

6. Reliability Physics and Failure Mechanisms in Electronics Packaging

Course Leader: Xuejun Fan – Lamar University

Course Description:

This course presents an overview of the physics of failures in electronics packaging. The course discusses key fundamental concepts of reliability physics associated with various stress conditions, including thermal degradation, thermo-mechanical stress, dynamic and vibrational loading, moisture, and humidity, as well as electrical current stress. Failure mechanisms studied include chip-package interactions, micro bump reliability, electromigration performance, inter-layer dielectric (ILD) damage under bumps and Cu pillars, solder joint reliability, drop and vibrational damage, interfacial delamination, and the impact of moisture and environmental humidity. Acceleration factor models for different failure mechanisms are introduced. Stress analysis methods using finite element analysis (FEA) with specific applications to packaging are described.

Course Outline:

1. Introduction to advanced package reliability physics
2. Thermal and thermo-mechanical driven failure mechanisms
3. Dynamic and vibrational-driven damages
4. Moisture and humidity-induced failures
5. Electromigration

Who Should Attend:

This course is for all who work with IC packaging, package reliability, package development, package design, and package processing where a working knowledge of package failure mechanisms is beneficial. Beginning

Xuejun Fan is a Regents' Professor of Texas State University System, a Mary Ann and Lawrence E. Faust endowed chair professor in the Department of Mechanical Engineering at Lamar University, Beaumont, Texas. He received his Ph.D. degree in solid mechanics from Tsinghua University, Beijing, China in 1989. His interests and research lie in modeling, characterization, and reliability in heterogeneous integration in microelectronics. Dr. Fan has extensive experience in the semiconductor packaging industry, such as with Intel Cooperation, Philips Research, and the Institute of Microelectronics (IME), Singapore. Dr. Fan received the Outstanding Sustained Technical Contribution Award in 2017, and the Exceptional Technical Achievement Award in 2011 from IEEE Electronic Packaging Society (EPS). He is an Associate Editor of IEEE Transactions on Components, Packaging and Manufacturing Technology and Microelectronics Reliability. Dr. Fan is an IEEE Fellow and a Distinguished Lecturer. He serves as chair, co-chairs, and committee members of various conferences such as ECTC, EPTC, ESTC, EuroSimE, ICEPT, ESREF, and EMPT. He has published more than 300 papers, including four books, over 100 journal papers, many book chapters, and numerous conference papers. Dr. Fan currently serves as a co-chair of Modeling and Simulation in Heterogeneous Integration Roadmap (HIR).