

## 15. Reliability Mechanics and Modeling for IC Packaging -- Theory, Implementation and Practice

**Course Leaders: Ricky Lee - HKUST and Xuejun Fan – Lamar University**

### Course Objective:

This course aims to present a comprehensive coverage of reliability mechanics and modeling under various loading conditions. In addition to the introduction of fundamentals, the course contents are arranged in four modules. Module 1 covers modeling under thermal loading, such as problems related to mismatch of thermal expansion or non-uniform temperature distribution. Module 2 deals with the modeling under mechanical loading, such as mechanical bending and/or drop impact. Module 3 will cover modeling under humidity/moisture loading for moisture related problems, such as failures in soldering reflow as well as under HAST and biHAST. Module 4 will introduce multi-physics modeling that involves the combined thermal, moisture, electrical, and mechanical loading. Theoretical foundation, modeling implementation, and the best practices for numerical simulations will be covered. Emerging trend and future perspective in reliability mechanics and modeling will be discussed.

### Course Outline:

1. Fundamentals of Stress Analysis and Computational Modeling for IC Packaging
2. Reliability Issues and Modeling under Thermal Loading
3. Reliability Issues and Modeling under Mechanical Loading
4. Reliability Issues and Modeling under Moisture/Humidity Loading
5. Reliability Issues and Modeling under Combined Loading – Multi-physics Modeling

### Who Should Attend?

This course is intended for technical managers and staff members, reliability engineers, scientific researchers, and graduate students who are involved in thermal/mechanical modeling, package design, material selection, qualification and reliability assessment of chip-package interaction, package, and package/board interaction.

### Bio:

**Xuejun Fan** is 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 the areas of modeling and reliability in microelectronics packaging. Dr. Fan had extensive experience in 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 CMPT. He is an Associate Editor of IEEE Transactions on Components, Packaging and Manufacturing Technology, and an IEEE Fellow and 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 250 papers, including 4 books, over 100 journal papers, many book chapters, and numerous conference papers.

**Ricky Lee** received his PhD degree in Aeronautical & Astronautical Engineering from Purdue University in 1992. Currently he is Chair Professor of Mechanical and Aerospace Engineering and Director of Center for Advanced Microsystems Packaging at the Hong Kong University of Science & Technology (HKUST). Dr Lee has been focusing his research on the development of

packaging and assembly technologies for electronics and optoelectronics. The topics of his R&D interests include wafer level packaging and 3D IC integration, through silicon vias and high-density interconnects, LED packaging for solid-state lighting, lead-free soldering and reliability analysis. The research outcomes of Dr Lee's group have been documented in numerous technical papers in international journals and conference proceedings. He also co-authored three books and nine book chapters. Due to his technical contributions, Dr Lee received many honors and awards over the years. In addition to being the recipient of 12 best/outstanding paper awards and 5 major professional society awards, Dr Lee is Fellow of IEEE, ASME, IMAPS, and Institute of Physics (UK).