students for the past 15 years. It includes process knowledge from raw material preparation to the passivation of chips in a modular format.

Fundamentals Of: Thermal Processes in Semiconductor Manufacturing PTI Seminars, Inc,1997

Semiconductor Industry J. Michael Sherer, 2018-10-03 Given the myriad exhaust compounds and the corresponding problems that they can pose in an exhaust management system, the proper choice of such systems is a complex task. Presenting the fundamentals, technical details, and general solutions to real-world problems, Semiconductor Industry: Wafer Fab Exhaust Management offers practical guidance on selecting an appropriate system for a given application. Using examples that provide a clear understanding of the concepts discussed, Sherer covers facility layout, support facilities operations, and semiconductor process equipment, followed by exhaust types and challenges. He reviews exhaust point-of-use devices and exhaust line requirements needed between process equipment and the centralized exhaust system. The book includes information on wet scrubbers for a centralized acid exhaust system and a centralized ammonia exhaust system and on centralized equipment to control volatile organic compounds. It concludes with a chapter devoted to emergency releases and a separate chapter of examples illustrating these systems in use. Drawing on the author's 20 years of industry experience, the book shows you how to customize strategies specific to your needs, solve current problems, and prevent future issues in your exhaust management systems.

**Fundamental Principles of Optical Lithography** Chris Mack,2011-08-10 The fabrication of an integrated circuit requires a variety of physical and chemical processes to be performed on a semiconductor substrate. In general, these

processes fall into three categories: film deposition, patterning, and semiconductor doping. Films of both conductors and insulators are used to connect and isolate transistors and their components. By creating structures of these various components millions of transistors can be built and wired together to form the complex circuitry of modern microelectronic devices. Fundamental to all of these processes is lithography, ie, the formation of three-dimensional relief images on the substrate for subsequent transfer of the pattern to the substrate. This book presents a complete theoretical and practical treatment of the topic of lithography for both students and researchers. It comprises ten detailed chapters plus three appendices with problems provided at the end of each chapter. Additional Information: Visiting http://www.lithoguru.com/textbook/index.html enhances the reader's understanding as the website supplies information on how you can download a free laboratory manual, Optical Lithography Modelling with MATLAB®, to accompany the textbook. You can also contact the author and find help for instructors.

Green Manufacturing David A. Dornfeld,2012-12-09 Green Manufacturing: Fundamentals and Applications introduces the basic definitions and issues surrounding green manufacturing at the process,machine and system (including supply chain) levels. It also shows, by way of several examples from different industry sectors, the potential for substantial improvement and the paths to achieve the improvement. Additionally, this book discusses regulatory and government motivations for green manufacturing and outlines the path for making manufacturing more green as well as making production more sustainable. This book also: Discusses new engineering approaches for manufacturing and provides a path from traditional manufacturing to green manufacturing Addresses regulatory and economic issues surrounding green manufacturing Details new supply chains that need to be in place before going green Includes state-of-the-art case studies in the areas of automotive, semiconductor and medical areas as well as in the supply chain and packaging areas

Semiconductor Silicon Crystal Technology Fumio Shimura,2012-12-02 Semiconductor Silicon Crystal Technology provides information pertinent to silicon, which is the dominant material in the semiconductor industry. This book discusses the technology of integrated circuits (ICs) in electronic materials manufacturer. Comprised of eight chapters, this book provides an overview of the basic science, silicon materials, IC device fabrication processes, and their interaction for enhancing both the processes and materials. This text then proceeds with a discussion of the atomic structure and bonding mechanisms in order to understand the nature and formation of crystal structures, which are the fundamentals of material science. Other chapters consider the technological crystallography and classify natural crystal morphologies based on observation. The final chapter deals with the interrelationships among silicon material characteristics, circuit design, and IC fabrication in order to ensure the fabrication of very-large-scale-integration/ultra-large-scale-integration circuits. This book is a valuable resource for graduate students, physicists, engineers, materials scientists, and professionals involved in semiconductor industry.

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