Influence Of Temperature On Microelectronics And System Reliability A Physics Of Failure Approach Electronic Packaging

This book raises the level of understanding of thermal design criteria. It provides the design team with sufficient knowledge to help them evaluate device architecture trade-offs and the effects of operating temperatures. The author provides readers a sound scientific basis for system operation at realistic steady state temperatures without reliability penalties. Higher temperature performance than is commonly recommended is shown to be cost effective in production for life cycle costs. The microelectronic package considered in the book is assumed to consist of a semiconductor device with first-level interconnects that may be wirebonds, flip-chip, or tape automated bonds; die attach; substrate; substrate attach; case; lid; lid seal; and lead seal. The temperature effects on electrical parameters of both bipolar and MOSFET devices are discussed, and models quantifying the temperature effects on package elements are identified. Temperature-related models have been used to derive derating criteria for determining the maximum and minimum allowable temperature stresses for a given microelectronic package architecture. The first chapter outlines problems with some of the current modeling strategies. The next two chapters present microelectronic device failure mechanisms in terms of their dependence on steady state temperature, temperature cycle, temperature gradient, and rate of change of temperature at the chip and package level. Physics-of-failure based models used to characterize these failure mechanisms are identified and the variabilities in temperature dependence of each of the failure mechanisms are characterized. Chapters 4 and 5 describe the effects of temperature on the performance characteristics of MOS and bipolar devices. Chapter 6 discusses using high-temperature stress screens, including burn-in, for high-reliability applications. The burn-in conditions used by some manufacturers are examined and a physics-of-failure approach is described. The

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Increase profitability and reduce risk through effective parts selection and management Corporations recognize that technology can be the key to fueling product design and development. But just as crucial-if not more-to a company's success are the decisions about when, what, and how a technology will be used. Few companies have failed because the right technology was not available; many have failed when a technology was not effectively selected and managed. Parts Selection and Management is a guide to increasing company profitability and reducing the time-to-profit through the efficient management of the process of parts selection and management. Taking an "eyes-on, hands-off" approach to parts selection, this guidebook addresses risk-assessment, decision-making steps, and subsequent management activities. The book covers everything from methodologies for parts selection and management, product requirements and specifications, and manufacturer assessment procedures to ways to track part changes through the supply chain, reliability assessment, and environmental, legislative, and legal issues. Written by a seasoned professional, teacher, and author in the field, the book enables companies to: * Employ effective risk assessment and mitigation techniques * Make an informed company-wide decision about parts selection and management * Choose parts to fit the functionality of the product and other constraints * Maximize system supportability by preparing for parts obsolescence * Improve supply-chain interactions and communications with customers and regulatory agencies to minimize time-to-profit Shedding light on a neglected but essential aspect of product development, Parts Selection and Management will give your organization the tools you need to avoid the risks associated with product use while promoting flexibility, innovation, and creativity in your product development.

Parts Selection and Management

High Temperature Electronics

Papers Presented at MMN 2000, Athens, Greece, 20-22 November 2000

Advances in Microelectronics: Reviews, Vol. 2

Handbook of Lead-Free Solder Technology for Microelectronic Assemblies

Proceedings of the VI-th International Conference CADSM 2001, 12-17 February 2001, Lviv-Slavsko, Ukraine

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 tribometrology 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.

Influence of Temperature on Microelectronics and System ReliabilityA Physics of Failure ApproachCRC Press

The development of electronics that can operate at high temperatures has been identified as a critical technology for the next century. Increasingly, engineers will be called upon to design avionics, automotive, and geophysical electronic systems requiring components and packaging reliable to 200 °C and beyond. Until now, however, they have had no single resource on high temperature electronics to assist them. Such a resource is critically needed, since the design and manufacture of electronic components have now made it possible to design electronic systems that will operate reliably above the traditional temperature limit of 125 °C. However, successful system development efforts hinge on a firm understanding of the fundamentals of semiconductor physics and device processing, materials selection, package design, and thermal management, together with a knowledge of the intended application environments. High Temperature Electronics brings together this essential information and presents it for the first time in a unified way. Packaging and device engineers and technologists will find this book required reading for its coverage of the techniques and tradeoffs involved in materials selection, design, and thermal management and for its presentation of best design practices using actual fielded systems as examples. In addition, professors and students will find this book suitable for graduate-level courses because of its detailed level of explanation and its coverage of fundamental scientific concepts. Experts from the field of high temperature electronics have contributed to nine chapters covering topics ranging from semiconductor device selection to testing and final assembly.

Study of Heterostructure Field-Effect Devices with Low-Temperature Chemical-Treated Structure

Microelectronic Materials

Microelectronics, Microsystems And Nanotechnology: Papers Presented Of At Mmn 2000

A Physics of Failure Approach

Structural Analysis in Microelectronics and Fiber Optic Systems

Thermal Stress and Strain in Microelectronics Packaging

The 2nd volume of 'Advances in Microelectronics: Reviews' Book Series is written by 57 contributors from academy and industry from 11 countries (Bulgaria, Hungary, Iran, Japan, Malaysia, Romania, Russia, Slovak Republic, Spain, Ukraine and USA). The book contains 13 chapters from different areas of microelectronics: MEMS, materials characterization, and various microelectronic devices. With unique combination of information in each volume, the Book Series will be of value for scientists and engineers in industry and at universities. Each of chapter is ending by well selected list of references with books, journals, conference proceedings and web sites. This book ensures that readers will stay at the cutting edge of the field and get the right and effective start point and road map for the further researches and developments.

This volume contains papers on the following: CMOS devices and devices based on compound semiconductors; processing; silicon integrated technology and integrated circuit design; quantum physics; nanotechnology; nanodevices, sensors and microsystems. The latest news and future challenges in these fields are presented in invited papers.

Details the methods for integrating reliability into manufacturing, providing a methodology for meeting the technological challenges of VLSI and MMIC circuits. Includes a detailed assessment of the relationship between yield and reliability; reliability concepts in dual use electronics--the priority for the future; an examination of the effects of fabrication technology on microcircuit quality; coverage of quality and reliability in microwave and plastic packages; and a comprehensive review of the new technologies for the future, including micro-electromechanical systems, robotics, and microwave integrated devices. Annotation copyright by Book News, Inc., Portland, OR

Reliability and Quality in Microelectronic Manufacturing

Physikalische Berichte

Proceedings of the 1978 International Microelectronics Symposium

Benefiting from Thermal and Mechanical Simulation in Micro-Electronics

Microelectronics, Microsystems and Nanotechnology

This book raises the level of understanding of thermal design criteria. It provides the design team with sufficient knowledge to help them evaluate device architecture trade-offs and the effects of operating temperatures. The author provides readers a sound scientific basis for system operation at realistic steady state temperatures without reliability penalties. Higher temperature performance than is commonly recommended is shown to be cost effective in production for life cycle costs. The microelectronic package considered in the book is assumed to consist of a semiconductor device with first-level interconnects that may be wirebonds, flip-chip, or tape automated bonds; die attach; substrate; substrate attach; case; lid; lid seal; and lead seal. The temperature effects on electrical parameters of both bipolar and MOSFET devices are discussed, and models quantifying the temperature effects on package elements are identified. Temperature-related models have been used to derive derating criteria for determining the maximum and minimum allowable temperature stresses for a given microelectronic package architecture. The first chapter outlines problems with some of the current modeling strategies. The next two chapters present microelectronic device failure mechanisms in terms of their dependence on steady state temperature, temperature cycle, temperature gradient, and rate of change of temperature at the chip and package level. Physics-of-failure based models used to characterize these failure mechanisms are identified and the variabilities in temperature dependence of each of the failure mechanisms are characterized. Chapters 4 and 5 describe the effects of temperature on the performance characteristics of MOS and bipolar devices. Chapter 6 discusses using high-temperature stress screens, including burn-in, for high-reliability applications. The burn-in conditions used by some manufacturers are examined and a physics-of-failure approach is described. The final chapter overviews existing guidelines for thermal derating of microelectronic devices, which presently involve lowering the junction temperature. The reader then learns how to use physics-of-failure models presented in the previous chapters for various failure processes, to evaluate the sensitivity of device life to variations in manufacturing defects, device architecture, temperature, and non-temperature stresses.

"Benefiting from Thermal and Mechanical Simulation inMicro-Electronics" presents papers from the first internationalconference on this topic, EuroSimE2000. For the first time, peoplefrom the electronics industry, research institutes, software companiesand universities joined together to discuss present and possiblefuture thermal and mechanical related problems and challenges inmicro-electronics; the state-of-the-art methodologies for thermal &mechanical simulation and optimization of micro-electronics; and theperspectives of future simulation and optimization methodologydevelopment.Main areas covered are: - "Benefiting from Thermal and""Mechanical Simulation in Micro-Electronics" is suitable forstudents at graduate level and beyond, and for researchers, designersand specialists in the fields of microelectronics and mechanics.

This book aims to provide a comprehensive reference into the critical subject of failure and degradation in organic materials, used in optoelectronics and microelectronics systems and devices. Readers in different industrial sectors, including microelectronics, automotive, lighting, oil/gas, and petrochemical will benefit from this book. Several case studies and examples are discussed, which readers will find useful to assess and mitigate similar failure cases. More importantly, this book presents methodologies and useful approaches in analyzing a failure and in relating a failure to the reliability of materials and systems. Presents methodologies for analysing the reliability, failure, and degradation of different organic materials, used in optoelectronics and microelectronics; Provides an overview of different failure mechanisms in different organic materials; Explains how to correlate product performance and reliability to materials degradation; Provides an overview of simulation techniques and methodologies to predict lifetime and reliability of engineering materials and components; Integrates several degradation causes in different materials (thermal, moisture, light radiation, mechanical damage, and more) into large-scale system solutions in several industrial domains (lighting, automotive, oil/gas, and transport and more); Includes case studies from different failure/degradation mechanisms in different industrial sectors.

Integrating Reliability Into Microelectronics Manufacturing

Scientific and Technical Aerospace Reports

Transport Simulation in Microelectronics

Hall Effect Devices, Second Edition

Microcircuit Reliability Bibliography

Proceedings of the Nineteenth International Symposium

Robust Design of Microelectronics Assemblies Against Mechanical Shock, Temperature and Moisture discusses how the reliability of packaging components is a prime concern to electronics manufacturers. The text presents a thorough review of this important field of research, providing users with a practical guide that discusses theoretical aspects, experimental results, and modeling techniques. The authors use their extensive experience to produce detailed chapters covering temperature, moisture, and mechanical shock induced failure, adhesive interconnects, and viscoelasticity. Useful program files and macros are also included. Discusses how the reliability of packaging components is a prime concern to electronics manufacturers Presents a thorough review of this important field of research, providing users with a practical guide that discusses theoretical aspects, experimental results, and modeling techniques Includes program files and macros for additional study

This reference provides a complete discussion of the conversion from standard lead-tin to lead-free solder microelectronic assemblies for low-end and high-end applications. Written by more than 45 world-class researchers and practitioners, the book discusses general reliability issues concerning microelectronic assemblies, as well as factors specif

The CRC Handbook of Thermal Engineering, Second Edition, is a fully updated version of this respected reference work, with chapters written by leading experts. Its first part covers basic concepts, equations and principles of thermodynamics, heat transfer, and fluid dynamics. Following that is detailed coverage of major application areas, such as bioengineering, energy-efficient building systems, traditional and renewable energy sources, food processing, and aerospace heat transfer topics. The latest numerical and computational tools, microscale and nanoscale engineering, and new complex-structured materials are also presented. Designed for easy reference, this new edition is a must-have volume for engineers and researchers around the globe.

Reliability of Organic Compounds in Microelectronics and Optoelectronics

Microelectronics Failure Analysis

Proceedings of the Seventeenth International Symposium

Microelectronic Applications of Chemical Mechanical Planarization

Proceedings of the ... IEEE International Conference on Microelectronic Test Structures

Issues in Electronics Research and Application: 2011 Edition

Microelectronics packaging and interconnection have experienced exciting growth stimulated by the recognition that systems, not just silicon, provide the solution to evolving applications. In order to have a high density/ performance/yield/quality/reliability, low cost, and light weight system, a more precise understanding of the system behavior is required. Mechanical and thermal phenomena are among the least understood and most complex of the many phenomena encountered in microelectronics packaging systems and are found on the critical path of neatly every design and process in the electronics industry. The last decade has witnessed an explosive growth in the research and development efforts devoted to determining the mechanical and thermal behaviors of microelectronics packaging. With the advance of very large scale integration technologies, thousands to tens of thousands of devices can be fabricated on a silicon chip. At the same time, demands to further reduce packaging signal delay and increase packaging density between communicat ing circuits have led to the use of very high power dissipation single-chip modules and multi-chip modules. The result of these developments has been a rapid growth in module level heat flux within the personal, workstation, midrange, mainframe, and super computers. Thus, thermal (temperature, stress, and strain) management is vital for microelectronics packaging designs and analyses. How to determine the temperature distribution in the elec tronics components and systems is outside the scope of this book, which focuses on the determination of stress and strain distributions in the electronics

packaging.
The SBMicro symposium is a forum dedicated to fabrication and modeling of Microsystems, integrated circuits and devices. The goal of the symposium is to bring together researchers in the areas of processing, materials, characterization, modeling and TCAD of integrated circuits, microsensors, microactuators, and MEMS. This issue contains the papers presented at the 2007 conference.
This is the second edition of a very popular 1991 book describing the physics and technology of semiconductor electronic devices exploiting the Hall effect. These are magnetic field sensitive devices such as Hall elements, magnetoresistors, and magnetotransistors. Hall effect devices are commonly used as magnetic field sensors and as means for characterizing semiconductors. The book provides a clear analysis of the relationship between the basic physical phenomena in solids, the appropriate materials characteristics, and the characteristics of Hall effect devices. Particular emphasis is placed on important developments inspired and made possible by recent advances in microelectronics. A special feature of the book is its broad scope. The book provides physical basics of Hall effect devices, clear guidelines for the design of practical Hall elements, detailed descriptions of the best interface electronic circuits, examples of the most successful industrial products in the field, and interesting examples of their applications.
Technology Drivers Part I
Microelectronics Technology and Devices--SBMICRO 2007
Robust Design of Microelectronics Assemblies Against Mechanical Shock, Temperature and Moisture
September 25-27, 1978, Radisson Hotel Downtown, Minneapolis, MN
Electronic Materials Handbook
Packaging

Electronics has become the largest industry, surpassing agriCUlture, auto. and heavy metal industries. It has become the industry of choice for a country to prosper, already having given rise to the phenomenal prosperity of Japan. Korea. Singapore. Hong Kong. and Ireland among others. At the current growth rate, total worldwide semiconductor sales will reach $300B by the year 2000. The key electronic technologies responsible for the growth of the industry include semiconductors. the packaging of semiconductors for systems use in auto, telecom, computer, consumer, aerospace, and medical industries. displays. magnetic, and optical storage as well as software and system technologies. There has been a paradigm shift, however, in these technologies. from mainframe and supercomputer applications at any cost. to consumer applications at approximately one-tenth the cost and size. Personal computers are a good example. going from $500IMIP when products were first introduced in 1981, to a projected $lIMIP within 10 years. Thin. light portable. user friendly and very low-cost are. therefore. the attributes of tomorrow's computing and communications systems. Electronic packaging is defined as interconnection. powering, cool ing, and protecting semiconductor chips for reliable systems. It is a key enabling technology achieving the requirements for reducing the size and cost at the system and product level.
This practical book shows how an understanding of structure, thermodynamics, and electrical properties can explain some of the choices of materials used in microelectronics, and can assist in the design of new materials for specific applications. It emphasizes the importance of the phase chemistry of semiconductor and metal systems for ensuring the long-term stability of new devices. The book discusses single-crystal and polycrystalline silicon, aluminium- and gold-based metallisation schemes, packaging semiconductor devices, failure analysis, and the suitability of various materials for optoelectronic devices and solar cells. It has been designed for senior undergraduates, graduates, and researchers in physics, electronic engineering, and materials science.
Volume 1: Packaging is an authoritative reference source of practical information for the design or process engineer who must make informed day-to-day decisions about the materials and processes of microelectronic packaging. Its 117 articles offer the collective knowledge, wisdom, and judgement of 407 microelectronics packaging experts-authors, co-authors, and reviewers-representing 192 companies, universities, laboratories, and other organizations. This is the inaugural volume of ASMAs all-new ElectronicMaterials Handbook series, designed to be the Metals Handbook of electronics technology. In over 65 years of publishing the Metals Handbook, ASM has developed a unique editorial method of compiling large technical reference books. ASMAs access to leading materials technology experts enables to organize these books on an industry consensus basis. Behind every article. Is an author who is a top expert in its specific subject area. This multi-author approach ensures the best, most timely information throughout. Individually selected panels of 5 and 6 peers review each article for technical accuracy, generic point of view, and completeness.Volumes in the Electronic Materials Handbook series are multidisciplinary, to reflect industry practice applied in integrating multiple technology disciplines necessary to any program in advanced electronics. Volume 1: Packaging focusing on the middle level of the electronics technology size spectrum, offers the greatest practical value to the largest and broadest group of users. Future volumes in the series will address topics on larger (integrated electronic assemblies) and smaller (semiconductor materials and devices) size levels.
Proceedings of the ... International Microelectronics Symposium
Microelectronics Technology and Devices, SBMICRO 2002
Proceedings of the Symposium on Low Temperature Electronic Device Operation
Desk Reference
Space Microelectronics Volume 2: Integrated Circuit Design for Space Applications
Advanced Thermal Analysis of Microelectronics Using Spreading Resistance Models

This invaluable second volume of a two-volume set is filled with details about the integrated circuit design for space applications. Various considerations for the selection and application of electronic components for designing spacecraft are discussed. The basic constructions of submicron transistors and schottky diodes during the technological process of production are explored. This book provides details on the energy consumption minimization methods for microelectronic devices. Specific topics include: Features and physical mechanisms of the effect of space radiation on all the

main classes of microcircuits, including peculiarities of radiation impact on submicron integrated circuits;Special design, technology, and schematic methods of increasing the resistance to various types of space radiation;Recommendations for choosing research equipment and methods for irradiating various samples;Microcircuit designers on the composition of test elements for the study of the effect of radiation;Microprocessors, circuit boards, logic microcircuits, digital, analog, digital-analog microcircuits manufactured in various technologies (bipolar, CMOS, BiCMOS, SOI);Problems involved with designing high speed microelectronic devices and systems based on SOS-and SOI-structures;System-on-chip and system-in-package and methods for rejection of silicon microcircuits with hidden defects during mass production.

Thermal analysis of electronic devices is one of the most important steps for designing of modern devices. Precise thermal analysis is essential for designing an effective thermal management system of modern electronic devices such as batteries, LEDs, microelectronics, ICs, circuit boards, semiconductors and heat spreaders. For having a precise thermal analysis, the temperature profile and thermal spreading resistance of the device should be calculated by considering the geometry, property and boundary conditions. Thermal spreading resistance occurs when heat enters through a portion of a surface and flows by conduction. It is the primary source of thermal resistance when heat flows from a tiny heat source to a thin and wide heat spreader. In this thesis, analytical models for modeling the temperature behavior and thermal resistance in some common geometries of microelectronic devices such as heat channels and heat tubes are investigated. Different boundary conditions for the system are considered. Along the source plane, a combination of discretely specified heat flux, specified temperatures and adiabatic condition are studied. Along the walls of the system, adiabatic or convective cooling boundary conditions are assumed. Along the sink plane, convective cooling with constant or variable heat transfer coefficient are considered. Also, the effect of orthotropic properties is discussed. This thesis contains nine chapters. Chapter one is the introduction and shows the concepts of thermal spreading resistance besides the originality and importance of the work. Chapter two reviews the literatures on the thermal spreading resistance in the past fifty years with a focus on the recent advances. In chapters three and four, thermal resistance of a twodimensional flux channel with non-uniform convection coefficient in the heat sink plane is studied. The non-uniform convection is modeled by using two functions than can simulate a wide variety of different heat sink configurations. In chapter five, a non-symmetrical flux channel with different heat transfer coefficient along the right and left edges and sink plane is analytically modeled. Due to the edge cooling and non-symmetry, the eigenvalues of the system are defined using the heat transfer coefficient on both edges and for satisfying the orthogonality condition, a normalized function is calculated. In chapter six, thermal behavior of two-dimensional rectangular flux channel with arbitrary boundary conditions on the source plane is presented. The boundary condition along the source plane can be a combination of the first kind boundary condition (Dirichlet or prescribed temperature) and the second kind boundary condition (Neumann or prescribed heat flux). The proposed solution can be used for modeling the flux channels with numerous different source plane boundary conditions without any limitations in the number and position of heat sources. In chapter seven, temperature profile of a circular flux tube with discretely specified boundary conditions along the source plane is presented. Also, the effect of orthotropic properties are discussed. In chapter 8, a three-dimensional rectangular flux channel with a non-uniform heat convection along the heat sink plane is analytically modeled. In chapter nine, a summary of the achievements is presented and some systems are proposed for the future studies. It is worth mentioning that all the models and case studies in the thesis are compared with the Finite Element Method (FEM).

Computer simulation of semiconductor processing equipment and devices requires the use of a wide variety of numerical methods. Of these methods, the Monte Carlo approach is perhaps most fundamentally suited to mod eling physical events occurring on microscopic scales which are intricately connected to the particle structure of nature. Here physical phenomena can be simulated by following simulation particles (such as electrons, molecules, photons, etc.) through a statistical sampling of scattering events. Monte Carlo is, however, generally looked on as a last resort due to the extremely slow convergence of these methods. It is of interest, then, to examine when in microelectronics it is necessary to use Monte Carlo methods, how such methods may be improved, and what are the alternatives. This book ad dresses three general areas of simulation which frequently arise in semicon ductor modeling where Monte Carlo methods playa significant role. In the first chapter the basic mathematical theory of the Boltzmann equation for particle transport is presented. The following chapters are devoted to the modeling of the transport processes and the associated Monte Carlo meth ods. Specific examples of industrial applications illustrate the effectiveness and importance of these methods. Two of these areas concern simulation of physical particles which may be assigned a time dependent position and velocity. This includes the molecules of a dilute gas used in such processing equipment as chemi cal vapor decomposition reactors and sputtering reactors. We also consider charged particles moving within a semiconductor lattice.

1972 International Microelectronic Symposium

CRC Handbook of Thermal Engineering

From Physics-of-Failure to Physics-of-Degradation

Proceedings European Hybrid Microelectronics Conference 1979, Ghent, Belgium, May 21, 22 & 23, 1979

Physics Briefs

Microelectronics Packaging Handbook

For newcomers cast into the waters to sink or swim as well as seasoned professionals who want authoritative guidance desk-side, this hefty volume updates the previous (1999) edition. It contains the work of expert contributors who rallied to the job in response to a committee's call for help (the committee was assigned to the update by the Electron

Experience of Designing and Application of CAD Systems in Microelectronics

Microelectronics Technology and Devices, SBMICRO 2004
Influence of Temperature on Microelectronics and System Reliability