Device Degradation Reliability Analyzer

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Applied Reliability Engineering and Risk Analysis Springer
This book addresses the needs of electronic design engineers, reliability engineers, and their respective managers, stressing a pragmatic viewpoint rather than a vigorous mathematical presentation.
Hot-Carrier Reliability of MOS VLSI Circuits Springer Science & Business Media
Thermodynamic degradation science is a new and exciting discipline. This book merges the science of physics of failure with thermodynamics and shows how degradation modeling is improved and enhanced when using thermodynamic principles. The author also goes beyond the traditional physics of failure methods and highlights the importance of having new tools such as “Mesoscopic” noise degradation measurements for prognostics of complex systems, and a conjugate work approach to solving physics of failure problems with accelerated testing applications. Key features: • Demonstrates how the thermodynamics energy approach uncovers key degradation models and their application to accelerated testing. • Demonstrates how thermodynamic degradation models accounts for cumulative stress environments, effect statistical reliability distributions, and are key for reliability test planning. • Provides coverage of the four types of Physics of Failure processes describing aging: Thermal Activation Processes, Forced Aging, Diffusion, and complex combinations of these. • Coverage of numerous key topics including: aging laws; Cumulative Accelerated Stress Test (CAST) Plans; cumulative entropy fatigue damage; reliability statistics and environmental degradation and pollution. Thermodynamic Degradation Science: Physics of Failure, Accelerated Testing, Fatigue and Reliability Applications is essential reading for reliability, cumulative fatigue, and physics of failure engineers as well as students on courses which include thermodynamic engineering and/or physics of failure coverage.
Reliability and Degradation Analysis of Integrated Circuits CRC Press
AlGaN/GaN HEMTs reliability and stability issues were investigated in dependence on epitaxial design and process modification. DC-Step-Stress-Tests have been performed on wafers as a fast device robustness screening method. As a criterion of robustness they deliver a critical source-drain voltage for the onset of degradation. Several degradation modes were observed which depend on epi design, epi quality and process technology. Electrical and optical

characterizations together with electric field simulations were performed to get insight into respective degradation modes. It has been found that AlGaN/GaN HEMT devices with GaN cap show higher critical source-drain voltages as compared to non-capped devices. Devices with low Al concentration in the AlGaN barrier layer also show higher critical source-drain voltages. Superior stability and robustness performance have been achieved from devices with AlGaN backbarrier epi design grown on n-type SiC substrate. For the onset on any degradation modes the presence of high electrical fields is most decisive for ON- and OFF-state operation conditions. Therefore careful epi design to reduce high electric field is mandatory. It is also shown that epi buffer quality and growth process have a great impact on device robustness. Defects such as point defects and dislocations are assumed to be created initially during stressing and accumulated to larger defect clusters during device stressing. Electroluminescence (EL) measurements were performed to detect early degradation. Extended localized defects are resulting as bright spots at OFF-state conditions in conjunction with a gate leakage increase. AlGaN/GaN HEMTs mit unterschiedlichen epitaktischen Designs und Prozessmodifikationen wurden auf ihre Zuverlässigkeit und Stabilität untersucht. DC-Stufenstresstests wurden als Screeningmethode für die Bauelementrobustheit durchgeführt. Mit dieser Methode erhält man eine kritische Source-Drain-Spannung, die den Beginn der Degradation kennzeichnet. Verschiedene Degradationsmodi wurden beobachtet, die vom epitaxialem Design, der epitaxialen Qualität und der Prozesstechnologie abhängen. Elektrische und optische Messungen zusammen mit elektrischen Feldsimulationen wurden durchgeführt, um Einblick in das Degradationsverhalten zu bekommen. Es hat sich gezeigt, dass AlGaN/GaN HEMTs mit einer GaN Cap-Schicht eine höhere kritische Drain-Source-Spannung zeigen als Transistoren ohne diese Schicht. HEMTs mit niedriger Aluminiumkonzentration in der AlGaN-Barriere zeigen ebenfalls eine höhere kritische Drain-Source-Spannung. Transistoren mit AlGaNBackbarrier, die auf n-Typ SiC-Substraten gewachsen wurden, zeigen eine besonders hohe Stabilität und Robustheit. Für den Betrieb im ON-State als auch im OFF-State ist ein hohes elektrisches Feld entscheidend für den Beginn der Degradation. Daher sind epitaxiale Designs, die das elektrische Feld so weit wie möglich reduzieren, von großer Wichtigkeit. Es wird gezeigt, dass die Qualität der Bufferschicht und der Wachstumsprozess der epitaxierten Schichten großen Einfluß auf die Robustheit der Bauelemente haben. Zu Beginn des Stressprozesses werden Punktdefekte und Versetzungen erzeugt, die im weiteren Verlauf des Stresstests zu Agglomeration von Defektclustern führen. Der Beginn der Degradation wurde mit Hilfe der Elektrolumineszenz untersucht. Im OFF-State werden ausgedehnte lokalisierte Defekte als stark leuchtende Flecken detektiert, wobei gleichzeitig ein Anstieg der Leckströme zu beobachten ist.

Reliability Analysis Considering Product Performance Degradation (PHD). Woodhead Publishing

I C RELIABILITY, ACCELERATED LIFE TESTS, ELECTROMAGNETIC PULSE (EMP), ELECTROSTATIC DISCHARGE (ESD), RADIATION.

Modeling for Reliability Analysis CRC Press

This book takes a holistic approach to reliability engineering for electrical and electronic systems by looking at the failure mechanisms, testing methods, failure analysis, characterisation techniques and prediction models that can be used to increase reliability for a range of devices. The text describes the reliability behavior of electrical and electronic systems. It takes an empirical scientific approach to reliability engineering to facilitate a greater understanding of operating conditions, failure mechanisms and the need for testing for a more realistic characterisation. After introducing the fundamentals and background to reliability theory, the text moves on to

describe the methods of reliability analysis and characterisation across a wide range of applications. Takes a holistic approach to reliability engineering Looks at the failure mechanisms, testing methods, failure analysis, characterisation techniques and prediction models that can be used to increase reliability Facilitates a greater understanding of operating conditions, failure mechanisms and the need for testing for a more realistic characterisation

Microcircuit Device Reliability CRC Press

At an early stage of the development, the design teams should ask questions such as, "How reliable will my product be?" "How reliable should my product be?" And, "How frequently does the product need to be repaired / maintained?" To answer these questions, the design team needs to develop an understanding of how and why their products fails; then, make only those changes to improve reliability while remaining within cost budget. The body of available literature may be separated into three distinct categories: "theory" of reliability and its associated calculations; reliability analysis of test or field data – provided the data is well behaved; and, finally, establishing and managing organizational reliability activities. The problem remains that when design engineers face the question of design for reliability, they are often at a loss. What is missing in the reliability literature is a set of practical steps without the need to turn to heavy statistics. Executing Design for Reliability Within the Product Life Cycle provides a basic approach to conducting reliability-related streamlined engineering activities, balancing analysis with a high-level view of reliability within product design and development. This approach empowers design engineers with a practical understanding of reliability and its role in the design process, and helps design team members assigned to reliability roles and responsibilities to understand how to deploy and utilize reliability tools. The authors draw on their experience to show how these tools and processes are integrated within the design and development cycle to assure reliability, and also to verify and demonstrate this reliability to colleagues and customers.

Safety, Reliability and Risk Analysis Springer Science & Business Media

Are you buying a car or smartphone or dishwasher? We bet long-term, trouble-free operation (i.e., high reliability) is among the top three things you look for. Reliability problems can lead to everything from minor inconveniences to human disasters. Ensuring high reliability in designing and building manufactured products is principally an engineering challenge – but statistics plays a key role. Achieving Product Reliability explains in a non-technical manner how statistics is used in modern product reliability assurance. Features: Describes applications of statistics in reliability assurance in design, development, validation, manufacturing, and field tracking. Uses real-life examples to illustrate key statistical concepts such as the Weibull and lognormal distributions, hazard rate, and censored data. Demonstrates the use of graphical tools in such areas as accelerated testing, degradation data modeling, and repairable systems data analysis. Presents opportunities for profitably applying statistics in the era of Big Data and Industrial Internet of Things (IIoT) utilizing, for example, the instantaneous transmission of large quantities of field data. Whether you are an intellectually curious citizen, student, manager, budding reliability professional, or academician seeking practical applications, Achieving Product Reliability is a great

starting point for a big-picture view of statistics in reliability assurance. The authors are world-renowned experts on this topic with extensive experience as company-wide statistical resources for a global conglomerate, consultants to business and government, and researchers of statistical methods for reliability applications.

Reliability Analysis Using Destructive Degradation Data Cuvillier Verlag

This textbook reviews the methodologies of reliability prediction as currently used in industries such as electronics, automotive, aircraft, aerospace, off-highway, farm machinery, and others. It then discusses why these are not successful; and, presents methods developed by the authors for obtaining accurate information for successful prediction. The approach is founded on approaches that accurately duplicate the real world use of the product. Their approach is based on two fundamental components needed for successful reliability prediction; first, the methodology necessary; and, second, use of accelerated reliability and durability testing as a source of the necessary data. Applicable to all areas of engineering, this textbook details the newest techniques and tools to achieve successful reliabilityprediction and testing. It demonstrates practical examples of the implementation of the approaches described. This book is a tool for engineers, managers, researchers, in industry, teachers, and students. The reader will learn the importance of the interactions of the influencing factors and the interconnections of safety and human factors in product prediction and testing.

Degradation Failure Mode of Transistors Mdpi AG

This complete resource on the theory and applications of reliability engineering, probabilistic models and risk analysis consolidates all the latest research, presenting the most up-to-date developments in this field. With comprehensive coverage of the theoretical and practical issues of both classic and modern topics, it also provides a unique commemoration to the centennial of the birth of Boris Gnedenko, one of the most prominent reliability scientists of the twentieth century. Key features include: expert treatment of probabilistic models and statistical inference from leading scientists, researchers and practitioners in their respective reliability fields detailed coverage of multi-state system reliability, maintenance models, statistical inference in reliability, systemability, physics of failures and reliability demonstration many examples and engineering case studies to illustrate the theoretical results and their practical applications in industry Applied Reliability Engineering and Risk Analysis is one of the first works to treat the important areas of degradation analysis, multi-state system reliability, networks and large-scale systems in one comprehensive volume. It is an essential reference for engineers and scientists involved in reliability analysis, applied probability and statistics, reliability engineering and maintenance, logistics, and quality control. It is also a useful resource for graduate students specialising in reliability analysis and applied probability and statistics. Dedicated to the Centennial of the birth of Boris Gnedenko, renowned Russian mathematician and reliability theorist

Reliability Characterisation of Electrical and Electronic Systems McGraw Hill Professional

This book is a collective work by many leading

scientists, analysts, mathematicians, and engineers who have been working at the front end of reliability science and engineering. The book covers conventional and contemporary topics in reliability science, all of which have seen extended research activities in recent years. The methods presented in this book are real-world examples that demonstrate improvements in essential reliability and availability for industrial equipment such as medical magnetic resonance imaging, power systems, traction drives for a search and rescue helicopter, and air conditioning systems. The book presents real case studies of redundant multi-state air conditioning systems for chemical laboratories and covers assessments of reliability and fault tolerance and availability calculations. Conventional and contemporary topics in reliability engineering are discussed, including degradation, networks, and dynamic reliability, resilience, and multi-state systems, all of which are relatively new topics to the field. The book is aimed at engineers and scientists, as well as postgraduate students involved in reliability design, analysis, and experiments and applied probability and statistics.

Reliability Engineering for Electronic Design Academic Press

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.

AlGaN/GaN HEMTs Reliability John Wiley & Sons

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

Reliability Engineering for Electronic Design John Wiley & Sons

Since their conception, solid-state semuconductor devices have alwayS been regarded as having the potential of high reliability. This expectation was not diminished by the fact that early devices were characterlsed by lower lifetimes since it was quickly recognised that the sources of the device failure were the result of the relatively primitive technology. Research and development in the field of solid-state devices has concerned itself with two important problems. On one hand we have device physics, whose aim is to understaSd in terms of basic physical concepts the mode of failure of the various devices. In this way, one seeks to optimise the high reliability technology in order to achieve the best performance from each device. E e second aspect of this work is to establish a distribution which fits the data and gives a very good result. The objective of this thesis is to identify and investigate various modes of degradation which impair the reliability of the semiconductor devices and fit the log-normal and exponential distributionS to the available data, using the least square and maximum likelihood methods for the estimation of the parameters.

Reliability of Semiconductor Lasers and Optoelectronic Devices CRC Press

MDR-21 is a study of microcircuit field failure data based on various microcircuit types (digital SSI, MSI, LSI, linear, interface, memory and VLSI). The report includes failure rate data based on actual field failure records (data acquired from MDR-21A) calculated with Bayesian statistics. Failure distribution information is also presented in a quantifiable assembly of descriptive failure-related terms. Equipment-level comparisons were made to determine the impact on reliability relative to variations in manufacturers requirements. The text is complete with graphical representations and narratives in support of the study findings. Keywords include: Reliability trends; Bayesian statistics; Failure indicator/Mode distributions; Chi-square; Equipment manufacturer; and Influences.

Scalable Methods for Reliability Analysis in Digital Circuits Using Physics-based Device-level Models Springer Science & Business Media

Reliability of Microtechnology discusses the reliability of microtechnology products from the bottom up, beginning with devices and extending to systems. The book's focus includes but is not limited to reliability issues of interconnects, the methodology of reliability concepts and general failure mechanisms. Specific failure modes in solder and conductive adhesives are discussed at great length. Coverage of accelerated testing, component and system level reliability, and reliability design for manufacturability are also described in detail. The book also includes exercises

and detailed solutions at the end of each chapter.

Thermodynamic Degradation Science CRC Press

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.

Stochastic Models in Reliability Engineering Springer Science & Business Media

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.

Achieving Product Reliability John Wiley & Sons

ISO (the International Organization for Standardization) 10995:2011 is the inter-national standard providing guidelines for assessing the reliability and service life of optical media, which is designed to be highly reliable and possesses a long lifetime. A well-known challenge of reliability analysis for highly reliable devices is that it is hard to obtain sufficient failure data under their normal use conditions. Accelerated degradation tests (ADTs) are commonly used to quickly obtain physical degradation data under elevated stress conditions, which are then extrapolated to predict reliability under the normal use condition. This standard achieves the estimation of the lifetime of recordable media, such as Magneto-Optical media, via an accelerated degradation test for measuring the error rate of these hard devices under elevated temperature and relative humidity levels. The observed degradation measures are modeled with regression analysis to predict the unobserved failure time, which is then used as ob-served failure time for estimating the lifetime distribution and predict the device quantile/median lifetime. However, the ISO 10995:2011 analysis fails to consider the uncertainty of the predicted failure times, as well as the heterogeneity of the test units, and hence could lead to imprecise and overconfident estimation. This thesis presents a Bayesian method to analyze the ISO degradation data, which (1) provides more accurate quantification of uncertainty through the use of a hierarchical degradation path model, (2) includes random effects to capture the unit-to-unit variation for improving analysis of heterogeneity, and (3) offers more straightforward implementation for estimating reliability and its associated uncertainty based on generalADT data.

Reliability Analysis of the Gradual Degradation of Semiconductor Devices John Wiley & Sons

This is a book on the practical approaches of reliability to electrotechnical devices and systems. It includes the electromagnetic effect, radiation effect, environmental effect, and the impact of the manufacturing process on electronic materials, devices, and boards.

Semiconductor Device Reliability Springer Nature

As the complexity and the density of VLSI chips increase with shrinking design rules, the evaluation of long-term reliability of MOS VLSI circuits is becoming an important problem. The assessment and improvement of reliability on the circuit level should be based on both the failure mode analysis and the basic understanding of the physical failure mechanisms observed in integrated circuits. Hot-carrier induced degrada tion of MOS transistor characteristics is one of the primary mechanisms affecting the long-term reliability of MOS VLSI circuits. It is likely to become even more important in future generation chips, since the down ward scaling of transistor dimensions without proportional scaling of the operating voltage aggravates this problem. A thorough understanding of the physical mechanisms leading to hot-carrier related degradation of MOS transistors is a prerequisite for accurate circuit reliability evaluation. It is also being recognized that important reliability concerns other than the post-manufacture reliability qualification need to be addressed rigorously early in

the design phase. The development and use of accurate reliability simulation tools are therefore crucial for early assessment and improvement of circuit reliability : Once the long-term reliability of the circuit is estimated through simulation, the results can be compared with predetermined reliability specifications or limits. If the predicted reliability does not satisfy the requirements, appropriate design modifications may be carried out to improve the resistance of the devices to degradation.