THERMI AWARD: SIGNIFICANT CONTRIBUTOR

Dereje Agonafer,

Dr. Martin Luther King, Jr. Visiting Professor, Massachusetts Institute of Technology

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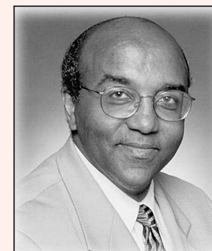
Thermomechanical Challenges in Electronic Packaging



As the Electronic Packaging industry develops technologies for fabrication of smaller, faster, economical and reliable products; thermal management and design play an important role. Following Moore s Law, the number of transistors on a single on "high density interconnect" chip has exceeded a billion. The feature size of the die, however, is not changing much leading to a significant increase in power density. Coupled with the increased dynamic power, is the fast increasing static power caused by leakage current (the gate oxide thickness for 90nm nodes is only 1.2nm). The push for multi-core processors and high k dielectric is partly attributed to this leakage current. In this paper, the author will discuss the studies that he and his graduate students in cooperation with numerous industry colleagues have conducted in the last ten years in the area of thermo/mechanical challenges in electronics cooling/packaging. The discussion will include stacked packaging and the related thermo/mechanical challenges; efforts to reduce thermal resistance due to highly non-uniform chip power distribution, development of a best known method (BKM) for design of microprocessors based on power and thermal-architectural co-design, thermal challenge related to leakage current, effect of weight of heat sink assembly on mechanical reliability of a wire bonded plastic ball grid array package, bump electromigration and back end design rules, development of constitutive equations for lead free solders and some discussion on data centers and related energy management.

Professor Agonafer received his PhD from Howard University and joined IBM. After 15 years at IBM, in 1999, Dr. Dereje Agonafer joined the University of Texas at Arlington as Professor and Director of Electronics, MEMS, and Nanoelectronics Systems Packaging Center). He currently advises 16 graduate students including 6 PhD s. Since joining UTA in 1999, he has graduated 53 graduate students. The research areas cover a broad area in electronic packaging including stacked packaging and the related thermo/mechanical challenges; efforts to reduce thermal resistance due to highly non-uniform chip power distribution, development of a best known method (BKM) for design of microprocessors based on power and thermal-architectural co-design, thermal challenge related to leakage current, effect of weight of heat sink assembly on mechanical reliability of a wire bonded plastic ball grid array package, bump electromigration and back end design rules, development of constitutive equations for lead free solders and thermal management of data centers. Professor Agonafer has published over 100 conference and journal papers and eight issued patents. In April 1998, Professor Agonafer was the recipient of the "The University of Colorado School of Engineering Distinguished Engineering Alumni Award (DEAA) in the category of Research and Invention." In November 1998, he received "The Howard University Distinguished PhD Alumni Award." Also, in November 1998, he received "ASME K-16/EEPD Clock Award for Outstanding Contribution in Computer Aided Thermal Management of Electronic Packages." In 2002, he received ASME International Electronic and Photonic Packaging Division Highest Division Award for "Outstanding Contributions to the Area of the Application of the Science and Engineering of Heat Transfer to Electronic and Photonic Packaging." He is currently the Editor in Chief of ASME Press Book Series in Electronic Packaging and Associate Editor of the Journal of Electronic Packaging. From July 1997 - July 2000, he served as Chair of the ASME K-16 Committee in the Heat Transfer Division. Professor Agonafer is a Fellow of the American Society of Mechanical Engineers International and a Fellow of American Association for the Advancement of Science. He is currently on a leave of absence as a Dr. Martin Luther King Visiting Professor at MIT in the Mechanical Engineering Department.

HARVEY ROSTEN AWARDS

Ari Glezer

Ari Glezer is the Woodruff Thermal Systems Chair and Professor in the George W. Woodruff School of Mechanical Engineering at Georgia Institute of Technology. Professor Glezer s research interests are in the area of manipulation and control of shear flows with particular emphasis on aerodynamic flow-control, heat transfer processes and novel thermal management techniques, small-scale mixing and heat transfer processes in non-reacting and reacting flows, and diffusion-convection flows in biological applications,. An important aspect of this work has been the development of novel actuation technologies that have included electromechanical (e.g., piezoelectric), fluidic (synthetic jets) and chemical actuators. Professor Glezer moved to the Woodruff School at the Georgia Institute of Technology in 1992 from the Aerospace and Mechanical Engineering Department at the University of Arizona. Before he became a member of the faculty at the University of Arizona in 1984, he worked as a senior research engineer at the Aircraft Division of Northrop Corporation, and was a Research Fellow in the Faculty of Engineering at Tel Aviv University. Professor Glezer received his B.S. in Mechanical Engineering from Tel Aviv University in 1974 and his M.S. and Ph.D. in Aeronautics from the California Institute of Technology in 1975 and 1981, respectively. Professor Glezer is a Fellow of the American Physical Society and of the American Society of Mechanical Engineers.

Raghav Mahalingam

Raghav Mahalingam is a co-founder of Nuventix, Inc., a thermal management startup, where he is primarily involved in the research and development of Synjet systems for cooling electronics. Prior to this, he was a Research Engineer at Georgia Tech, working on developing synthetic jets into a viable thermal management technology. His research interests include fluid mechanics, heat transfer, acoustics and thermal management in microelectronics. Dr. Mahalingam received his Ph.D. in Aerospace Engineering from Georgia Tech in 1999 and B. Tech in Aerospace Engineering from IIT-Madras, India in 1994. He is a member of the International Microelectronics and Packaging Society.