IEEE Components, Packaging and Manufacturing Technology Society
Phoenix Chapter

Monday, September 22nd, 2008 Tutorial

Enabling Technologies for Green Electronic Packaging

Dr. Darrel Frear, Freescale Semiconductor Inc., Tempe, Arizona
Prof. Dr.C.P.Wong, Georgia Inst. Tech., Atlanta, Georgia
Prof. Brad Allenby, Arizona State University, Tempe, Arizona
Ms. Linda Young, Intel Corporation, Ocotillo, Arizona

Tutorial Scope

In our modern day living we are all very much aware of the waste materials we create, improper disposal of products at the end-of-life and many health and environmental consequences resulting from such actions. According to the UN Environment Programme, electronic waste totals 50 million tons a year worldwide ["High Tech Trash", National Geographic, Jan. 2008]. In the electronics industry this is a growing problem due to "rapid technology changes" and the practice of "planned obsolescence" in consumer electronic products. If the waste material is not properly recycled and treated, they become major sources of toxins and carcinogens. To combat the situation, RoHS (Restriction of Hazardous Substances) Directive came into effect in 2003 and this directive restricts the use of six hazardous materials in the manufacture of electronic and electrical equipment. We need to be more thoughtful and creative in the future in reducing and/or eliminating the use of harmful materials as we develop new materials, new assembly/manufacturing processes and new products.

This technical tutorial will focus on the theme of **"Enabling Technologies for Green Electronic Packaging"**. It is organized by IEEE Phoenix CPMT Chapter. Following four topics are planned: (i) Pb free solders in electronic packaging (ii) Conductive adhesives as a lead-free alternative in electronic packaging (iii) Electronics and Sustainable Engineering: an IEEE perspective (iv) Component Manufacturer's Perspective on Design for Environment Including Recycling. Each presenter will provide an overview of basic technologies, discuss current challenges, and offer solutions in the respective areas. They will also look beyond today's limitations.

Tutorial Agenda

12:00 – 12:50 PM	Registration
12:50 PM – 1:00 PM	Welcome Address Dr. Mali Mahalingam, Freescale Semiconductor Inc. Dr. Vasu Atluri, Intel Corporation
1:00 PM – 2:00 PM	Pb free solders in electronic packaging Dr. Darrel Frear, Freescale Semiconductor Inc.
2:00 PM – 3:00 PM	Conductive adhesives as a lead-free alternative in electronic packaging Prof. C.P.Wong, Georgia Inst. of Tech
3:00 PM – 3:30 PM	Refreshment Break
3:30 PM – 4:30 PM	Electronics and Sustainable Engineering: an IEEE perspective Prof. Braden R. Allenby, Arizona State University
4:30 PM – 5:30 PM	Component Manufacturer's Perspective on Design for Environment Including Recycling Ms. Linda Young, Intel Corporation
5:30 PM – 5:45 PM	Tutorial Wrap-Up

Tutorial Abstracts

Pb free solders in electronic packaging
Dr. Darrel Frear, Freescale Semiconductor Inc.

Electronic Packaging has undergone tremendous change in the past ten years as a result of legislative actions restricting hazardous materials (notably RoHS in Europe and China). One of the key elements targeted in the legislative bans is Pb that has historically been extensively used in the form of Sn-Pb alloys as electrical and mechanical interconnects in electronic packages. Through extensive efforts of research and development in the industry, national labs and academia, a variety of Pb-free solder alloys have been, for the most part, successfully implemented for component to board attach applications. A few exemptions to the ban on Pb still exist (e.g., automotive applications and flip chip) but these are at risk of expiring in the near future. A number of challenges have been met in the Pb-free transition but there are still quite a few technical items that need to be addressed. This presentation will give an overview of current, and planned, legislative efforts to ban or restrict Pb in electronics including the status of exemptions. The composition and metallurgy of typical Pb-free solders will be discussed along with the thermomechanical behavior (including aging, fatigue, drop impact, time dependent deformation). The issues associated with developing Pb-free solutions for the current Pb exemptions (e.g., flip chip, die attach) will be highlighted. A summary of future work needed will also be given.

Recent advances of Conductive adhesives as a lead-free alternative in electronic packaging
Prof. C.P.Wong, Georgia Inst. of Tech.

Tin-lead solder alloys are widely used in the electronic industry. They serve as interconnects that provide the conductive path required to achieve connection from one circuit element to another. There are increasing concerns with the use of tin-lead alloy solders with the recognition of hazards of using lead. Lead-free solders and electrically conductive adhesives (ECAs) have been considered as the most promising alternatives of tin-lead solder. ECAs consist of a polymeric resin (for example, an epoxy, silicone, or polyimide) that provides mechanical properties such as adhesion, mechanical strength, and impact strength and a metal filler that conducts electricity. ECAs offer numerous advantages over conventional solder technology, such as environmental friendliness(lead-free), mild processing conditions (enabling the use of heat-sensitive and low-cost components and substrates), fewer processing steps (reducing processing cost), low stress on the substrates, and fine pitch capability (enabling the miniaturization of electronic devices). Therefore, conductive adhesives have been used in flip chip assembly, LCD display, CSP and BGA applications. However, no currently commercialized ECAs can replace tin-lead metal solders in all applications due to some challenging properties such as lower electrical conductivity, conductivity fatigue in reliability testing, limited current-carrying capability, and poor impact strength. Considerable research has been conducted recently on the improvement of electrically conductive adhesives as a solder replacement. This review will discuss the materials, applications and recent advances of electrically conductive adhesives as a solder replacement in electronic packaging industry.

Electronics and Sustainable Engineering: an IEEE perspective
Prof. Braden R. Allenby, Arizona State University

Over ten years ago, the electronics sector began work on industrial ecology and design for environment, structured means by which environmental considerations could be integrated into electronic product design. Since then, with the rise of everything from synthetic realities to instantaneous search capabilities across the Web, the importance of electronics products, and the services platformed on them, has only increased. The challenges this poses to us as engineers, and to the IEEE as an organization, are substantial, and demand thoughtful and comprehensive change.

Component Manufacturer's Perspective on Design for Environment Including Recycling
Ms. Linda Young, Intel Corporation

Throughout the last decade, we have become increasingly aware of how production and use of electronics can potentially affect the environment. Intel has responded to this increased interest by designing products that offer a reduced environmental footprint in the production, use and ultimate disposal. This session will explore Design for the Environment (DfE) with regard to recycling through the lifecycle of the technology. We will discuss materials use, enabling the supply chain, partnerships and our challenges.

Speaker Biographies

Dr. Darrel Frear earned an A.B. in Engineering Science from Dartmouth College (1982) and M.S. (1984) and Ph.D. (1987) degrees in Materials Science from the University of California, Berkeley. He is a Distinguished Member of the Technical Staff at Freescale Semiconductor and is Department manager in the Advanced Packaging Systems Integration Laboratory. Previously, Darrel was with Sandia National Labs as a Principle Member of the Technical Staff. Darrel works in advanced packaging research and development including materials, manufacturing and reliability and has spent over 15 years in Pb-free solder research and development.

Prof. C. P. Wong is a Regents' Professor and holder of the Charles Smithgall Institute Endowed Chair at the School of Materials Science and Engineering at Georgia Institute of Technology. He received his B.S. degree from Purdue University, his Ph.D. degree from the Pennsylvania State University and a postdoctoral fellowship with Nobel Laureate Professor Henry Taube at Stanford University.He was with AT&T and was elected to an AT&T Bell Laboratories Fellow in 1992. Since 1996, he is a Professor at Georgia Tech. He holds over 50 U.S. patents, numerous international patents, has published over 600 technical papers. He is a Fellow of the IEEE and was the President of IEEE-CPMT Society (1992 &1993). He is a member of the National Academy of Engineering since 2000.

Prof. Braden R. Allenby is currently Professor of Civil and Environmental Engineering, and of Law, at Arizona State University, having moved from his previous position as the Environment, Health and Safety Vice President for AT&T in 2004. Dr. Allenby received his BA from Yale University, his J. D. from the University of Virginia Law School, his Masters in Economics from the University of Virginia, and his Ph.D. in Environmental Sciences from Rutgers. He is currently President of the International Society for Industrial Ecology; Chair of the AAAS Committee on Science, Engineering, and Public Policy; a Batten Fellow in Residence at the University of Virginia's Darden Graduate School of Business Administration; and a Fellow of the Royal Society for the Arts, Manufactures & Commerce. From 1995 to 1997, he was Director for Energy and Environmental Systems at Lawrence Livermore National Laboratory, and from 1991 to 1992 he was the J. Herbert Holloman Fellow at the National Academy of Engineering in Washington, DC. His areas of expertise include Design for Environment, industrial ecology, telework and netcentric organizations, and earth systems engineering and management.

Ms. Linda Young has close to 20 years experience in the environmental field. Early in her career, she worked in the oil industry on both the east and west coasts supporting water, waste, and air programs. Linda joined Intel in 1992 where she has held a variety of technical and management positions in the Arizona Environmental, Health & Safety (EHS)

Department. Linda is currently the Product Ecology Manger and is responsible for developing product ecology vision and direction for Intel and establishing strategies for addressing emerging regulatory requirements.
Linda has a BS degree in Chemical Engineering from Oregon State University.

Date: Monday, September 22nd, 2008

Location: Amphitheater (Located in Third Floor)
Hilton Phoenix Airport, 2435 South 47th Street, Phoenix, Arizona - 85034
Tel: (480) 894-1600; Website: http://www1.hilton.com/en_US/hi/hotel/PHXAHHF/index.do

Time: 12:00 PM – 12:50 PM Registration
12:50 PM – 5:45 PM Program
3:00 PM – 3:30 PM Refreshment Break

Cost: $30 for IEEE members / $40 for Non-IEEE Members (Includes Tutorial Material and Refreshments)

Registration: www.ieee.org/phoenix (Web Registration by Sept. 15th, 2008, is strongly encouraged)

Audience: IEEE members and non-members all are welcome to attend.

For more information please call any of the following officers:

Mali Mahalingam (480) 413-5368
Vivek Gupta (480) 413-5849
Samir Pandey (480) 552-7502

Vasu Atluri (480) 554-0360
Vladimir Noveski (480) 554-2375
Surinder Tuli (480) 554-8275

Qing Zhou (480) 552-9177
Rao Bonda (480) 413-6121
Sunit Mahajan (480) 552-5317

IEEE Components, Packaging and Manufacturing Technology Society
Phoenix Chapter
Monday, September 22nd, 2008 Tutorial Meeting

Enabling Technologies for Green Electronic Packaging

Dr. Darrel Frear, Freescale Semiconductor Inc., Tempe, Arizona
Prof. C.P.Wong, Georgia Inst. of Tech., Atlanta, Georgia
Prof. Brad Allenby, Arizona State University, Tempe, Arizona
Ms. Linda Young, Intel Corporation, Ocotillo, Arizona

Tutorial Registration at www.ieee.org/phoenix

(Web Registration by Monday, Sept. 15th, 2008, is strongly encouraged)
Cost: $30 for IEEE members / $40 for Non-IEEE Members

TUTORIAL LOCATION DETAILS

Hilton
Phoenix Airport

Hilton Phoenix Airport
is located at
2435 South 47th Street
Phoenix, Arizona 85034

West of 143 Freeway and North of University Drive

For Further Assistance Call
(480) 894-1600