

**NSF- CAVE3
Electronics
Research Center**

Center Research Projects Spring-Review
March 7- 9, 2017
Room 1409, Wiggins Mechanical Engineering Hall
Agenda

TUESDAY, March 7, 2016 (Joint Meeting with IPC-PERM)

Room: Wiggins 1409 (All Day)

- 8:00 – 8:30 Auburn University Badging Check-In
- 8:30 – 8:45 Sign In / Coffee – Wiggins Hall Room 1409**
- 8:45 – 9:00 Welcome and Introductions (Dave Pinsky, PERM Council Chair)
9:00 – 9:30 Auburn/CAVE3 Welcome and Overview (Dr. Pradeep Lall, CAVE3)
- 9:30 – 9:45 Pb-free Electronics Risk Management (PERM) Council –
Overview & Status
- 9:45 – 10:00 Overview of November 2016 PERM 30 Meeting (David Pinsky, PERM Chair)
- 10:00 – 10:30 Break – Coffee in Kitchen Area of Wiggins Hall**
- 10:30 – 11:15 Electronics Thermal Management Strategies Through Thermal Interface Materials and Bendable Heat Pipes (Dr. Harris)
Experiments and Modeling in Convective Cooling of Electronics (Dr. Knight)
- 11:15 – 12:00 High Strain Rate Properties of Pb-Free Solders (Dr. Pradeep Lall, CAVE3)
- 12:00 – 13:00 Lunch (Catered) in Kitchen Area of Wiggins**
- 13:00 – 13:45 Aging Behavior of Lead Free Solders (Dr. Jeff Suhling, CAVE 3)
13:45 – 14:15 NASA DoD Phase 3 Consortium Testing Plan (Jeff Kennedy, Celestica)
- 14:15 – 14:45 Update on DoD Executive Agent for Printed Circuits/Electronics Interconnects, (Denny Fritz, SAIC)
- 14:45 – 15:00 Break- Catered Cookies and Coffee in Kitchen Area of Wiggins**
- 15:00 - 15:30 Update on IPC Standards Concerning PERM Input (Dave Hillman, Rockwell Collins)
- 15:30 – 16:00 Update on AVSI ISRP Airplane Environmental Monitor (Joe Juarez, Honeywell)
- 16:00 - 16:15 Discuss Wednesday Agenda (Dave Pinsky, PERM Chair)

WEDNESDAY, March 8, 2016 (CAVE3 MEMBERS ONLY)

Room: Wiggins 1409 (All Day)

8:00- 8:15 **Continental Breakfast- in Kitchen Area of Wiggins**

8:15- 8:45 **Center Overview & Status**

*Pradeep Lall, John and Anne MacFarlane Endowed Professor,
Mechanical Engineering; Director, NSF-CAVE3 Research Center
Director, NextFlex Harsh Environment Node*

8:45- 9:00 **Break- Coffee in Kitchen Area of Wiggins**

9:00- 10:00 **Chip-Level Interconnects, Flip-Chip and Underfills**

*Jeff Suhling, Quina Professor and Department Chair, Mechanical
Engineering*

P14-201: Effects of Moisture on the Mechanical Behavior of
Packaging Materials

P13-201: Effects of Moisture on the Reliability of Flip Chip
Assemblies

P14-202: Effects of Moisture on the Reliability of Plastic Packaging

P15-201: Improved FEA Modeling of Area Array Assemblies

10:00- 11:00 **Harsh Environment Electronics Systems**

*John Evans, Charles D. Miller Endowed Chair, and Samuel Ginn College
of Engineering Chair; Center Associate Director, Industrial and Systems
Engineering*

Special Sponsored Project- Reliability Study on Isothermally Aged
Doped Lead- Free Solders for Accelerated Life Testing

Special Sponsored Project 2- Solder Dopant Selection Test: Downselect

Special Sponsored Project 3- Reliability Study on Isothermally Aged
Doped Lead- Free Solders for Accelerated Life Testing with Downselect

P14-501: Reliability of Aged Lead- Free Solder Dopants for
Temperature Accelerated Life Testing (TV9)

11:00- 11:15 **Break**

11:15- 12:00 **Connectors, and System-Level Interconnects: Degradation and Wear Mechanisms**

George Flowers, Dean Graduate School, Mechanical Engineering

- P15-407 Connector Failure Diagnosis in Communication System
- P15-404 Influence of CTE Mismatch on Sn Whiskering
- P15-405 Effect of Small Wt% Impurities on Sn Whiskering
- P15-403 Capacitance Effects in Fretted Electrical Connectors

12:00- 1:00 **Lunch (Catered) in Kitchen Area of Wiggins**

1:00- 2:30 **Component Reliability and Prognostic Health Management Systems**

*Pradeep Lall, John and Anne MacFarlane Endowed Professor, Mechanical Engineering; Director, NSF-CAVE3 Research Center
Director, NextFlex Harsh Environment Node*

- P16-101 Test Protocols for Flexible Electronics Systems
- P16-102 High-G Survivability and Reliability Modeling of Advanced Interconnects
- P16-103 Simultaneous Temperature & Vibration Reliability of Electronic Systems
- P16-104 Thermo-mechanical Reliability of Leadfree Electronics under wide temperature extremes
- P16-105 Characterization of High Strain-Rate Properties at High and Low Operating Temperatures
- P16-106 Reliability Models for SSL Luminaires
- P16-107 Harsh Environment Survivability of MEMS Sensors
- P16-108 Wirebond Interconnects under High-Voltage and High Current

2:30- 3:15 **Leadfree Solders Alloys Constitutive and Wetting Behavior**

Mike Bozack, Professor, Physics

- P14-301 Anand Model and FEA Predictions for Lead Free Solder Alloys Including Aging Effects
- P15-301 Effects of Aging on the Cyclic Fatigue Life of Pb-Free Alloys
- P16-301 Aging Behavior of Solder Joints at Elevated Temperatures
- P16-302 Microstructural Evolution in Aging Lead Free Solders
- P16-303 The Poisson's Ratio of Lead Free Solder

3:15- 3:30 **Break- Snacks and Coffee Catered in Kitchen Area of Wiggins**

3:30-5:30 **Project Posters and Demonstrations:**

Posters: Component Reliability and Prognostic Health Management Systems

*Pradeep Lall, John and Anne MacFarlane Endowed Professor,
Mechanical Engineering; Director, NSF-CAVE3 Research Center
Director, NextFlex Harsh Environment Node*

Effect of Simultaneous High Temperature and Vibration on MEMS based Vibratory Gyroscope

- Amrit Abrol (ME), Pradeep Lall (ME)

Electromigration Phenomenon in High Current and Extreme Environment Wirebonded Applications

- Shantanu Deshpande (ME), Pradeep Lall (ME)

Effect of Prolonged Storage up to 1-year on the High Strain Rate Properties of SAC Leadfree Alloys at Operating Temperatures of upto 200C

- Di Zhang (ME), Pradeep Lall (ME)

Effectiveness of Potting Methods and Underfills on the Enhancement of Survivability of Fine Pitch Electronics at 25000g Shock Loads

- Kalyan Dornala (ME), Pradeep Lall (ME)

Development of FE Models and Measurement of Internal Deformations of Fuze Electronics Using X-Ray MicroCT Data with Digital Volume Correlation

- Nakul Kothari (ME), Pradeep Lall (ME)

Warpage of the Double-Sided Flexible Printed Circuit Board on Multiple Fixtures During Reflow using DIC and Comparison with Rigid Circuit Board

- Kartik Goyal (ME), Pradeep Lall (ME)

Predictive Models for Cu-Al WB Interconnect under Biased High Humidity Environment Conditions

- Yihua Luo (ME), Pradeep Lall (ME)

De-bonding Simulation of Cu-Al Wirebond Intermetallic Compound Layers

- Yihua Luo (ME), Pradeep Lall (ME)

Health Monitoring of Electronic Assemblies Subjected to Vibration Load

- Tony Thomas (ME), Pradeep Lall (ME)

X-ray CT and DVC based Analysis of Strains in Metallization of Flexible Electronics

- Junchao Wei (ME), Pradeep Lall (ME)

PBGA Package Finite Element Analysis Based on the Physical Geometry Modeling using X-ray MicroCT Digital Volume Reconstruction

- Junchao Wei (ME), Pradeep Lall (ME)

Effect of Prolonged Storage on High strain Rate Mechanical Properties of SAC 105 at Operating Temperature Up to 200C

- Vikas Yadav (ME), Pradeep Lall (ME)

High strain Rate Mechanical Properties of SAC-Q Lead Free Solder Alloys at Very High Operating Temperatures

- *Vikas Yadav (ME), Pradeep Lall (ME)*

Color Shift Analysis and Modeling of High Power Warm White pc-LED under High Temperature and High Humidity Environment

- *Hao Zhang (ME), Pradeep Lall (ME)*

Reliability Resting of SnPb, SAC105 and SAC305 Alloys Under Combined Temperature and Vibration

- *Vikas Yadav (ME), Di Zhang (ME), Pradeep Lall (ME)*

Posters: Chip-Level Interconnects, Flip-Chip and Underfills

Jeff Suhling, Quina Professor and Department Chair, Mechanical Engineering

Effect of Temperature and Humidity Level on Moisture Properties of Polymer Materials

- *Quang Nguyen (ME), Jeffrey Suhling (ME)*

The Dependence of Moisture Induced Die Stress upon the Moisture Properties of Polymer Materials in Electronic Packages

- *Quang Nguyen (ME), Jeffrey Suhling (ME)*

Effect of Moisture of Underfill Materials Exposed to Different Humidity Conditions

- *Promod R Chowdhury (ME), Jeffrey Suhling (ME)*

Improved Finite Element Simulation Strategy for Detailed Modeling of Solder Joints in BGAs Packages Subjected to Thermal Cycling

- *Chienchi Chen (ME), Jeffrey Suhling (ME)*

Posters: Connectors, and System-Level Interconnects: Degradation and Wear Mechanisms

George Flowers, Dean Graduate School, Mechanical Engineering

High Frequency Characterization, Modeling, and Fault Diagnosis of Coaxial Connectors in Communication Systems

- *George Flowers (ME), Beijing University of Post and Telecommunications.*

Capacitance Build-up in Electrical Connectors due to Vibration Induced Fretting Corrosion

- *H. Yang (ME), George Flowers (ME), Za Cheng (ME).*

Effect of Fretted Electric Contacts on High Frequency Data Transmission

- *H. Yang (ME), T. Stegeman, R. Ji, M.C. Hamilton (EE), J. Gao (ME), George Flowers (ME)*

The Generation and Prediction of Passive Intermodulation in Coaxial Connectors

- *Qiuyan Jin (Beijing University of Post and Telecommunications) George Flowers (ME), Jinchun Gao (ME).*

High Frequency Characterization, Modeling and Fault Diagnosis of Coaxial Connectors in Communication Systems

- *George Flowers (ME), Qingya Li (Beijing University of Post and Telecommunications.), Jinchun Gao (ME)*

Two Previous Whiskers Investigation 1.5 Years Later

- *Z. Wang (ME), M. J. Bozack (Phys.), George Flowers (ME)*

Posters: Harsh Electronics Systems and Manufacturing

John Evans, Charles D. Miller Endowed Chair and Center Associate Director, Industrial and Systems Engineering

Individual Solder Joints in Low Cycling Fatigue

- *Sa'd Hamasha (ISE), Sinan Su (ISE), Ahmad Dawahdeh (ISE)*

Reliability Study on Isothermally-aged doped Lead-free Solders for Accelerated Life Testing

- *Sivasubramanian Thirugnanasambandam (ISE), Anto Jeson Raj (ISE), Seth Gordon (ISE), Sharath Sridhar (ISE), John Evans (ISE), Wayne Johnson (Tenn. Tech), Michael Bozack (Phys.), Jeff Suhling (ME)*

Posters: Leadfree Solders Alloys Constitutive and Wetting Behavior

Mike Bozack, Professor, Physics

Creep Properties of SCA305 Solder Joints at Elevated Temperatures

- *Sudan Ahmed (ME), Jeffrey Suhling (ME)*

Visualization of Microstructure Evolution in Leadfree Solders During Isothermal Aging Using SPM Imaging

- *Sudan Ahmed (ME), Nianjun Fu (ME), Jeffrey Suhling (ME)*

High Temperature Tensile and Creep Behavior of Lead Free Solders

- *Mohammad Alam (ME), Jeffrey Suhling (ME), Pradeep Lall (ME)*

Evolution of the Cyclic Stress-Strain Behavior of Doped SAC Solder Materials Subjected to Isothermal Aging

- *Md. Mahmudur R Chowdhury (ME), Jeffrey Suhling (ME), Nianjun Fu (ME)*

Evolution of the Microstructure and Constitutive Behavior of SCA 305 Lead Free Solder During Fatigue Testing

- *Nianjun Fu (ME), Jeffrey Suhling (ME)*

Microstructural Evolution of Leadfree Solder Joints During Aging

- *Nianjun Fu (ME), Sudan Ahmed (ME), Jeffrey Suhling (ME)*

The Influence of Poisson's ratio on The Reliability of SAC Leadfree Solders

- *K.M. Rafidh Hassan (ME), Jeffrey Suhling (ME)*

Nanomechanical Characterization of IMCs Formed in SAC Solder Joints
Subjected to Isothermal Aging

- *Abdullah Fahim (ME), Sudan Ahmed(ME), Jeffrey Suhling (ME)*

5:45 Networking- McCartney Suite, Shelby Center (Catered)

6:30 Dinner- McCartney Suite, Shelby Center (Catered)

THURSDAY, March 9, 2017 (Joint Meeting with IPC-PERM)

Room: Wiggins 1409 (All Day)

8:00 – 8:30	Breakfast/ Coffee and Check-in Wiggins Hall Room 1409
8:30 – 8:45	Status of PERM Pb-free Design Guide Effort (Anthony Rafanelli, Raytheon)
8:45 – 9:15	Tin whisker self-mitigation study Update (Dave Pinsky, Raytheon)
9:15 – 9:45	Tin Whisker Mitigation Test Vehicle (Stephan Meschter, BAE Systems)
9:45 – 10:00	Break- Coffee in Kitchen Area of Wiggins
10:00 – 11:00	Tin-Whisker Reliability Physics (Mike Bozack and George Flowers, CAVE3)
11:00 – 12:00	Reliability Impact of Long- term Thermal Aging on Lead Free Solders (Dr. John Evans, CAVE3)
12:00-13:00	Lunch (Catered) in Kitchen Area of Wiggins
13:00 – 14:30	Tour of Auburn University Labs (IPC-PERM)
13:00 – 14:30	Industrial Advisory Board (IAB) Closed-Session for CAVE3 Only
14:30 – 15:00	Future PERM Meeting Dates/Locations (Dave Pinsky, Raytheon)
15:00 – 15:30	Break- Cookies and Coffee in Kitchen Area of Wiggins
15:30 – 16:30	Feedback Session (CAVE3 MEMBERS ONLY)
16:45 – 17:45	Optional Topical Area Meetings (TBD by Request Only)
18:00	Adjourn
