14. Analysis of Fracture and Delamination in Microelectronic Packages

Course Leader: Andrew Tay - National University of Singapore

Course Description:
The main objective of this course is to provide a fundamental understanding as well as techniques of applying the fracture mechanics methodology to predicting fracture and delamination in microelectronic packages. The mechanism of delamination failure due to thermal stress and moisture will be described and analyzed. Simulation of transient heat transfer and moisture diffusion processes occurring during package qualification will be described. An introduction to the fundamentals of interfacial fracture mechanics will be given together with descriptions of some numerical methods of calculating fracture mechanics parameters. Experiments which verify the methodology for predicting delamination in packages will then be described followed by some interesting case studies.

Course Outline:

1. Development of Hygrothermal Stresses in Microelectronics Packages.
2. Finite Element Analysis and Stress Singularities in Microelectronic Packages.
    - Inadequacy of Maximum Stress Failure Criterion.
3. Fundamentals of Fracture Mechanics Methodology.
4. Computation of Fracture Mechanics Parameters.
5. Measurement of Fracture Toughness.
6. Experimental Verification of the Methodology.
7. Case Studies on delamination of pad-encapsulant interfaces, die-attach layers, and on-chip interconnect structures (BEOL).
8. Cohesive Zone Modeling of Delamination and Case Study.

Who Should Attend: This course is designed for packaging design engineers who perform reliability analysis of microelectronics and photonics packages.

Dr. Andrew Tay is currently a Visiting Scientist at the Singapore Hybrid-Integrated Next-Generation μ-Electronics Centre (SHINE), National University of Singapore. He was a Professor of Mechanical Engineering at the National University of Singapore. He obtained his B.E. (Hons I and University Medal) and PhD in Mechanical Engineering from the University of New South Wales, Australia. His research interests include electronics packaging (thermo-mechanical failures, delamination, effects of moisture, solder joint reliability), thermal management of electronic systems and EV batteries, infrared and thermo-reflectance thermography, solar photovoltaics reliability and fracture mechanics. He is currently a member of the Board of Governors of the IEEE Electronics Packaging Society (EPS) and the Director of Region 10 Programs. He was awarded the 2019 IEEE EPS David Feldman Outstanding Contribution Award, the 2012 IEEE CPMT Exceptional Technical Achievement Award, and the 2012 IEEE CPMT Regional Contributions Award. For his outstanding contributions in the application of engineering mechanics to electronics and/or photonics packaging, he was awarded the ASME EPPD Engineering Mechanics Award in 2004. He is a Fellow of ASME and IEEE.