

THERMAL Management of Microelectronic Equipment

Heat Transfer Theory,
Analysis Methods,
and Design Practices

Lian-Tuu Yeh and Richard C. Chu

ASME Press Book Series on Electronic Packaging
Dereje Agonafer, Editor-in-Chief

Thermal Management Of Microelectronic Equipment 801683

Lian-Tuu Yeh



Thermal Management Of Microelectronic Equipment 801683:

Thermal Management of Microelectronic Equipment Lian-Tuu Yeh, Richard C. Chu, 2002 With an increased demand on system reliability and performance combined with the miniaturization of devices thermal consideration has become a crucial factor in the design of electronic packaging from chip to system levels This new book emphasizes the solving of practical design problems in a wide range of subjects related to various heat transfer technologies While focusing on understanding the physics involved in the subject area the authors have provided substantial practical design data and empirical correlations used in the analysis and design of equipment The book provides the fundamentals along with a step by step analysis approach to engineering making it an indispensable reference volume The authors present a comprehensive convective heat transfer catalog that includes correlations of heat transfer for various physical configurations and thermal boundary conditions They also provide property tables of solids and fluids Lian Tuu Yeh and Richard Chu are recognized experts in the field of thermal management of electronic systems and have a combined 60 years of experience in the defense and commercial industries *Journal of Tribology* ,2003 **Journal of Heat Transfer** ,2003 **Thermal Management of Microelectronic Equipment, Second Edition** Lian-Tuu Yeh, 2016 This Second Edition of a classic text is fully updated and greatly expanded with in depth revisions that include advancements in the component technology of microelectronics The most noticeable one is the addition of an entirely new chapter on microwave modules and the gallium arsenide GaAs chips which have seldom been discussed in any of the textbooks or publications in the area of thermal management of electronic equipment With this new chapter the book is complete and whole in the area of thermal design of electronics systems With an increased demand on system reliability and performance combined with the miniaturization of devices thermal consideration has become a crucial factor in the design of electronic packaging from chip to system levels This book emphasizes the solving of practical design problems in a wide range of subjects related to various heat transfer technologies While focusing on understanding the physics involved in the subject area the authors have provided substantial practical design data and empirical correlations used in the analysis and design of equipment The book provides the fundamentals along with a step by step analysis approach to engineering making it an indispensable reference volume *Thermal Management of Microelectronic Devices Using Gooove Substrates* Kenneth Robinson, 1992 **Heat Transfer in Microelectronic Equipment** John H. Seely, Richard C. Chu, 1972 **Wiley Series in Thermal Management of Microelectronic & Electronic Systems** ,19?? **Heat Transfer in Microelectronic Equipment** John H. Seely, Richard C. Chu, 1972 **Thermal Management Handbook: For Electronic Assemblies** Jerry E. Sargent, Al Krum, 1998 Publisher's Note Products purchased from Third Party sellers are not guaranteed by the publisher for quality authenticity or access to any online entitlements included with the product The hands on guide to thermal management In recent years heat sensitive electronic systems have been miniaturized far more than their heat producing power supplies leading to major design and

reliability challenges and making thermal management a critical design factor This timely handbook covers all the practical issues that any packaging engineer must consider with regard to the thermal management of printed circuit boards hybrid circuits and multichip modules Readers will also benefit from the extensive data on material properties and circuit functions thus enabling more intelligent decisions at the design stage and preventing thermal related problems from occurring in the first place

Advanced Thermal Management Materials Guosheng Jiang,Liyong Diao,Ken Kuang,2014-10-15 Advanced Thermal Management Materials provides a comprehensive and hands on treatise on the importance of thermal packaging in high performance systems These systems ranging from active electronically scanned radar arrays to web servers require components that can dissipate heat efficiently This requires materials capable of dissipating heat and maintaining compatibility with the packaging and dye Coverage includes all aspects of thermal management materials both traditional and non traditional with an emphasis on metal based materials An in depth discussion of properties and manufacturing processes and current applications are provided Also presented are a discussion of the importance of cost performance and reliability issues when making implementation decisions product life cycle developments lessons learned and future directions

Heat Transfer In Electronic And Microelectronic Equipment A. E. Bergles,1990-03-01 Examining one of the major heat transfer issues of the decade this reference volume presents new contributions from international researchers The volume contains information on thermal control of devices from microelectronic chips in computers to devices for power conversion

3rd Annual Technical Symposium on Thermal Management in Microelectronics 2007 Microelectronics Packaging and Test Engineering Council (Meptec),2008-06-30 *Qpedia Thermal Management - Electronics Cooling Book, Volume 2* Advanced Thermal Solutions,Kaveh Azar,Bahman Tavassoli,2008 The complete editorial contents of Qpedia Thermal eMagazine Volume 2 Issues 1 12 features in depth technical articles on the most critical topics in the thermal management of electronics

Hot Markets Marc Favreau,1996-01-01 **The Market for Electronics Thermal Management Technologies** Andrea Dace,2000 **The Market for Electronics Thermal Management Technologies** Ravi Krishnan,2002 Heat Transfer Investigation of Microelectronic Equipment Using Finite Element Modelling Techniques Jacob Bishara Abboud,1987

Thermal Management of Electronic Components Ravi Kandasamy,ARUN S. MUJUMDAR,2010-05 Thermal design in electronics cooling is to achieve effective heat removal to increase reliability and life of the components and systems This book focuses on cooling of a Flip Chip FC package without the use of phase change materials PCM A numerical thermal model was developed and validated CFD Simulation is performed for PCM and non PCM based material studies Relevant thermal performance data were obtained to show the effects of thermal interface material lid heat sink and process variables Excellent agreement found between the numerical and the measured data A novel PCM based passive thermal control of electronic devices was investigated experimentally A tall enclosure with uniform discrete heat sources applied on sides for PCM melting and another with a PCM filled heat sink

setup developed and tested PCM based cooling technique is attractive thermal concept for transient applications Effects of various parameters on melting freezing times were studied Flow visualization experiments were also made to determine the PCM melting rates Finally a 2D numerical study was conducted to compare simulation results with experimental data

Thermal Management of 3-D Stacked Chips Using Thermoelectric and Microfluidic Devices Matthew J. Redmond, 2013

This thesis employs computational and experimental methods to explore hotspot cooling and high heat flux removal from a 3 D stacked chip using thermoelectric and microfluidic devices Stacked chips are expected to improve microelectronics performance but present severe thermal management challenges The thesis provides an assessment of both thermoelectric and microfluidic technologies and provides guidance for their implementation in the 3 D stacked chips A detailed 3 D thermal model of a stacked electronic package with two dies and four ultrathin integrated TECs is developed to investigate the efficacy of TECs in hotspot cooling for 3 D technology The numerical analysis suggests that TECs can be used for on demand cooling of hotspots in 3 D stacked chip architecture A strong vertical coupling is observed between the top and bottom TECs and it is found that the bottom TECs can detrimentally heat the top hotspots As a result TECs need to be carefully placed inside the package to avoid such undesired heating Thermal contact resistances between dies inside the TEC module and between the TEC and heat spreader are shown to significantly affect TEC performance TECs are most effective for cooling localized hotspots but microchannels are advantageous for cooling large background heat fluxes In the present work the results of heat transfer and pressure drop experiments in the microchannels with water as the working fluid are presented and compared to the previous microchannel experiments and CFD simulations Heat removal rates of greater than 100 W cm² are demonstrated with these microchannels with a pressure drop of 75 kPa or less A novel empirical correlation modeling method is proposed which uses finite element modeling to model conduction in the channel walls and substrate coupled with an empirical correlation to determine the convection coefficient This empirical correlation modeling method is compared to resistor network and CFD modeling The proposed modeling method produced more accurate results than resistor network modeling while solving 60% faster than a conjugate heat transfer model using CFD The results of this work demonstrate that microchannels have the ability to remove high heat fluxes from microelectronic packages using water as a working fluid Additionally TECs can locally cool hotspots but must be carefully placed to avoid undesired heating Future work should focus on overcoming practical challenges including fabrication cost and reliability which are preventing these technologies from being fully leveraged

Special Issue: Enhanced Thermal Management of Electronic Devices and Components

Basant Singh Sikarwar, Balkrishna Mehta, Krishna Mohan Singh, 2022

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