Semiconductor Process Reliability In Practice

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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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In semiconductor manufacturing, understanding how various materials behave and interact is critical to making a reliable and robust semiconductor package. Semiconductor Packaging: Materials Interaction and Reliability provides a fundamental understanding of the underlying physical properties of the materials used in a semiconductor package. By tying together the disparate elements essential to a semiconductor package, the authors show how all the parts fit and work together to provide durable protection for the integrated circuit chip within as well as a means for the chip to communicate with the outside world. The text also covers packaging materials for MEMS, solar technology, and LEDs and explores future trends in semiconductor packages.

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.

In writing this book, our goal was to produce a much needed teaching and reference text with a fresh approach to c1eanroom technology. The most obvious technological reason for bringing this book into being is that c1ean rooms 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 c1ean 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 c1eanrooms. 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 c1eanrooms, and may be used as a training aid for students who intend to pursue a career involving controlled environments and others such as c1eanroom 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.

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.

The book focuses on the design, materials, process, fabrication, and reliability of advanced semiconductor packaging components and systems. Both principles and engineering practice have been addressed, with more weight placed on engineering practice. This is achieved by providing in-depth study on a number of major topics such as system-in-package, fan-in wafer/panel-level chip-scale packages, fan-out wafer/panel-level packaging, 2D, 2.1D, 2.3D, 2.5D, and 3D IC integration, chiplets packaging, chip-to-wafer bonding, wafer-to-wafer bonding, hybrid bonding, and dielectric materials for high speed and frequency. The book can benefit researchers, engineers, and graduate students in fields of electrical engineering, mechanical engineering, materials sciences, and industry engineering, etc.

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.

This publication is a compilation of papers presented at the Semiconductor Device Reliabi lity Workshop sponsored by the NATO International Scientific Exchange Program. The Workshop was held in Crete, Greece from June 4 to June 9, 1989. The objective of the Workshop was to review and to further explore advances in the field of semiconductor reliability through invited paper presentations and discussions. The technical emphasis was on quality assurance and reliability of optoelectronic and high speed semiconductor devices. The primary support for the meeting was provided by the Scientific Affairs Division of NATO. We are indebted to NATO for their support and to Dr. Craig Sinclair, who admin isters this program. The chapters of this book follow the format and order of the sessions of the meeting. Thirty-six papers were presented and discussed during the five-day Workshop. In addi tion, two panel sessions were held, with audience participation, where the particularly controversial topics of bum-in and reliability modeling and prediction methods were dis cussed. A brief review of these sessions is presented in this book.

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 AlGaN 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, InGaN LEDs and lasers, AIGaN LEDs, and more.