PoP Packaging & Assembly: Materials, Processes, Reliability
SYLLABUS

INSTRUCTOR INFORMATION

Instructor: Dr. Jennie Hwang

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Contact Procedure: Between 3 p.m. and 5 p.m., Eastern Standard Time, USA. Leave message anytime.

PROGRAM DESCRIPTION

Miniaturizing electronics while increasing circuit density and functionality requires advanced packaging solutions. Among them, Package-on-Package (PoP) is widely used in Integrated Circuit (IC) design. This course examines PoP packaging and its role in downstream manufacturing assembly, with a focus on high-yield production and product reliability.

Combining real-world applications with fundamental manufacturing principles, this course is designed for all who are involved with or interested in PoP and BGA assembly. Key topics include materials, techniques, processes, and reliability considerations for both lead-free and tin-lead products. Participants will also examine the similarities and differences between PoPs and BGAs, including co-planarity, thermal stability of molding materials, and the application of conformal coatings.

The course covers best practices for PoP assembly, including solder material properties, PCB assembly processes, and rework strategies. It also addresses real-world production challenges, particularly PoP solder joint reliability for both upper and lower packages, as well as the factors that contribute to strong, reliable solder joints.

Led by an International Hall of Famer of Women in Technology—an industry expert and author of groundbreaking, globally recognized books on lead-free technology, electronics manufacturing, and reliability—this course delivers in-depth, hands-on knowledge. With experience solving some of the industry's toughest reliability and production challenges, the instructor provides insights applicable to both commercial and military applications.

LEARNING AND PERFORMANCE OBJECTIVES

In this course, you will:

- Acquire general knowledge in all relevant aspects of PoP packaging and assembly
- Acquire specific knowledge on key areas of PoPs and BGAs that require attention on the production floor
- Help achieve high-yield, low-defect production related to PoP and BGA assembly
- Have the opportunity to discuss individual issues.

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 Learning Management System.
- The course can be accessed on virtually any device with an Internet connection and a major web browser, including Chrome, Firefox, Safari, Edge, and Internet Explorer.

IPC STANDARDS COVERED (PROVIDED WITH COURSE)

- IPC-7094A: Design and Assembly Process Implementation for Flip Chip and Die-Size Components
- IPC-7095E: Design and Assembly Process Guidance for Ball Grid Arrays (BGAs)
- IPC-7351B: Generic Requirements for Surface Mount Design and Land Pattern Standard
- IPC/EIA J-STD-032: Performance Standards for Ball Grid Array Balls
- IPC-9641: High Temperature Printed Board Flatness Guidelines
- IPC J-STD-001J: Requirements for Soldered Electrical and Electronic Assemblies

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.

COURSE SCHEDULE

Focusing on PoP/BGA assembly in materials, processes, and reliability, the course is mapped out to balance between real-world hands-on practice and the engineering fundamentals behind sound practice.

Topics include:

- Overview: Industry trends – Semiconductor, package, assembly
- Package-on-package evolution: High-density packages, challenges
- PoP: Material, process, best practices
- PoP: Manufacturing steps with a single reflow process
- PoP vs. BGA: Parallelism, distinction
- PoP major players: Production defects – Paste + PCB substrates
- Solder paste: Principles & practice
- Performing solder paste: Halogen-free, critical characteristics
- Paste dipping: Paste rheology, process parameters
- Paste printing: Powder, stencil, squeegee, parameters, area ratio, 1 or 2 steps
- Role of solderability: Effects of intrinsic wetting ability on solderability
- Reflow techniques and profiling: Convection, vapor phase, N2
- PoP potential defects/issues: Moisture sensitivity, BGA crack, warpage
- Effects of solder mask: PoP/BGA solder joint reliability
- Effects of warpage: Package, PCB
- PoP rework
- PoP underfill
- PoP solder joint reliability: Fundamentals, case studies
- PoP: Additional considerations vs. reliability
- Study: PoP on PCB Solder Joint – Reliability – ATC & Drop test
- Study: 0.3mm Pitch CSP / PoP
- Concluding remarks

ASSIGNMENT:

- Participants to bring further questions and issues for discussion

ABOUT THE SPEAKER: DR. JENNIE S. HWANG

The International Hall of Famer of Women in Technology, Dr. Hwang brings deep knowledge and comprehensive experience to this course through both hands-on and advisory capacities. She has provided solutions to the most challenging and toughest issues in production yield and high-reliability products, covering commercial and military applications.

Dr. Hwang, a long-standing pioneer in SMT manufacturing and lead-free implementation, is the author of seven internationally-used textbooks and 750+ publications; a featured speaker in innumerable international/national events; has received numerous honors/ awards; on the Board of NYSE Fortune 500 companies and various civic, government, and university boards and committees (e.g., DoD - Globalization Committee, DoD - Forecasting Future Disruptive Technologies Committee; National Materials & Manufacturing Board; Board Chair of Army Science and Technology; and NIST Technical Assessment Board). She is Chair of the Artificial Intelligence Committee of DoD/National Academies; Chair of the National Laboratory Assessment Board; Chair of the Assessment Board of Army Research Laboratory; Chair of the Assessment Board of Army Engineering Centers; and Chair of the panel of the National Artificial Intelligence Institute of NSF.

Her formal education includes the Harvard Business School Executive Program; and four academic degrees in Metallurgical Engineering and Materials Science, Physical Chemistry, Organic Chemistry, and liquid Crystal Science (Ph.D. M.S., M.S., B.S.).

She has held senior executive positions with Lockheed Martin Corp. and CEO of International Electronic Materials Corp., among others. She is also an invited distinguished adj. Professor of Engineering School of Case Western Reserve University and serves on the University's Board of Trustees. Further Info: www.JennieHwang.com