



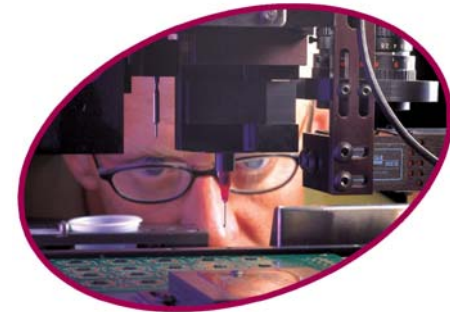
Advanced Process Lab

Failure Analysis

defining the future

Binghamton Advanced Process Laboratory

- **Founded in 1987**
 - First and most complete advanced process laboratory in the equipment industry generally accessible to customers
- **Founded first Consortium 1992**
- **Provides**
 - Research and development
 - Process audits and support
 - Prototyping
 - Root cause failure analysis
 - Knowledge transfer and training
- **Complete analytical laboratory**
- **ITAR-compliant**
- **ISO 9001-certified**



Partnering Throughout The Product Life Cycle



- Process and Material Research and Development

- Product Layout and Design
- Process Design
- Applications Review

- Process Development
- Process Solutions
- Prototyping on Manufacturing Equipment

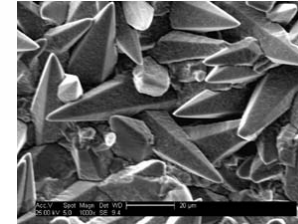
- Process Optimization
- Design for Manufacturability
- Process and Equipment Optimization
- Reliability Testing
- Qualification

- Assembly Equipment Solutions
- Integrated Process Solutions
- Process Scale-up
- Failure Analysis
- Incremental Production
- Capacity Increase
- Worldwide Scalability
- New Products Support



Root Cause Failure Analysis

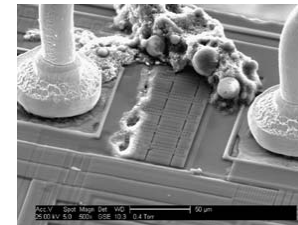
- Enhance performance and profitability
- The APL has developed critical manufacturing processes for all component families
- Specialized, precision analytical tools
- The fastest and most cost-effective route to the failure data you need
- Detailed analysis of sample packages, including characterization of inherent weaknesses and recommendations to enhance product lifetime and yield
 - Identify and rectify the root cause of the defect
 - Provide evidence to support product liability cases or vendor returns
 - Deliver rapid return on investment (ROI)
- **Component-level Interconnect/PCB Failure Analysis:**
 - Microanalysis of failures
 - Dye penetration, cross section, shear test
 - Solder rupture and inter-facial failure modes identified
 - Prediction of "time zero" and long term field failures
 - Contamination studies
 - EOS/ESD die failures
 - PCB fabrication problems



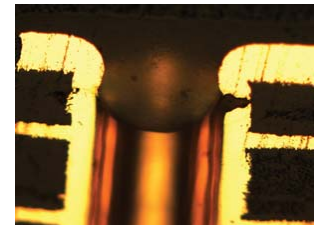
Plated Copper



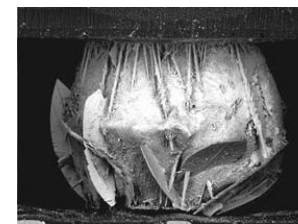
Dendrites



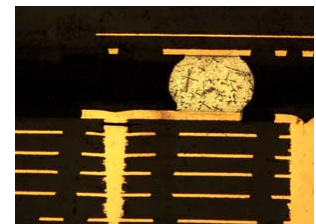
EOS failed die



Dry film lock-in void

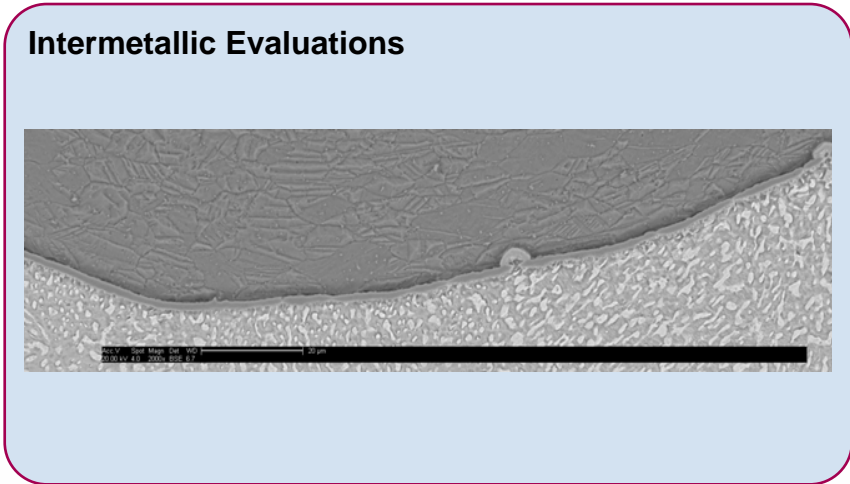
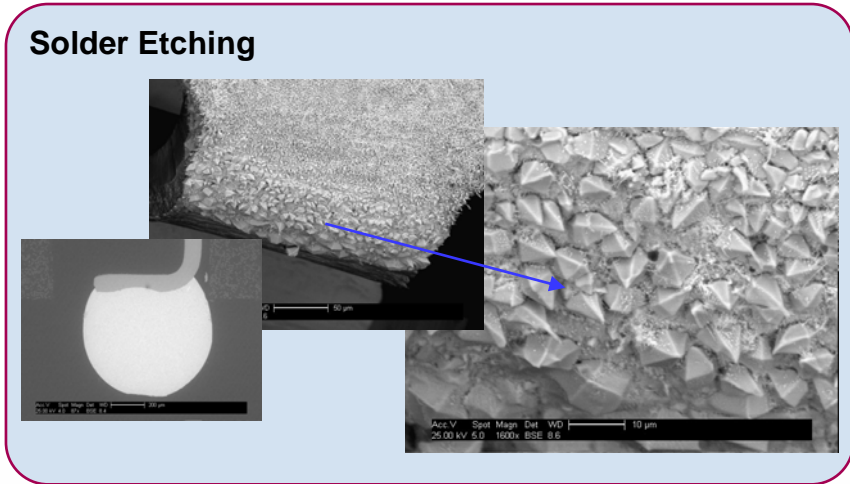
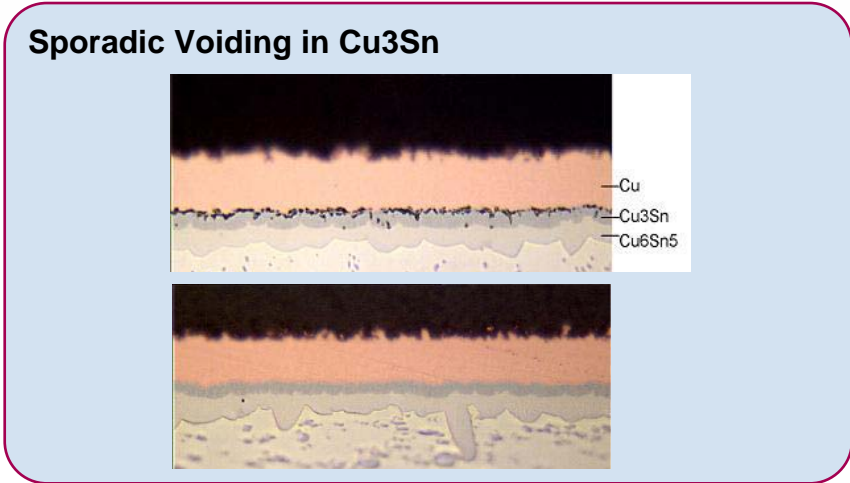
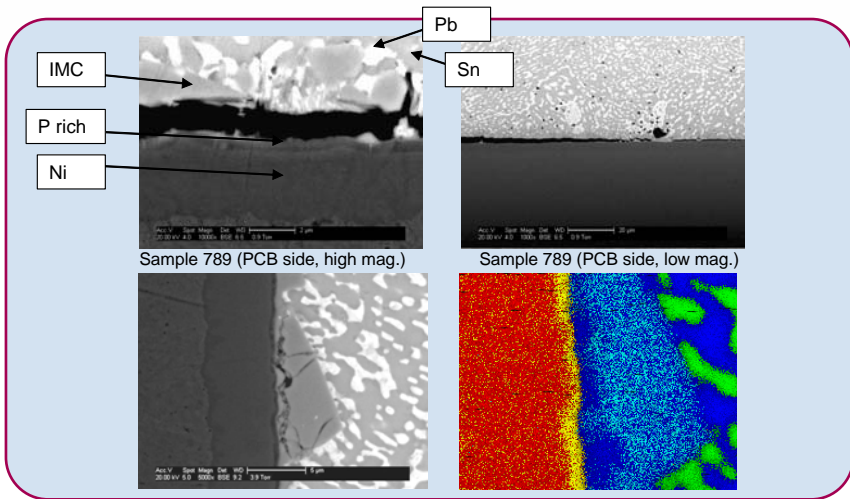


Etched, thermal-cycled, lead-free solder



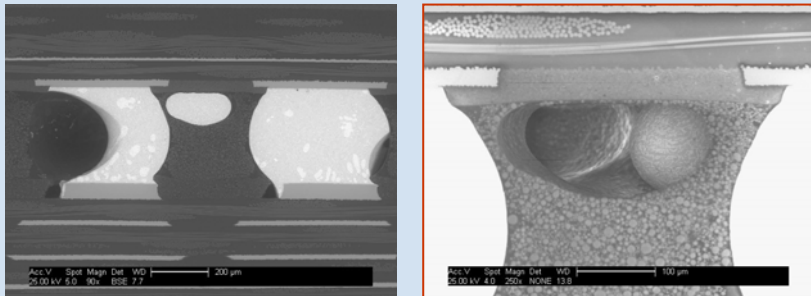
PTH barrel crack

Failure Analysis - Metallurgical

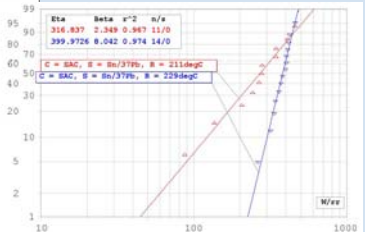
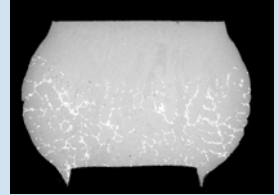


Failure Analysis – Early Detection

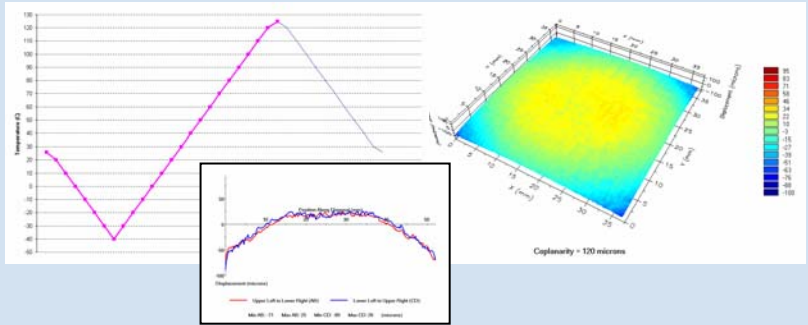
Process Development – Underfill



Life Testing – Infant Mortalities



Package Level – Warpage

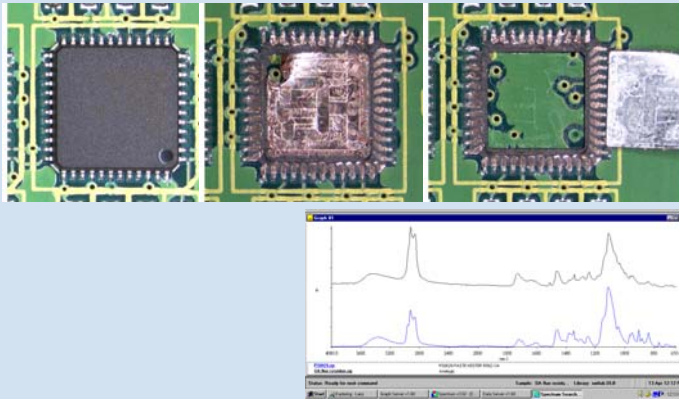


Board Level – Pad Breakout



Failure Analysis – Process

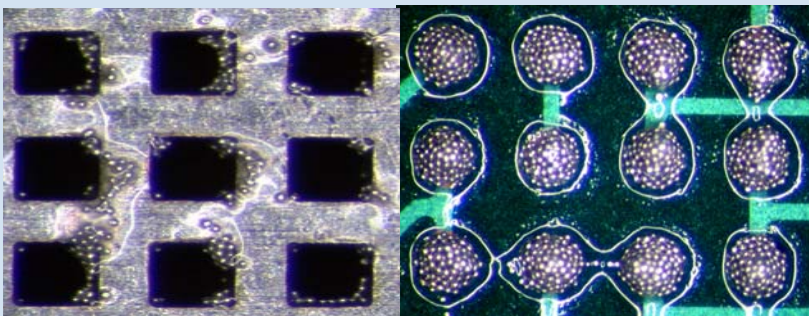
Cleaning Process, Compositional Analysis



Dye Testing



Stencil Bottom-side Contamination

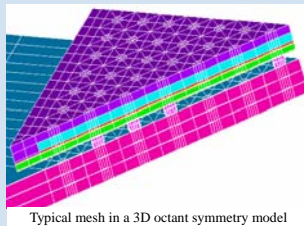
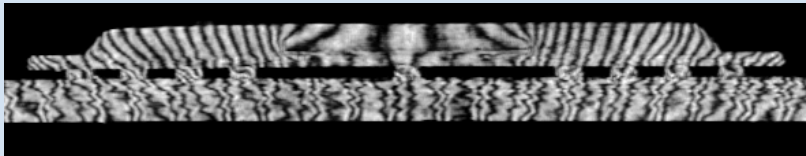


Understanding of the process, material systems, components and the issues which drive production related failures

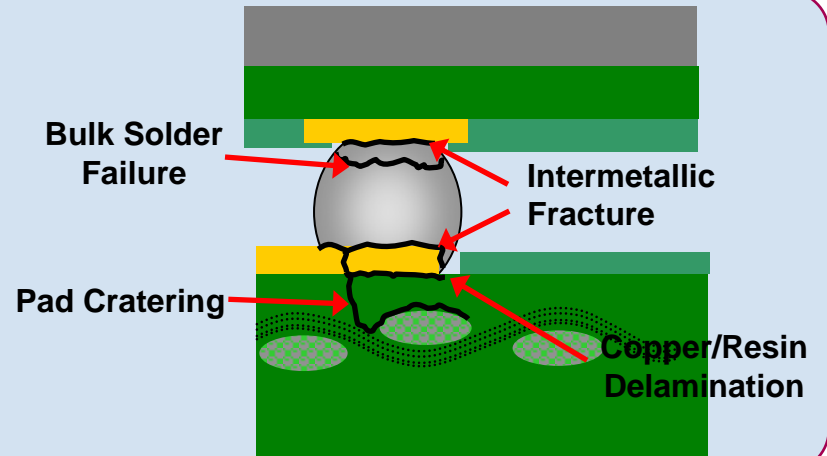


Failure Analysis – Mechanical

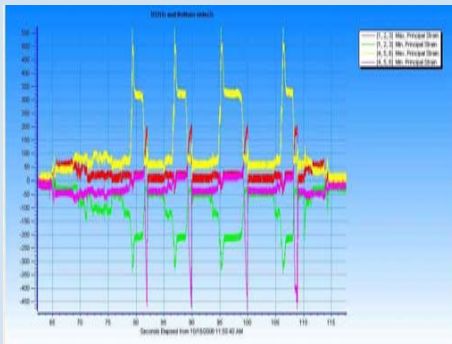
PEMI Moiré and Modeling



Typical mesh in a 3D octant symmetry model



Strain Gauge Analysis

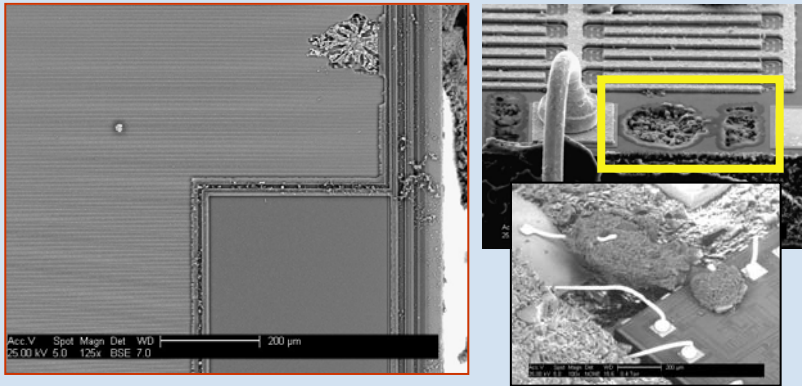


Board-level Stresses

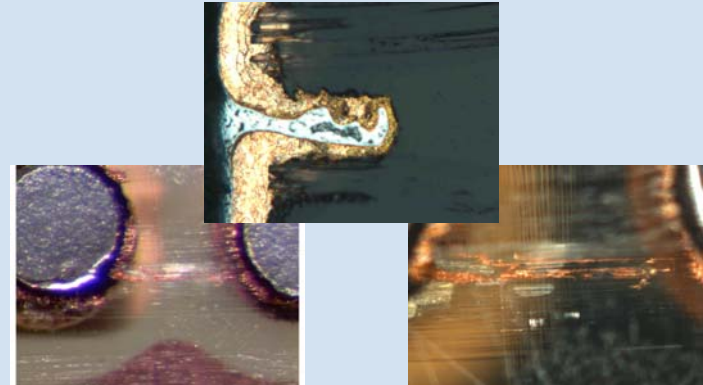


Failure Analysis – Electrical

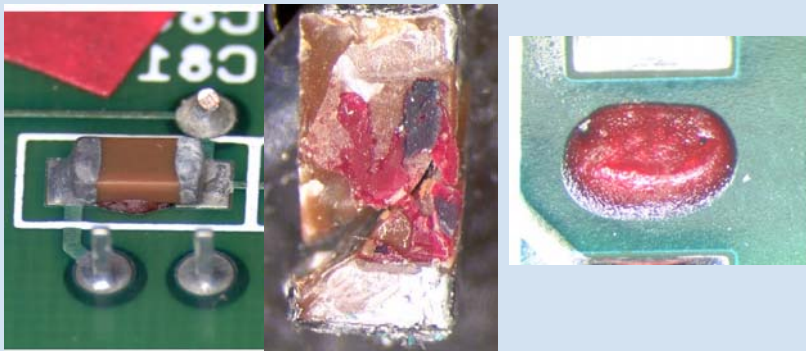
Die Level FA – ESD/EOS



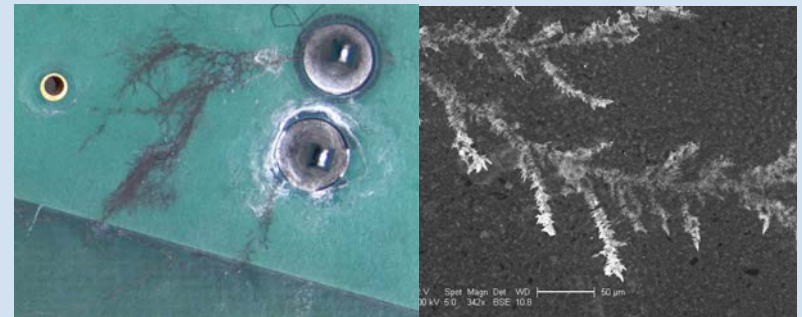
CAF Formation



Voiding in Passive Adhesive



Dendrite Formation



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