

The 28th Annual Thermal
Measurement, Modeling
& Management Symposium

SEMI-
THERM
TWENTY
EIGHT 28



March 18-22, 2012
Doubletree by Hilton
San Jose, CA USA



NIST

Mentor
Graphics

Mechanical Analysis Division

ElectronicsCooling

MEPTEC
THE NEXT GENERATION

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SEMI-THERM®

THERMAL INNOVATIONS THAT MAKE THE WORLD'S TECHNOLOGY COOL...

ADVANCE PROGRAM

SEMI-THERM is proud to announce the Advance Program for our 28th year of technical excellence in semiconductor thermal sciences.

- ◆ Pre-conference **short-courses** from world-class thermal experts
- ◆ **Over 55 peer-reviewed papers** presented by the industry's best and brightest semiconductor thermal professionals and educators
- ◆ Chip to system **thermal management, modeling and measurement solutions**
- ◆ **Tracks include** 3D Packaging, Liquid and Air Cooling, Multidisciplinary Thermal Management, Thermal Management in Multi-Core Architectures and more...
- ◆ **New!** for SEMI-THERM 28: Special **Data Center Cooling** track with short courses and paper presentations
- ◆ Co-Located with **MEPTEC "Heat is On"** Symposium March 19
- ◆ SEMI-THERM exhibition with **over 40 vendors plus workshops and food and beverage receptions** Tuesday and Wednesday evening
- ◆ **Keynote** and opening ceremony, **evening technical program and special luncheon speakers**
- ◆ **THERMI** and **Harvey Rosten Award** presentations
- ◆ Check out the information on the next few pages and visit www.semi-therm.org for details on the program and other events coming to SEMI-THERM 2012!

THANK YOU TO OUR SEMI-THERM 28 PROGRAM COMMITTEE

General Chair	<i>Herman Chu</i> , Cisco Systems, Inc.
Program Chair	<i>Zeki Celik</i> , LSI Corporation
Vice-Program Chair	<i>Genevieve Martin</i> , Phillips Research

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NEW SHORT COURSES FOR SEMI-THERM 28!

Six new technical short courses are being offered in the SEMI-THERM pre-conference program. These highly informative courses span two days; **Sunday March 18 - Monday March 19, 2012**. These reasonably priced and outstanding technical courses are focused on the thermal sciences and are presented by leaders in the semiconductor cooling field. New for 2012 are two short half-day short courses on *Data Center* thermal management. Lunch is included with registration and CEU credits are available. Registration opens November 15, 2011.

Short Course A. Sunday and Monday, 8AM-5:30PM Two Days
Thermal Management for LED-based Applications
Clemens Lasance, Philips Research Emeritus, Cathy Biber, Thermal Consulting

Course Description

This two-day course covers all aspects of thermal management knowledge required to solve thermally-related problems in LED-based components and systems. Designers will learn about:

- ◆ Theory of heat transfer mechanisms from an industrial point of view
- ◆ Unique features of LEDs
- ◆ Basics of thermal design for LEDs
- ◆ Critical elements of a successful thermal design
- ◆ Active and passive cooling of LED-based systems
- ◆ Lifetime and performance issues
- ◆ Rules-of-thumb and hand calculations, numerical and experimental analysis and more!

Who Should Attend

Engineers directly involved with thermal design and cooling of LED-based products and students who want to understand and learn more about this increasingly important field of electronics would benefit from the course.

Short Course B. Sunday, 8AM-Noon Half-day
Thermal Design of Electronic Systems for use in Data Centers
Dr. Chris Aldham and Mark Seymour, Future Facilities

Course Description:

This half-day course will discuss the thermal design of electronic systems with specific emphasis on the interaction between the system and its environment. It will also mention future trends in both system and data center design and the need to ensure that both are fully compatible.

Who Should Attend

This short course is intended as an introduction for engineers responsible for thermal management of electronic systems designed for use in data centers and anyone interested in understanding more about the interaction of the cooling systems used in data centers and the electronic systems they house.

Short Course C. Sunday, 1:30PM-5:30PM Half-day
Data Center Design Cannot Ignore Electronic System Details
Mark Seymour and Dr. Chris Aldham, Future Facilities

The course will demonstrate the resulting thermal problems and show the ad-hoc fixes that are becoming standard in data centre operation to cope with disconnect between the electronics thermal design and data centre cooling design.

Who Should Attend

This short course is intended as an introduction for engineers interested in designing cooling strategies for data centers or managing data centers. Attendees include facility managers interested in understanding the common challenges and how to address them and IT managers interested in maximising the capacity and life of their data center whilst minimising risk by making informed deployment decisions.

Short Course D. Monday, 8AM-5:30PM Full Day
Transitioning from Air to Liquid Cooling: Design Fundamentals for Heat Sinks and Cold Plates
Alfonso (Al) Ortega, Ph.D., Villanova University
Rahima Mohammed, Ph.D., Intel Corporation

Course Description

The course is organized into the following modules:

- ◆ Semiconductor industry and role of thermal management

- ◆ Fundamentals of heat transfer and fluid flow
- ◆ Design of Air-Cooled Heat Sinks: Conventional and advanced air-cooled heat sinks: Air-Cooling limits
- ◆ Fundamental elements of thermal-fluid design: Compact Heat Exchanger Effectiveness
- ◆ Design of liquid cooled macro to micro-scale heat sinks and cold plates
- ◆ Thermal and Hydraulic design elements for box and server level liquid cooling systems
- ◆ Supply chain management in designing and deploying liquid cooled systems

Who Should Attend

Engineers tasked with thermal management design, engineers considering the transition from air to liquid cooled systems, technical leads and technical mgrs overseeing strategic direction on thermal management decisions.

Short Course E. Monday, 1:30PM-5:30PM Half-day
Overview of Thermal Management Analysis and Testing for Electronics used in Harsh Environments
Ross Wilcoxon, Dave Dlouhy, Rockwell-Collins

Course Description

The course will present a brief overview of heat transfer fundamental concepts and describe how they establish physical limitations for thermal management. First order analysis approaches using general design guidelines and thermal resistance-based calculations will be presented. The course will also include an overview on thermal/fluid testing that describes proper use of thermocouples, IR cameras, flow recapture, etc. The course will also include a discussion on the capabilities and limitations of a number of advanced thermal management technologies that may be considered for especially challenging problems.

Who Should Attend

This is a review of electronics cooling topics that focuses on providing guidelines for assessing thermal management requirements and designs for equipment used in harsh environments. The target audience is primarily mechanical, electrical, and systems engineers who need to understand how thermal management issues affect overall system design.

Short Course F. Monday, 8:00AM-Noon Half-day
CFD Applied to Electronics Cooling, focusing on Realistic Design Expectations
Peter Rodgers, Ph.D.
The Petroleum Institute, Abu Dhabi, United Arab Emirates

Course Description

This course provides numerical modeling strategies and methodologies for the thermal design of electronic equipment, which are generically applicable with CFD codes dedicated to the thermal analysis of electronic systems. The course also permits an understanding of the technical capabilities and limitations of CFD analysis at the various phases of the product design cycle. Practical application examples are presented for the analysis of component, board, system, and facility-level heat transfer. The course has no bias towards a particular CFD code.

Who Should Attend

This half-day short course will benefit engineers, managers and scientists involved in the thermal management of electronic systems. It is aimed at participants with varying expertise levels in Computational Fluid Dynamics (CFD), from novice to advanced.

Visit www.SEMI-THERM.org today for full course descriptions and registration information!

TUESDAY MARCH 20, 2012

OPENING CEREMONY

History and Charter of SEMI-THERM: Herman Chu, ST28 General Chair, Cisco Systems

KEYNOTE: The Energy Costs of Cooling Electronic Systems: Reflections on Past Lessons and Future Opportunities

Dr. Alfonso (Al) Ortega, James R. Birle Professor of Energy Technology, Villanova University

SEMI-THERM TRACK A**3-D Packaging**

- ◆ Measurement of Microbump Thermal Resistance in 3D Chip Stack
- ◆ Experimental Thermal Resistance Evaluation of a Three-dimensional (3D) Chip stack
- ◆ Impact of Die-to-Die Thermal Coupling on the Electrical Characteristics of 3D Stacked SRAM Cache
- ◆ Dynamic Compact Thermal Model for Stacked-Die Components

Liquid Cooling

- ◆ Two-Phase Flow Control of On-Chip Two-Phase Cooling Systems of Servers
- ◆ Numerical Prediction of the Junction-to-Fluid Thermal Resistance of a 2-Phase Immersion-Cooled IBM Dual Core POWER6 Processor
- ◆ Thermal Performances of Sub-Atmospheric Loop Thermosyphon With and Without Enhanced Boiling Surface
- ◆ Loop Heat Pipes with High Performance Wick Structures

SEMI-THERM TRACK B**Multidisciplinary Thermal Management**

- ◆ Novel 3D Electro-Thermal Robustness Optimization Approach of Super Junction Power MOSFETs
- ◆ Energy Reduction in Server Cooling Via Real Time Thermal Control
- ◆ A Case study on Impact of Free Air Cooling on Performance of Telecom Equipment
- ◆ Enhancement of Photovoltaic Solar Module Performance for Power Generation in the Middle East

Embedded Tutorial

Thermal Test Methodology and Standards for Lighting LEDs
Andras Poppe
Mentor Graphics Corporation
Mechanical Analysis Division

DATA CENTER TRACK A**Sustainable Data Centers**

- ◆ Air Vs. Liquid Vs. Two-Phase Cooling of Data Centers—Principles, Energy Efficiency Considerations and Market Driven Forces
- ◆ Design And Management Of Data Center Effectiveness, Risks And Costs
- ◆ Sustainable Data Centers Powered by Renewable Energy Sources

Modeling and Analysis

- ◆ Data Center Cooling Management And Analysis – A Model Based Approach
- ◆ Datacenter Power Savings through High Ambient Datacenter Operation: CFD Modeling Study
- ◆ CFD Analysis of Free Cooling of Modular Data Centers

EXHIBIT HALL OPEN 1:30-6:30PM - VENDOR WORKSHOPS 2:00 - 5:00PM - RECEPTION 6:00PM

Visit the exhibits and join us in the exhibition hall for a reception followed by the ST28 evening tutorial.

WEDNESDAY MARCH 21, 2012

SEMI-THERM TRACK C**Thermal Management in Multi-Core Architectures**

- ◆ Performance Optimization of Multi-Core Processors using Core Hopping - Thermal and Structural
- ◆ Thermal System Identification (TSI): A Methodology for Post-silicon Characterization and Prediction of the Transient Thermal Field in Multicore Chips
- ◆ On-chip Cooling of Hot-Spots with a Copper Micro-Evaporator
- ◆ Energy Efficient Liquid-Thermoelectric Hybrid Cooling for Hot-Spot Removal
- ◆ Test ASIC for Investigation of Thermal Coupling in Many-Core Architectures

Thermal Issues in GaN Devices

- ◆ Thermoreflectance CCD Imaging of Self Heating in AlGaN/GaN High Electron Mobility Power Transistors at High Drain Voltage
- ◆ Thermal Factors Influencing the Reliability of GaN-based HEMTs
- ◆ Integration of a Phase Change Material for Junction Level Cooling in GaN Devices

SEMI-THERM TRACK D**Experimental Methods**

- ◆ Socket Thermal Testing Procedure and Correlation
- ◆ A Method to Measure the Heat Dissipation from Component on PCB
- ◆ Thermal Conductivity Measurements of Novel SOI Films Using Submicron Thermography and Transient Thermoreflectance
- ◆ Measurement of Thermal Conductivity of Carbon Nanotube Films by Steady-State Heat Conduction
- ◆ Application of Thermal Transient Testing for Solar Cell Characterization

Heat Transfer Fundamentals I

- ◆ A Heatsink Design Methodology Using the Thermal ShortCut Concept
- ◆ A Framework Theory for Dynamic Compact Thermal Models
- ◆ A Method to Adapt Zth-Junction-to-Ambient Curves to Varying Ambient Conditions

DATA CENTER TRACK B**Panel: Current trends in data center industry: challenges and opportunities**

- ◆ Panelists: Madhusudan Iyengar (IBM), Tahir Cader (HP), Kushagra Vaid (Microsoft), Amir Michael (Facebook), Mark Seymour (Future Facilities)

Liquid Cooling

- ◆ Server Liquid Cooling with Chiller-Less Data Center Design to Enable Significant Energy Savings
- ◆ Experimental Investigation of Water Cooled Server Microprocessors and Memory Devices in an Energy Efficient Chiller-less Data Center
- ◆ Experimental Characterization of an Energy Efficient Chiller-less Data Center Test Facility with Warm Water Cooled Services

WEDNESDAY MARCH 21, 2012 (Continued)

SEMI-THERM TRACK C**Fan Cooling**

- ◆ A Multiple Vibrating Fans System Using Interactive Magnetic Force and Piezo-electric Force
- ◆ Study of a Cooling System with a Piezo-electric Fan
- ◆ Modeling of Fan Failures in Networking Enclosures
- ◆ SynJet Augmented Cooling of a 1U Security Chassis

SEMI-THERM TRACK D**Heat Transfer Fundamentals II**

- ◆ Two-Layer Heat Spreading Revisited
- ◆ Heat Spreading From a Small Source on a Thin Plate
- ◆ Optimization of Thermal Performance for Scale-roughened Surface
- ◆ Design Considerations for Heat Spreader in High Heat Flux Systems

DATA CENTER TRACK B**Cooling Management**

- ◆ Achieving Energy Efficient Data Centers Using Cooling Path Management Coupled with ASHRAE Standards
- ◆ Use of Ducting to Improve Inlet Conditions for Side-to-Side Airflow Switches in Data Centers
- ◆ Effect of Perforated Tile Vent Pattern on Rack Air Flow Distribution in a Raised Floor Data Center Facility

EXHIBIT HALL OPEN 1:30-6:30PM - VENDOR WORKSHOPS 2:00 - 5:00PM - RECEPTION 6:00PM

Visit the exhibits and join us in the exhibition hall for a reception and exciting giveaways!

THURSDAY MARCH 22, 2012

(Single Track)

Thermal Aware IC Design

- ◆ Enabling Reliability-Aware Floorplanning With Fast Thermal Simulations
- ◆ Cache Leakage Power Estimation Using Architectural Model for 32 nm and 16 nm Technology
- ◆ New Simulation Approaches Supporting Temperature-Aware Design of Digital ICs

2012 THERMI Award Presentation**LED Thermal Management**

- ◆ A Step Forward in Multi-Domain Simulation of Power LEDs
- ◆ How Thermal Environment Affects OLEDs' Operational Characteristics
- ◆ An Innovative Passive Cooling Method for High Performance Light-emitting Diodes

Advances in Materials, Thermal Imaging and Validation Platforms

- ◆ High Performance Thermal Interface Materials with Enhanced Reliability
- ◆ System and Methodology of Chip Thermal Imaging Capability to Explore a Flexible and Efficient Supplement to Traditional Thermal Test Vehicle (TTV)
- ◆ Side-by-Side Comparison Between Infrared and Thermoreflectance Imaging Using a Thermal Test Chip with Embedded Diode Temperature Sensors
- ◆ Performance Improvements of Air-Cooled Thermal Tool with Advanced Technologies

Closing Ceremony and Luncheon

SEMI-THERM EXHIBITION
1:30 - 6:30PM TUESDAY, WEDNESDAY
MARCH 20 and 21, 2012

Don't miss the SEMI-THERM 28 exhibits!
The exhibit hall features over 40 vendors focused on thermal management products and services are here to discuss the newest products and solutions.

Parking vouchers, giveaways and nightly complimentary food and beverage receptions are held in the exhibit area.

Free vendor workshops are featured in the afternoons on the hour!

SPECIAL SEMI-THERM PROGRAMS**LUNCHEON SPEAKERS****Tuesday:** Status and Challenges of Meeting Global Energy Demands for 2030 Peter Rodgers, Ph.D.**Wednesday:** How We Caught the Unabomber - Terry Turchie, FBI (ret.)**EVENING TUTORIAL 6:30-8:00PM Tuesday, March 20****Thermal Challenges and Opportunities in Concentrated Photo-Voltaics - Seri Lee, Nanyang Technical University, Singapore**

In this tutorial, technical challenges and market opportunities associated with the thermal management of concentrated photovoltaics, (CPV), are examined.

**The Heat is On Symposium 2012**

MEPTEC will again join SEMI-THERM with their popular Thermal Management symposium to be held on **Monday, March 19**. Industry forecasts and roadmaps, regardless of the source, are in agreement that semiconductor devices are hot and getting hotter. This symposium will bring together a group of key speakers in the industry to share their concerns and solutions. Individuals from management to development groups to sales and marketing continue to monitor the thermal industry to look for new business opportunities. All professionals involved in or concerned about effective thermal management should attend. Visit www.MEPTEC.org.

FOR INFORMATION, DETAILS, FULL EVENT DESCRIPTIONS AND MORE, VISIT WWW.SEMI-THERM.ORG