

**The George W. Woodruff School of Mechanical Engineering  
Georgia Institute of Technology**

# Mechanical Engineering Seminar

**Dr. Charles Ume, Professor**

George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology

**Thursday, May 7, 2009 - - MRDC 4211 - - 11:00 a.m.**

## ***ABSTRACT***

### **Thermomechanical Reliability Evaluations and Analyses of Microelectronic and Electronic Packages**

The first part of this presentation will provide an overview of Prof. Ume's activities in the general area of Mechatronics at GIT, and their impact on the Mechatronics activities in the rest of the United States. This will be followed by a description of his research efforts in Laser Ultrasonics, and its application to (1) weld quality assessments, and (2) defect evaluations of solder bumps in microelectronic packages.

Over the last several decades consumers of electronic products have been demanding high powered products that are light weight, portable and low cost. In response to consumer demands, the microelectronic and electronic packaging industries started to manufacture thin and small size printed wiring boards (PWBs) and densely packed PWB assemblies to go into new generations of electronic products. This has resulted in many failures related to thermomechanical reliability and in problems caused by excessive PWB and chip package warpage. These failures and problems include: component misregistration, die cracking, delamination and solder bump failures. The PWB and chip package warpage are caused by the coefficient of thermal expansion (CTE) mismatch between the heterogeneous board (PWB assembly) materials, and the temperature gradients across the thickness of the PWB assembly. Therefore, the second part of his presentation will focus on the development of an integrated Moire and Convective Solder Reflow Heating System for real-time warpage/flatness measurement of PWBs, PWB assemblies and chip packages. The measurement results obtained with this system will be presented. These experimental results will be compared with analytical and finite element results. Finally, the impacts of this research will be summarized.

## ***BIOSKETCH***

I. Charles Ume is a Professor and Director of Instructional Mechatronics Laboratory, and Advanced Electronic Packaging and Laser Processing Laboratories at the Woodruff School of Mechanical Engineering, Georgia Tech. He joined the Woodruff School in 1985 as an Assistant Professor after he graduated from the University of SC in Columbia. In 1989 and 1990, he was a Visiting Scientist at IBM-Austin and Motorola-Schaumburg, respectively. Prof. Ume is the Founder and the Chairman of the Board of Directors, AkroMetrix LLC. AkroMetrix is a high-tech commercial enterprise company that grew out of his research endeavors at Georgia Tech. His research interests are in the areas of thermo-mechanical reliability of electronic systems, laser ultrasound for process monitoring/control and for non-destructive evaluation of materials, and intelligent mechatronics. He has co-authored over 200 refereed archival publications; received four patents and has two utility patents and four provisional patents pending; has edited 11 books (a book chapter, conference proceedings, a lab manual and special journal issues). He has advised/advising 23 Ph.D. and 21 MS thesis students.

Three of his former students (2 Ph.D. and 1 MS) have won the Best Sigma Xi Dissertation/Thesis Awards. Prof. Ume has been honored with the following awards: ASME Electronic and Photonics Packaging Division Best Paper of the Year Award; Instrument, System, and Automation (ISA) Society E. G. Bailey Award; Georgia Tech's Outstanding Interdisciplinary Activities Award; ISA Society Donald P. Eckman Education Award; ASEE Robert G. Quinn Award for Excellence in Engineering Education; IEEE-CPMT Outstanding Sustained Technical Contribution Award; Sigma Xi Sustained Research Award; The Nigerian National Order of Merit Award (the nation's highest honor in science and technology); IEEE Fellow; ASME Fellow; and Fellow of Nigerian Academy of Science. Prof. Ume was a Co-Editor-in-Chief of Mechatronics Journal; an Associate Technical Editor of IEEE Transactions on Components and Packaging Technologies; an Associate Technical Editor of the ASME Journal of Electronic Packaging; and a Regional Editor of Mechatronics Journal. He was the General Chair of the 7<sup>th</sup> Mechatronics Forum International Conference & Mechatronics Education Workshop. He is currently the Chairman of the Executive Committee, ASME Electronic and Photonics Packaging Division.

**For more information, please contact the host, Dr. Wayne Book at 404-894-3247.**