Reliability of Electronics – Role of Intermetallic Compounds

SYLLABUS

INSTRUCTOR INFORMATION:

Instructor: Dr. Jennie Hwang

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Best time to call: Between 3:00PM to 5:00PM ET USA. Leave message anytime.

PROGRAM DESCRIPTION

To the chip level, package level and board level of lead-free electronics, intermetallic compounds (IMCs) play an increasingly critical role in performance and integrity of solder interconnections and the product reliability.

This course covers the relevant and important aspects of IMCs ranging from scientific fundamentals to practical application scenarios. IMCs before solder joint formation, during solder joint formation and after solder joint formation in storage and during service life will be examined. Intermetallics at-interface and in-bulk, as well as the role of PCB surface finish/component coating in relation to IMCs, in turn, to reliability will be discussed.

The difference between SnPb and Pb-free solder joint in terms of IMCs, which affects production-floor phenomena and the actual field failure, will be outlined. The course will also address the relevant aspects of newer lead-free alloys and the coined “low temperature” solders that were recently introduced to the market. Attendees are welcome to bring their own selected systems for deliberation.

LEARNING AND PERFORMANCE OBJECTIVES

The course, comprising two (2) 2-hour sessions during a week.

Dr. Hwang, a long-standing pioneer in SMT manufacturing and lead-free implementation, brings deep knowledge and broad experience to this course through both hands-on and advisory capacities in commercial as well as military applications. Her comprehensive knowledge has solved the toughest reliability and production issues. The course provides working knowledge and pragmatic perspectives to all who are concerned about the reliability

or interested in understanding the product reliability and solder joint behavior in relation to intermetallic compounds, including designers, researchers, managers, quality, manufacturing and reliability professionals, and business decision-makers; also designed for those who desire the broad-based information.

COURSE STRUCTURE

- Instructor and participants meet online twice per week from the comfort of their own home.
- Participants can view recorded online sessions to review course content and class discussions.
- Participants apply key concepts to create a real-world design from concept to completion.
- All required materials are included in the course.
- Course materials are accessible 24/7 on the new IPC Edge Learning Management System.
- The course can be accessed on virtually any device with an Internet connection and major web browser, including Chrome, Firefox, Safari, Edge, and Internet Explorer.

SUPPLEMENTAL MATERIALS

- Book: (ISBN-0-07-143048-2) "*Lead-free Implementation: A Guide to Manufacturing*" McGraw-Hill, New York, 2005, Jennie S. Hwang.
- Book: (ISBN-0 901 150 401) "*Environment-Friendly Electronics—Lead Free Technology*", Electrochemical Publications, LTD, Great Britain, 2001, Jennie S. Hwang.
- Book: (ISBN-0-07-031749-3) "*Modern Solder Technology for Competitive Electronics Manufacturing*", McGraw-Hill, New York, 1996, Jennie S. Hwang.
- Book: (ISBN-0-90-115029-0*)"IC Ball Grid Array & Fine Pitch Peripheral Interconnections*", Electrochemical Publications, LTD, Great Britain, 1995, Jennie S. Hwang.
- Book: In Japanese, "*Solder Paste: Technology and Applications for Surface Mount, Hybrid Circuits, and IC Component Manufacturing*", Industrial Research, Japan 1990, Jennie S. Hwang.
- Book: (ISBN-0442-2075-49) "*Solder Paste: Technology and Applications for Surface Mount, Hybrid Circuits, and IC Component Manufacturing*", Van Nostrand Reinhold, New York, 1988, Jennie S. Hwang.

IPC STANDARDS COVERED (PROVIDED WITH COURSE)

- IPC-4553 Specification for Immersion Silver Plating for Printed Boards
- IPC-4555 Performance Specification for High Temperature Organic Solderability Preservatives (OSP) for Printed Boards

- IPC-4556 Specification for Electroless Nickel/Electroless Palladium/Immersion Gold (ENEPIG) Plating for Printed Circuit Boards
- IPC-9701 Performance Test Methods and Qualification Requirements for Surface Mount Solder Attachments
- IPC-9709 Guidelines for Acoustic Emission Measurement Method During Mechanical Testing

COURSE SCHEDULE

WEEK 1

Topics include:

1. Intermetallic compounds – definition, fundamentals, characteristics
2. Role of phase diagrams of Pb-free vs. SnPb
3. Intermetallic compounds in the intrinsic material- Pb-free vs. SnPb
4. Formation and growth during production process and product service life
5. Intermetallic compounds - at-interface vs. in-bulk
6. Failure phenomena as the result of IMCs
7. Effects from substrate compositions (hybrid module thick film pads, PCB surface finish, IC package component surface coating)
8. Gold embrittlement – phenomena, factors, criteria
9. Different types of intermetallic compounds – effects on solder joint reliability (Ni/Au, Ni/Pd/Au, Ni/Pd, Cu)
10. SAC alloys incorporated with various doping elements – characteristics, performance
11. “Low-Temperature” solders – critical areas to product reliability
12. Effects on failure mode
13. Effects on reliability
14. Selected case studies
15. Summary

ASSIGNMENT:

Participants to bring further questions and issues for discussions.