

## Electronic Thin Film Reliability

Electronic Thin-Film Reliability Thin Film Materials, Processes, and Reliability Thin-film Reliability Trends Toward Improved Stability Materials Science of Thin Films The Mechanics and Reliability of Films, Multilayers and Coatings Descendencia de la casa y mayorazgo de los Céspedes, de Ciudad Real Thin-Film Reliability Trends Toward Improved Stability: Preprint Thin Film Materials, Processes, and Reliability Thin-Film Transistor Reliability Environmental Reliability of Thin Film Sealing on Thick Film LTCC Adhesion and Thin-film Module Reliability Adhesion and Thin-film Module Reliability Scientific and Technical Aerospace Reports Packaging, Reliability and Manufacturing Issues Associated with Electronic and Photonic Products Investigation of the Reliability Implications of Mechanical Interactions Between Thin Films Electromigration in Thin Films and Electronic Devices Reliability Characterization and Prediction of High K Dielectric Thin Film Ultra-Thin Film Dielectric Reliability Characterization Reliability Study of Poly-Si Thin-film Transistors Proceedings of the International Symposium on Thin Film Materials, Processes, Reliability, and Applications, Thin Film Processes King-Ning Tu G. S. Mathad Dirk C. Jordan Milton Obring Matthew R. Begley Electrochemical Society. Meeting Meng Zhang, Mingxiang Wang Charles Robert Bourland T. J. McMahon T. J. McMahon Charles Ume Jason Coughlan Choong-Un Kim Wen Luo JS. Suehle ( ) ( ) ( ) ( ) ( ) G. S. Mathad

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thin films are widely used in the electronic device industry as the trend for miniaturization of electronic devices moves into the nanoscale domain the reliability of thin films becomes an increasing concern building on the author's previous book electronic thin film science by tu mayer and feldman and based on a graduate course at ucla given by the author this new book focuses on reliability science and the processing of thin films early chapters address fundamental topics in thin film processes and reliability including deposition surface energy and atomic diffusion before moving onto systematically explain irreversible processes in interconnect and packaging technologies describing electromigration thermomigration and stress migration with a closing chapter dedicated to failure analysis the reader will come away with a complete theoretical and practical understanding of electronic thin film reliability kept mathematically simple with real world examples this book is ideal for graduate students researchers and practitioners

the symposium covered three topics i plasma processing for

long term stable performance of photovoltaic pv modules will be increasingly important to their successful penetration of the power grid this paper summarizes more than 150 thin film and more than 1700 silicon pv degradation rates rd quoted in publications for locations worldwide partitioning the literature results by technology and date of installation statistical analysis shows an improvement in degradation rate especially for thin film technologies in the last decade a cigs array deployed at nrel for more than 5 years that appears to be stable supports the literature trends indoor and outdoor data indicate undetectable change in performance 0.2 ± 0.2 yr one module shows signs of slight degradation from what appears to be an initial manufacturing defect however it has not affected the overall system performance

this is the first book that can be considered a textbook on thin film science complete with exercises at the end of each chapter obring has contributed many highly regarded reference books to the ap list including reliability and failure of electronic materials and the engineering

science of thin films the knowledge base is intended for science and engineering students in advanced undergraduate or first year graduate level courses on thin films and scientists and engineers who are entering or require an overview of the field since 1992 when the book was first published the field of thin films has expanded tremendously especially with regard to technological applications the second edition will bring the book up to date with regard to these advances most chapters have been greatly updated and several new chapters have been added

a comprehensive treatment of the mechanics of multilayers and its implications for reliability with easy to use software to compute key results

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thin film transistor reliability provides a comprehensive analysis of the reliability challenges in thin film transistors tfts essential components in modern electronics covering topics from fundamental structures to degradation mechanisms this book equips researchers and engineers with the tools to assess analyze and improve tft reliability the book systematically explores key reliability concerns including performance characterization defect states voltage stress effects circuit level degradation and environmental influences advanced reliability analysis methods and practical improvement strategies are also discussed offering insights into future developments key features in depth discussion of tft degradation mechanisms and reliability concerns comprehensive analysis techniques including transfer curve and noise analysis effects of dc ac voltage stress self heating and environmental factors strategies for enhancing tft reliability through structural modifications

as electronic components and systems become more intricate and expand into new realms of use case scenarios new materials systems must be explored with new systems comes the balancing acts of cost and reliability presented here is a thesis that explores a new hybrid electronics packaging system using low temperature co fired ceramics referred to as ltcc an ltcc system was designed to explore the environmental reliability of numerous thick film ltcc features and parameters a key element was to explore how a thin film metallization stack up used to cap or seal underlying thick film structures would decrease environmental susceptibility while at the same time optimizing costs a material matrix of 16 recipes was developed with 14 primary feature types to be evaluated it was decided that the ltcc systems undergo five environmental reliability tests which were as follows lifetime at elevated temperature thermal cycling humidity thermal shock and corrosion via salt fog spray all environmental reliability tests were performed in accordance to either mil or jedec standards or specifications an investigation of occurring phenomena through each environmental test is presented

as technologies continue advancing semiconductor devices with dimensions in nanometers have entered all spheres of human life this research deals with both the statistical aspect of reliability and some electrical aspect of reliability characterization as an example of nano devices tao subscript x based high k dielectric thin films are studied on the failure mode identification accelerated life testing lifetime projection and failure rate estimation experiment and analysis on dielectric relaxation and transient current show that the relaxation current of high k dielectrics is distinctive to the trapping detrapping current of sio subscript 2 high k films have a lower leakage current but a higher relaxation current than sio subscript 2 based on the connection between polarization relaxation and film integrity demonstrated in ramped voltage stress tests a new method of breakdown detection is proposed it monitors relaxation during the test and uses the disappearing of relaxation current as the signal of a breakdown event this research develops a bayesian approach which is suitable to reliability estimation and prediction of current and future generations of nano devices it combines the weibull lifetime distribution with the empirical acceleration relationship and put the model parameters into a hierarchical bayesian structure the value of the bayesian approach lies in that it can fully utilize available information in modeling uncertainty and provide cogent prediction with limited resources in a reasonable period of time markov chain monte carlo simulation is used for posterior inference of the reliability projection and for sensitivity analysis over a variety of vague priors time to breakdown data collected in the accelerated life tests also are modeled with a bathtub failure rate curve the decreasing failure rate is estimated with a non parametric bayesian approach and the constant failure rate is estimated with a regular parametric bayesian approach this method can provide a fast and reliable estimation of failure rate for burn in optimization when only a small sample of data is available

the reliability of gate oxides is becoming a critical concern as oxide thickness is scaled below 4 nm in future technology the breakdown detection algorithms in traditional reliability characterization techniques must be modified for sub 4 nm thick sio2 films that exhibit

excessive tunneling currents and soft breakdown it becomes essential to fully understand the physical mechanisms responsible for gate oxide wear out and breakdown if reliability projections are based on the results of highly accelerated wafer level goi tests issues relating to the reliability testing of ultra thin oxides are discussed with examples

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