

## **Microelectronic Packaging Failure Modes and Analysis (1/2 Day)**

The design and packaging of microelectronic devices such as hybrids, RF microwave modules, Class III medical implants and other types of packaged microcircuits intended for high reliability systems is a critical aspect of reliability engineering. This course is intended to review and highlight the typical kinds of microelectronic packaging related failures that occur during manufacturing, qualification and the unfortunate field failures. In addition a review of FA tools and techniques that are utilized to understand root cause of failure and guide corrective actions.

The instructor shares his years of experience related root cause FA investigations of microcircuit packaging defects and failures. Mismatched CTEs and poorly designed packages geometries often lead to mechanical failure at the die and substrate interface or cracking at the heel of a wire or ribbon bond interconnect. Careful delid, visual inspection followed by SEM and EDAX/Auger are required to identify root cause. Reliability engineers must be cognizant of the full range of FA tools available to diagnose failures and, resist the temptation to rush to judgment, which often happens destroying valuable evidence along the way. The instructor will review real world specific examples of packaging failures and resultant FA analysis and problem resolution.

This course is intended for reliability engineers, design, quality and process engineers involved in microelectronic packaging.

### **Course Outline**

- Introduction to Microelectronic Packaging
- Terminology and Product Definitions
  - Hybrids, Microwave Modules, MEMS, Optoelectronic Devices, Class III implants
- Typical Package Related Defects and Failures
- Failure Analysis (FA) Process Flow
  - Review of common FA equipment and procedures
- Specific Examples of Package Related Failures and FA Investigation
  - Die, substrate and package compatibility issues
    - Coefficient of Thermal Expansion (CTE) problems
    - Voiding under the die
    - Sliver dendrites growing from silver loaded epoxy

- Wire and ribbon bond failures
    - Bond lifts due to contamination
    - Heel cracks
    - Excessive intermetallic formation
  
  - Package plating issues
    - Plating issues that lead to wirebond failures
    - Au embrittlement
  
  - Loose conductive particles and Murphy's law
    - Foreign material identification and control
  
  - Hermetic package seal issues
    - Moisture related failures
    - Outgassing problems
  
  - Using Residual Gas Analysis (RGA) as an FA tool and process indicator
  
  - Non-hermetic molded package defects and failures
- Case studies from the field
- Review plus Q&A

## **Instructor Biography:**

Mr. Thomas Green is the principal at TJ Green Associates, LLC ([www.tjgreenllc.com](http://www.tjgreenllc.com)), a Veteran Owned Small Business focused on training and consulting for military, space and medical microelectronic devices. He has thirty years of experience in the field of microelectronics packaging and has worked at Lockheed Martin Astro Space and USAF Rome Laboratories. At Lockheed he was a staff engineer responsible for the materials and manufacturing processes used in building custom high reliability space qualified hybrid microcircuits for military and commercial applications. Tom has demonstrated expertise in substrate fabrication, die bond, wirebond, seam sealing, leak testing and failure analysis processes.

