

Semiconductor Process Reliability In Practice

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Co-written by experts in the field, Semiconductor Process Reliability in Practice contains detailed descriptions and analyses of reliability and qualification for semiconductor device manufacturing and discusses the underlying physics and theory. The book covers initial specification definition, test structure design, analysis of test structure data, and final qualification of the process.

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Proven processes for ensuring semiconductor device reliability Co-written by experts in the field, Semiconductor Process Reliability in Practice contains detailed descriptions and analyses of reliability and qualification for semiconductor device manufacturing and discusses the underlying physics and theory. The book covers initial specification definition, test structure design, analysis of test structure data, and final qualification of the process. Real-world examples of test structure designs to qualify front-end-of-line devices and back-end-of-line interconnects are provided in this practical, comprehensive guide. Coverage includes: Basic device physics Process flow for MOS manufacturing Measurements useful for device reliability characterization Hot carrier injection Gate-oxide integrity (GOI) and time-dependent dielectric breakdown (TDDB) Negative bias temperature instability Plasma-induced damage Electrostatic discharge protection of integrated circuits Electromigration Stress migration Intermetal dielectric breakdown

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A practical guide to semiconductor manufacturing from process control to yield modeling and experimental design Fundamentals of Semiconductor Manufacturing and Process Control covers all issues involved in manufacturing microelectronic devices and circuits, including fabrication sequences, process control, experimental design, process modeling, yield modeling, and CIM/CAM systems. Readers are introduced to both the theory and practice of all basic manufacturing concepts. Following an overview of manufacturing and technology, the text explores process monitoring methods, including those that focus on product wafers and those that focus on the equipment used to produce wafers. Next, the text sets forth some fundamentals of statistics and yield modeling, which set the foundation for a detailed discussion of how statistical process control is used to analyze quality and improve yields. The discussion of statistical experimental design offers readers a powerful approach for systematically varying controllable process conditions and determining their impact on output parameters that measure quality. The authors introduce process modeling concepts, including several advanced process control topics such as run-by-run, supervisory control, and process and equipment diagnosis. 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 examination 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 editorial department. An Instructor Support FTP site is also available.

In writing this book, our goal was to produce a much needed teaching and reference text with a fresh approach to cleanroom technology. The most obvious technological reason for bringing this book into being is that cleanrooms have become vital to the manufacture and development of high technology products in both the commercial and military sectors, and there fore people have to develop an understanding of them. Examples of clean room applications include the manufacture of integrated circuits and other electronic components, precision mechanical assemblies, computer disks and drives, compact disks, optical components, medical implants and prostheses, pharmaceuticals and biochemicals, and so on. The book is written for anyone who is currently involved, or intends to become involved, with cleanrooms. We intend it to be used by a wide range of professional groups including process engineers, production engineers, plant mechanical and electrical engineers, research engineers and scientists, managers, and so on. In addition, we believe it will be beneficial to those who design, build, service, and supply cleanrooms, and may be used as a training aid for students who intend to pursue a career involving controlled environments and others such as cleanroom operators and maintenance staff. We have attempted to steer clear of complex theory, which may be pursued in many other specialist texts, and keep the book as understandable and applicable as possible.

Electrostatic discharge (ESD) is one of the most prevalent threats to electronic components. In an ESD event, a finite amount of charge is transferred from one object (i.e., human body) to another (i.e., microchip). This process can result in a very high current passing through the microchip within a very short period of time. Thus, more than 35 percent of single-event chip damages can be attributed to ESD events, and designing ESD structures to protect integrated circuits against the ESD stresses is a high priority in the semiconductor industry. Electrostatic Discharge Protection: Advances and Applications delivers timely coverage of component- and system-level ESD protection for semiconductor devices and integrated circuits. Bringing together contributions from internationally respected researchers and engineers with expertise in ESD design, optimization, modeling, simulation, and characterization, this book bridges the gap between theory and practice to offer valuable insight into the state of the art of ESD protection. Amply illustrated with tables, figures, and case studies, the text: Instills a deeper understanding of ESD events and ESD protection design principles Examines vital processes including Si CMOS, Si BCD, Si SOI, and GaN technologies Addresses important aspects pertinent to the modeling and simulation of ESD protection solutions Electrostatic Discharge Protection: Advances and Applications provides a single source for cutting-edge information vital to the research and development of effective, robust ESD protection solutions for semiconductor devices and integrated circuits.

Materials and Reliability Handbook for Semiconductor Optical and Electron Devices provides comprehensive coverage of reliability procedures and approaches for electron and photonic devices. These include lasers and high speed electronics used in cell phones, satellites, data transmission systems and displays. Lifetime predictions for compound semiconductor devices are notoriously inaccurate due to the absence of standard protocols. Manufacturers have relied on extrapolation back to room temperature of accelerated testing at elevated temperature. This technique fails for scaled, high current density devices. Device failure is driven by electric field or current mechanisms or low activation energy processes that are masked by other mechanisms at high temperature. The Handbook addresses reliability engineering for III-V devices, including materials and electrical characterization, reliability testing, and electronic characterization. These are used to develop new simulation technologies for device operation and reliability, which allow accurate prediction of reliability as well as the design specifically for improved reliability. The Handbook emphasizes physical mechanisms rather than an electrical definition of reliability. Accelerated aging is useful only if the failure mechanism is known. The Handbook also focuses on voltage and current acceleration stress mechanisms.

This book introduces piezoelectric microelectromechanical (pMEMS) resonators to a broad audience by reviewing design techniques including use of finite element modeling, testing and qualification of resonators, and fabrication and large scale manufacturing techniques to help inspire future research and entrepreneurial activities in pMEMS. The authors discuss the most exciting developments in the area of materials and devices for the making of piezoelectric MEMS resonators, and offer direct examples of the technical challenges that need to be overcome in order to commercialize these types of devices. Some of the topics covered include: Widely-used piezoelectric materials, as well as materials in which there is emerging interest Principle of operation and design approaches for the making of flexural, contour-mode, thickness-mode, and shear-mode piezoelectric resonators, and examples of practical implementation of these devices Large scale manufacturing approaches, with a focus on the practical aspects associated with testing and qualification Examples of commercialization paths for piezoelectric MEMS resonators in the timing and the filter markets ...and more! The authors present industry and academic perspectives, making this book ideal for engineers, graduate students, and researchers.

Practical tools for analyzing, calculating, and reporting availability, reliability, and maintainability metrics Engineers in the telecommunications industry must be able to quantify system reliability and availability metrics for use in service level agreements, system design decisions, and daily operations. Increasing system complexity and software dependence require new, more sophisticated tools for system modeling and metric calculation than those available in the current literature. Telecommunications System Reliability Engineering, Theory, and Practice provides a background in reliability engineering theory as well as detailed sections discussing applications to fiber optic networks (earth station and space segment), microwave networks (long-haul, cellular backhaul and mobile wireless), satellite networks (teleport and VSAT), power systems (generators, commercial power and battery systems), facilities management, and software/firmware. Programming techniques and examples for simulation of the approaches presented are discussed throughout the book. This powerful resource: Acts as a comprehensive reference and textbook for analysis and design of highly reliable and available telecommunications systems Bridges the fields of system reliability theory, telecommunications system engineering, and computer programming Translates abstract reliability theory concepts into practical tools and techniques for technical managers, engineers and students Provides telecommunication engineers with a holistic understanding of system reliability theory, telecommunications system engineering, and reliability/risk analysis Telecommunications System Reliability Engineering, Theory, and Practice is a must-have guide for telecommunications engineers or engineering students planning to work in the field of telecommunications.

Reliability of Semiconductor Lasers and Optoelectronic Devices simplifies complex concepts of optoelectronics reliability with approachable introductory chapters and a focus on real-world applications. This book provides a brief look at the fundamentals of laser diodes, introduces reliability qualification, and then presents real-world case studies discussing the principles of reliability and what occurs when these rules are broken. Then this book comprehensively looks at optoelectronics devices and the defects that cause premature failure in them and how to control those defects. Key materials and devices are reviewed including silicon photonics, vertical-cavity surface-emitting lasers (VCSELs), InGaN LEDs and lasers, and AlGaIn LEDs, covering the majority of optoelectronic devices that we use in our everyday lives, powering the Internet, telecommunication, solid-state lighting, illuminators, and many other applications. This book features contributions from experts in industry and academia working in these areas and includes numerous practical examples and case studies. This book is suitable for new entrants to the field of optoelectronics working in R&D. • Includes case studies and numerous examples showing best practices and common mistakes affecting optoelectronics reliability written by experts working in the industry • Features the first wide-ranging and comprehensive overview of fiber optics reliability engineering, covering all elements of the practice from building a reliability laboratory, qualifying new products, to improving reliability on mature products. • Provides a look at the reliability issues and failure mechanisms for silicon photonics, VCSELs, InGaIn LEDs and lasers, AlGaIn LEDs, and more.

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