

1. Achieving High Reliability of Lead-Free Solder Joints -- Materials Considerations

Course Leader: Ning-Cheng Lee – Consultant

Course Objective:

This course covers the detailed material considerations required for achieving high reliability for lead-free solder joints. The reliability discussed includes joint mechanical properties, development of type and extent of intermetallic compounds (IMC) under a variety of material combinations and aging conditions, and how those IMCs affect the reliability. The failure modes, thermal cycling reliability, and fragility of solder joints as a function of material combination, thermal history, and stress history will be addressed in detail. The selection of novel alloys with reduced fragility will be presented. Crucial parameters for high reliability solder alloy for automotive industry will be presented. Electromigration, and tin whisker growth will also be discussed. The emphasis of this course is placed on the understanding of how the various factors contribute to the failure modes, and how the selection of proper solder alloys and surface finishes for achieving high reliability are key.

Course Outline:

1. Mainstream lead-free soldering practices
2. Surface finishes issues - ENIG, ImAg, ImSn, OSP
3. Mechanical properties - Shear, Pull, and Creep
4. Intermetallic Compounds - Interaction of Cu and Ni, Cu content and additive effect
5. Failure modes - Grain boundary sliding & cavitation, grain coarsening, orientation
6. Reliability – Thermal cycle: Effect of test condition, surface finish & solder composition
7. Reliability - Fragility: Effect of additive on IMC growth, grain size, IMC type
8. Reliability – Rigidity & Ductility
9. Reliability – Composite Solder Enable Hierarchy Assembly & Shock Resistance
10. Reliability - Tin Whisker

Who Should Attend:

Directors, managers, design engineers, process engineers, and reliability engineers who care about achieving high reliability lead-free solder joints and would like to know how to achieve it should take this course.

BIO: Ning-Cheng Lee is Consultant. Prior to that, he was Vice President of Technology of Indium Corporation. He has been with Indium from 1986 to 2021. Prior to joining Indium, he was with Morton Chemical and SCM. He has more than 30 years of experience in the development of fluxes and solder materials for SMT industries. He received his PhD in polymer science from University of Akron in 1981, and BS in chemistry from National Taiwan University in 1973. Ning-Cheng is the author of “Reflow Soldering Processes and Troubleshooting: SMT, BGA, CSP, and Flip Chip Technologies” by Newnes, and co-author of five other books. He received 1991 award from SMT Magazine and 1993 and 2001 awards for best proceedings papers of SMI or SMTA International Conferences, 2003 Lead Free Co-Operation Award from Soldertec, 2008 and 2014 awards from IPC for Honorable Mention Paper – USA Award of APEX conference, and 2010 Best Paper Award of SMTA China South Conference. He was honored as 2002 Member of Distinction from SMTA, 2006 Exceptional Technical Achievement Award from CPMT, 2007 Distinguished Lecturer from CPMT, 2009 Distinguished Author from SMTA, 2010 Electronics Manufacturing Technology Award from CPMT, 2015 Founder’s Award from SMTA, and 2017 IEEE Fellow.