

SEMI-THERM[®] 25

T W E N T Y - F I F T H A N N U A L

Semiconductor Thermal Measurement, Modeling and Management Symposium

March 15-19, 2009 Fairmont Hotel 170 South Market Street, San Jose, CA 95113 408-998-1900

CLICK ==> [Registration Page](#)
[Schedule, Sessions](#)
[Exhibitors Listing](#)
[Vendor Workshops](#)
[Short Courses](#)

Final Program

S E S S I O N S

Tuesday, March 17

KEYNOTE SPEAKER: Forward Looking View of High Definition Computing
– JEAN BOUFARHAT, Vice President ASIC Service and Technology, Advanced Micro Devices

SESSION 1: PANEL DISCUSSION – Thermal Market and Technology Drivers for the Future

PARALLEL SESSIONS: **SESSION 2: Two Phase Cooling**
SESSION 3: Test Methods

LUNCHEON TALK: Sustainable Information Technology Ecosystems
– CHANDRAKANT PATEL, Hewlett Packard

Wednesday, March 18

PARALLEL SESSIONS: **SESSION 4: Modeling and Simulation**
SESSION 5: Fans and Pumps
SESSION 6: Microchannel Cooling
SESSION 7: Die Level Cooling
SESSION 8: Standardization
SESSION 9: TIMs I
SESSION 10: Poster I
SESSION 11: Poster II

LUNCHEON TALK: Renewable Oil Production – HARRISON F. DILLON, Solazyme

Thursday, March 19

SESSION 12: Innovative Cooling

Significant Contributor "THERMI" Award Presentation
YOGENDRA JOSHI, Georgia Institute of Technology

PARALLEL SESSIONS: **SESSION 13: TIMs II**
SESSION 14: Package Level Cooling

EXHIBITS AND VENDOR WORKSHOPS

Tuesday and Wednesday, March 17, 18 AFTERNOON

93.7

86.4

75.9

61.4

56.5

24.6

13.7

6.7



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SEMI-THERM[®] 25

March 15-19, 2009

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Registration includes: 3 lunches, dinner on Tuesday, Vendor Reception on Wednesday, 1 copy of the Proceedings and admission to technical sessions, poster session, evening tutorials, exhibits, and vendor workshops. CD-ROM version of Proceedings is available for \$40.00.

Paying at the door: Cash, check or credit card.

Cancellation fee: Cancellations must be made prior to 5:00 p.m. Mountain Standard Time, March 11, 2009 to receive a full refund. Substitutions may be made at any time.

Persons with a disability may request reasonable accommodation, such as a sign language interpreter, by contacting ST Exhibits. Requests should be made as early as possible to allow time to arrange the accommodation.

I have the following special needs/requirements _____

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Speaker **Session Chair** **Committee**

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Circle the appropriate rate:

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Advance registration	\$760	\$840
On-site registration	\$875	\$950

Mark the Short Courses you wish to attend:

Two-day Short Course (Sun-Mon, Mar 15-16) **\$675** (per person)
Thermal Management from an Industrial Point of View
 — Clemens Lasance and Wendy Luiten

One-day Short Course (Sun, Mar 15) **\$425** (per person)
Engineering Analysis Methods Using Spreadsheets
 — Ross Wilcoxon

Two-day Short Course (Sun-Mon, Mar 15-16) **\$675** (per person)
Compact Thermal Models for Microelectronics Cooling
 — M. Michael Yovanovich

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Spreadsheet-Based Thermal Analysis
 — Ross Wilcoxon

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Reservations must be received by February 20, 2009

Room Rate: (Single or Double) \$199 per night, plus 10% hotel room tax and \$2 HBID tax. All rooms are run-of-the-house and based on availability at time of check in. After **February 20, 2009** rooms and rate are subject to availability. Specify that you are attending **IEEE SEMI-THERM** to receive the convention rate.

Check in time 3 p.m., check out time 12 noon

Room deposit: \$199 per night, plus 10% hotel room tax, will guarantee reservations.

Transportation from airport: TAXI 5 miles

Parking information: For parking information go to Website: semi-therm.org — Click on [Hotel and Regional Information](#)

Short Courses:

9 AM - 5 PM; registration at 8:30 AM

2009 Schedule of Events**Monday, March 16, 2009**

1:00 p.m. – 6:00 p.m.	<i>Exhibitor Set Up</i>	IMPERIAL BALLROOM
4:00 p.m. – 6:00 p.m.	<i>Attendee Registration</i>	MARKET STREET FOYER
6:00 p.m. – 8:30 p.m.	Program Committee Meeting / Dinner	VALLEY

Tuesday, March 17, 2009

7:00 a.m. – 5:00 p.m.	<i>Attendee Registration</i>	MARKET STREET FOYER
7:00 a.m. – 7:45 a.m.	<i>Speakers' Breakfast</i> (March 17 speakers only)	VALLEY
8:00 a.m. – 12:00 noon	<i>Exhibitor Set Up</i>	IMPERIAL BALLROOM
8:00 a.m. – 8:15 a.m.	Symposium Opening and Welcome General Chair: George Meyer, Celsia Technologies	REGENCY BALLROOM I
8:20 a.m. – 9:00 a.m.	KEYNOTE ADDRESS: Forward Looking View of High Definition Computing JEAN BOUFARHAT, AMD	REGENCY BALLROOM I
9:00 a.m. – 10:00 a.m.	SESSION 1: Panel Discussion: Thermal Market and Technology Drivers for the Future	REGENCY BALLROOM I
10:00 a.m. – 10:20 a.m.	<i>Break</i> – Sponsored by National Science Foundation	REGENCY BALLROOM FOYER
10:20 a.m. – 12:00 noon	PARALLEL SESSION 2: Two-Phase Cooling	REGENCY BALLROOM I
10:20 a.m. – 12:00 noon	PARALLEL SESSION 3: Test Methods	GOLD
12:10 p.m. – 1:30 p.m.	LUNCHEON SPEAKER: Sustainable Information Technology Ecosystems – CHANDRAKANT PATEL, Hewlett Packard	CLUB REGENT
1:30 p.m. – 6:00 p.m.	<i>Exhibits Open</i>	IMPERIAL BALLROOM
2:00 p.m. – 2:45 p.m.	VENDOR WORKSHOP – Future Facilities	GOLD
2:00 p.m. – 2:45 p.m.	VENDOR WORKSHOP – Dow Corning Corporation	CRYSTAL
3:00 p.m. – 3:45 p.m.	VENDOR WORKSHOP – Software Cradle Company	GOLD
3:00 p.m. – 3:45 p.m.	VENDOR WORKSHOP – Indium	CRYSTAL
4:00 p.m. – 4:45 p.m.	VENDOR WORKSHOP – Mentor Graphics/FLOTHERM	GOLD
4:00 p.m. – 4:45 p.m.	VENDOR WORKSHOP – Innovative Research	CRYSTAL
6:15 p.m. – 7:15 p.m.	<i>Dinner</i>	CLUB REGENT
7:30 p.m. – 9:00 p.m.	EVENING TUTORIAL: Making Sense of Recent Research in Temperature-Aware Design KEVIN SKADRON, University of Virginia, Charlottesville, VA	REGENCY BALLROOM I

Wednesday, March 18, 2009

7:00 a.m. – 5:00 p.m.	<i>Attendee Registration</i>	MARKET STREET FOYER
7:00 a.m. – 7:45 a.m.	<i>Speakers' Breakfast</i> (March 18 speakers only)	VALLEY
8:00 a.m. – 9:00 a.m.	PARALLEL SESSION 4: Modeling and Simulation	REGENCY BALLROOM I
8:00 a.m. – 9:00 a.m.	PARALLEL SESSION 5: Fans and Pumps	GOLD
9:00 a.m. – 10:00 a.m.	PARALLEL SESSION 6: Microchannel Cooling	REGENCY BALLROOM I
9:00 a.m. – 10:00 a.m.	PARALLEL SESSION 7: Die-Level Cooling	GOLD
10:00 a.m. – 10:20 a.m.	<i>Break</i> – Sponsored by National Science Foundation	REGENCY BALLROOM FOYER
10:20 a.m. – 11:20 a.m.	PARALLEL SESSION 8: Standardization	REGENCY BALLROOM I
10:20 a.m. – 11:20 a.m.	PARALLEL SESSION 9: Thermal Interface Materials I	GOLD
11:20 a.m. – 11:30 a.m.	<i>Break</i>	REGENCY BALLROOM FOYER
11:30 a.m. – 12:00 noon	PARALLEL SESSION 10: Poster Session I	REGENCY BALLROOM I
11:30 a.m. – 12:00 noon	PARALLEL SESSION 11: Poster Session II	GOLD
12:00 p.m. – 1:30 p.m.	LUNCHEON SPEAKER: Renewable Oil Production – HARRISON F. DILLON, Solazyme Inc.	CLUB REGENT
1:30 p.m. – 6:30 p.m.	<i>Exhibits Open</i>	IMPERIAL BALLROOM
2:00 p.m. – 3:30 p.m.	Poster Papers	IMPERIAL BALLROOM
2:00 p.m. – 2:45 p.m.	VENDOR WORKSHOP – Metal Matrix Cast Components	GOLD
3:00 p.m. – 3:45 p.m.	VENDOR WORKSHOP – Mentor Graphics/TERALED	GOLD
5:15 p.m. – 6:30 p.m.	<i>Exhibitor Reception / 25th Anniversary Celebration</i>	IMPERIAL BALLROOM

Thursday, March 19, 2009

7:00 a.m. – 12:00 noon	<i>Attendee Registration</i>	REGENCY BALLROOM FOYER
7:00 a.m. – 7:45 a.m.	<i>Speakers' Breakfast</i> (March 19 speakers only)	VALLEY
8:00 a.m. – 9:40 a.m.	SESSION 12: Innovative Cooling	REGENCY BALLROOM I
9:40 a.m. – 10:20 a.m.	Significant Contributor "THERMI" Award Presentation: Professor Yogendra Joshi, Georgia Institute of Technology	REGENCY BALLROOM I
10:20 a.m. – 10:40 a.m.	<i>Break</i>	REGENCY BALLROOM FOYER
10:40 a.m. – 12:00 noon	PARALLEL SESSION 13: Thermal Interface Materials II	REGENCY BALLROOM I
10:40 a.m. – 12:00 noon	PARALLEL SESSION 14: Package Level Cooling	GOLD
12:00 Noon – 2:00 p.m.	<i>Awards Luncheon</i> – Presentation of THERMI and Harvey Rosten Awards	CLUB REGENT
2:30 p.m. – 4:30 p.m.	Post SEMI-THERM Committee Meeting	CRYSTAL

Friday, March 20, 2009

8:30 a.m. – 5:00 p.m.	JEDEC JC-15 Meeting	HOLIDAY INN, SAN JOSE
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SEMI-THERM Office: TERRACE ROOM

SEMI-THERM Committee Meeting Room: PLAZA ROOM

PROGRAM

Tuesday, March 17

8:00 SYMPOSIUM OPENING AND WELCOME

GENERAL CHAIR: George Meyer, Celsia Technologies

8:20 KEYNOTE ADDRESS

Forward Looking View of High Definition Computing

Jean Boufarhat, Vice President ASIC Service and Technology, Advanced Micro Devices

SESSION 1 – PANEL DISCUSSION

9:00 **Thermal Market and Technology Drivers for the Future**MODERATORS: Gamal Refai-Ahmed, Advanced Micro Devices, Canada
Dereje Agonafer, University of Texas at Arlington10:00 *BREAK* — Sponsored by National Science FoundationPARALLEL SESSION 2: **Two-Phase Cooling**

SESSION CHAIR: Sharon Adam, Infinera, USA

10:20 **Effect of Inlet Orifice on Saturated CHF and Flow Visualization in Multi-microchannel Heat Sinks**

Jung Eung Park and John R. Thome

.....Polytechnique Fédérale de Lausanne, Switzerland
Bruno Michel . . . IBM Zurich Research Laboratory, Switzerland

KEYNOTE ADDRESS

Tuesday, March 17

Forward Looking View of High Definition Computing

Jean Boufarhat, Vice President ASIC Service and Technology, Advanced Micro Devices

Mr. Jean Boufarhat is Vice President of AMD's ASIC Service and Technology, a central engineering organization supporting AMD's high-performance Graphics and Chipset products. His organization is also responsible for Analog/Mixed-Signal design and ASIC Physical Design, including PCI Express integration, display and video technology development, as well as ASIC packaging technology. In his current position, his organization has developed the highest performance series of graphics processor based on 55nm process and the graphics processors for Xbox and Wii. Prior to joining AMD in 2008, Mr. Boufarhat spent ten years at LSI where he was Vice President of IP Solutions. Before his last role at LSI, Mr. Boufarhat held various management positions in IP development, high-speed mixed-signal design and design methodology. In addition, Mr. Boufarhat held various engineering and management positions at Symbios, AT&T and NCR. Mr. Boufarhat has B. Sc. and M. Sc. Degrees in electrical engineering from the University of North Carolina at Charlotte.



10:40 **Sub-Atmospheric Pressure Pool Boiling of Water on a Screen Laminate-Enhanced Extended Surface**
Paul Laca and R. A. Wirtz . . . University of Nevada Reno, USA

11:00 **A Condensate-Less Design of Cold Plate in Vapor-compression System Applicable to High-end Computing**

Yu-Lieh Wu . . National Chin-Yi University of Technology, Taiwan
Kai-Shing Yang, Shih-Jie Lin, Wen-Ruey Chang and Chi-Chuan Wang Industrial Technology Research Institute, Taiwan

PANEL DISCUSSION

Tuesday, March 17

Thermal Market and Technology Drivers for the Future

This event marks the 25th anniversary of the SEMI-THERM Symposium. With this in mind, and with support by the National Science Foundation's "Grand Challenges in Thermal Management of Electronics: From Devices to Systems" activity, the SEMI-THERM Technical Committee has organized a Panel Discussion on future trends in electronics cooling. This panel won't attempt to predict what will happen in the electronics industry in the next quarter century; instead it will identify trends likely to impact our industry over the next 5-10 years. The panel includes experts from industry (AMD, HP, Sun Microsystems, Pipeline Micro and Rockwell Collins), government agencies (DARPA and Office of Naval Research) and academia (University of Texas at Arlington and Stanford University). SEMI-THERM attendees are highly encouraged to participate in the open discussion that follows the panelists' presentations and will likely continue well into the NSF-sponsored coffee break following the Panel Discussion:

Moderators:

Gamal Refai-Ahmed, AMD Fellow, Graphics Products Group, Advanced Micro Devices

Dereje Agonafer, Professor, Director Electronics, MEMS & Nanoelectronics Systems Packaging Center, University of Texas at Arlington

Panelists:

Thomas Kenny, Professor, Department of Mechanical Engineering, Stanford University, On Leave to serve as Program Manager, Microsystems Technology Office, DARPA

Mark S. Spector, Program Officer, Ships and Engineering Systems Division Office of Naval Research

Chandrakant Patel, Fellow & Director, Sustainable IT Ecosystem Laboratory, Hewlett Packard

Bruce Guenin, Sr. Staff Engineer, Sun Microsystems, Microelectronics Group, San Diego, CA

Seri Lee, Chief Technical Officer, Pipeline Micro

Ross Wilcox, Rockwell Collins, Principal Mechanical Engineer, Advanced Technology Center, Rockwell Collins

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PROGRAM

- 11:20 Stability Analysis of Refrigeration Systems for Electronics Cooling**
Tiejun Zhang, John T. Wen, Juan Catano, Rongliang Zhou, Greg Michna, Yoav Peles, and Michael K. Jensen
.....Rensselaer Polytechnic Institute, USA
- 11:40 Thin Vapor Chamber Heat Sink and Embedded Heat Pipe Heat Sink Performance Evaluations**
Garrett Glover and Herman ChuCisco Systems, Inc., USA
Yongguo Chen and Annie LuoCisco Systems, Inc., China

PARALLEL SESSION 3: **Test Methods**

SESSION CHAIR: Marta Rencz, MicReD, Hungary

- 10:20 Methodology for Thermal and Electrical Characterization of Large Area OLEDs**
A. PoppeMentor Graphics MicReD Division, and
Budapest University of Technology (BME), Hungary
L. Pohl, E. Kollár and Zs. Kohári
.....Budapest University of Technology (BME), Hungary
H. Lifka and C. Tanase
.....Philips Research Laboratories, the Netherlands
- 10:40 Transient Thermal Imaging of Pulsed-Operation Superlattice Micro-Refrigerators**
J. Christofferson, Y. Ezzahri, K. Maize and A. Shakouri
.....University of California Santa Cruz, USA
- 11:00 Thermal Characterization of High Power Transistor Arrays**
Kerry Maize, Xi Wang, Dustin Kendig and Ali Shakouri
.....University of California Santa Cruz, USA
William French, Barry O'Connell, Philip Lindorfer
and Peter HopperNational Semiconductor, USA
- 11:20 Do You Really Know the Thermal Conductivity of Your Boards?**
Mohsen EsmailpourTeradyne Inc. and UCLA School
of Mechanical Engineering, USA
- 11:40 Thermal Load Boards – Another Thermal Management Design Tool**
Bernie Siegal, Thermal Engineering Associates, Inc. USA
- 12:00 LUNCH**
- LUNCHEON SPEAKER**
Sustainable Information Technology Ecosystems
Chandrakant Patel, Hewlett Packard
- 1:30–6:00 Exhibits Open**
- 2:00–5:00 Vendor Workshops**
- 7:30 EVENING TUTORIAL**
Making Sense of Recent Research in Temperature-Aware Design
Kevin Skadron, University of Virginia

LUNCHEON SPEAKER

Tuesday, March 17**Sustainable Information Technology Ecosystems****Chandrakant Patel**, Fellow & Director, Sustainable IT Ecosystem Laboratory, Hewlett Packard, Palo Alto, CA

Chandrakant Patel is an HP Fellow and director of the Sustainable IT Ecosystem Lab. At HP Labs, Patel pioneered a holistic approach to power and cooling that encompasses everything from the chip to the data center. Patel joined HP Labs in 1991, initially leading the cooling and packaging research of the 'wide word' microprocessor. Patel also has taught computer-aided design as an adjunct faculty member at Chabot College in Hayward, Calif., and undergraduate and graduate-level thermal management courses at University of California, Berkeley Extension, Santa Clara University and San Jose State University. A senior member of IEEE, he has authored many refereed journal and conference papers in the area of electronics cooling and has been granted more than 95 U.S. patents.

EVENING TUTORIAL

Tuesday, March 17**Making Sense of Recent Research in Temperature-Aware Design****Kevin Skadron**, University of Virginia, Charlottesville, VA

ABSTRACT: The past few years have seen an explosion of published work on temperature-aware design at the same time that architectures are becoming increasingly multi-core and process variations are becoming more severe. Proposed solutions have included temperature-aware layout, power-management, runtime thermal throttling, core hopping, various temperature-sensing schemes, and even reliability "management." This tutorial will summarize the most important developments and distill a few broad lessons.

BIOGRAPHY: Kevin Skadron is an associate professor of computer science at the University of Virginia, where he has been on the faculty since 1999. For 2007-2008, he was a Visiting Professor with NVIDIA Research. Skadron received his Ph.D. in Computer Science from Princeton University, and his BS and BA degrees in Computer Engineering and Economics from Rice University. Skadron's research interests focus on physical design challenges and programming models for multicore and manycore architectures, including graphics architectures. To support research in these areas, he and Mircea Stan led the development of HotSpot and HotLeakage, for pre-RTL modeling of thermal and leakage effects. He is a senior member of the IEEE and ACM, co-founder of IEEE Computer Architecture Letters, and Secretary-Treasurer of ACM SIGARCH.

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PROGRAM

Wednesday, March 18

PARALLEL SESSION 4: Modeling and Simulation

SESSION CHAIR: Greg Xiong, NetApp, USA

- 8:00 **The Better Box Model: an Analytical Estimation of Temperature and Flow in a Free Convection Air-Cooled Electronics Enclosure**
Wendy Luiten and Simon Kadijk
.....Philips Applied Technologies, the Netherlands
- 8:20 **Validation and Sensitivity Analysis of an Image Processing Technique to Derive Thermal Conductivity Variation within a Printed Circuit Board**
Byron BlackmoreMentor Graphics Corporation, Canada
- 8:40 **Detailed Thermal Modeling of High Powered LED's**
G. ScheeperNorth-West University, South Africa
J. A. VisserQfinsoft Technologies Inc., Canada

PARALLEL SESSION 5: Fans and Pumps

SESSION CHAIR: Herman Chu, Cisco Systems, USA

- 8:00 **High Efficiency Electronic Cooling Fans**
Norman SmithAmetek/Rotron Division, USA
- 8:20 **Numerical and Experimental Studies of a One-Side Actuating Micropump with Piezoelectric Effect**
H.K. Ma and B. R. ChenNational Taiwan University, Taiwan
- 8:40 **The Influence of Cooling Requirements, Chassis Resistance, and Fan Selection on Noise Emission**
David A. NelsonNelson Acoustics, USA

PARALLEL SESSION 6: Microchannel Cooling

SESSION CHAIR: Wendy Luiten, Philips, the Netherlands

- 9:00 **Pressure Drop for Laminar Flow in Microchannels of Arbitrary Cross-Sections**
Zhipeng Duan and M. M. Yovanovich
.....University of Waterloo, Canada
- 9:20 **Frictional and Collector Pressure Losses in Rectangular Microchannels**
Tom Saenen, Tim Persoons, Jan Peirs, and Martine BaelmansKatholieke Universiteit Leuven, Belgium
Tim PersoonsTrinity College, Ireland
- 9:40 **Fabrication and Performance of Tree-Branch Microchannels in Silicon Carbide for Direct Cooling of High-Power Electronics Applications**
Jason A. Carter, Lucas A. Forster and Mark D. Stitt
.....Pennsylvania State University, USA

PARALLEL SESSION 7: Die-Level Cooling

SESSION CHAIR: Yan Zhang, Tessera, USA

- 9:00 **Thermo-Mechanical Reliability Considerations with Dynamic Voltage/Frequency Scaling in Microprocessor Applications**
Sai Ankireddi and David CopelandSun Microsystems Inc., USA
- 9:20 **CPU Dynamic Thermal Management via Thermal Spare Cores**
M. A. Elsawaf, H. A. Fahmy and A. L. Elshafei
.....Cairo University, Egypt

PROGRAM

9:40 Real Time Temperature Monitoring of ICs with Boundary Temperature Scan
Marcin Janicki, Michal Szermer, Piotr Pietrzak and Andrzej Napieralski Technical University of Lodz, Poland

10:00 BREAK – Sponsored by National Science Foundation

PARALLEL SESSION 8: **Standardization**

SESSION CHAIR: Dave Saums, DS&A LLC, USA

10:20 On the Standardization of Thermal Characterization of LEDs
András PoppeMentor Graphics MicReD Division, Hungary
Clemens J.M. Lasance
. Philips Research Laboratories, the Netherlands

10:40 Preliminary Specification for a Closed Loop Liquid Cooling System Product Reliability Test Plan
Margaret Stern, David Copeland, Marlin Vogel, John Dunn, Don Kearns and Steve LindquistSun Microsystems, USA

11:00 Experimental Techniques for Thermo-mechanical Design in Silicon Validation Platforms
Rahima K. Mohammed, Yi Xia, Ying - Feng Pang, Mohanraj Prabhugoud and Ridvan A. SahanIntel Corporation, USA

PARALLEL SESSION 9: **Thermal Interface Materials I**

SESSION CHAIR: Guy Wagner, Storage Genetics / Electronic Cooling Solutions, USA

10:20 How to Evaluate Transient Dual Interface Measurements of the Rth-JC of Power Semiconductor Packages
Dirk Schweitzer, Heinz Pape, Rudolf Kutscherauer and Martin WalderInfineon Technologies, Germany

10:40 Indium Solder as a Thermal Interface Material Using Fluxless Bonding Technology
Tanawan Chaowasakoo, Teng Hoon Ng and Jinda SongninluckCelestica, Thailand
Margaret B.Stern and Sai Ankireddi . . .Sun Microsystems, USA

11:00 Indium Thermal Interface Material Development for Microprocessors
Sean S. Too, Maxat Touzelbaev, Mohammad Khan, Raj Master and Jacquana DiepAdvanced Micro Devices, Inc., USA
Kee-Hean KeokAdvanced Micro Devices Export Sdn Bhd, Malaysia

11:20 BREAK

PARALLEL SESSION 10: **Poster Session I**

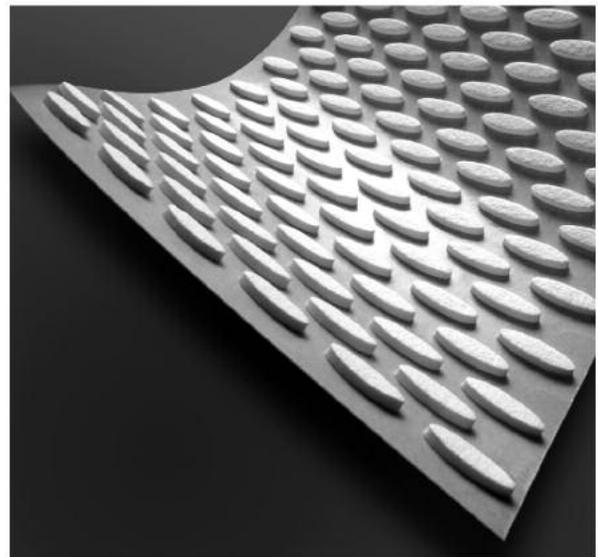
SESSION CHAIR: Marcelle Ibrahim, Raytheon Company, USA

11:30 Optimal Heat Transfer Criterion and Inclination Angle Effects on Non-boiling Regime Spray Cooling
Yong-xian GUO and Jian-yuan JIAXidian University, China
Zhi-fu ZHOUXi'an Jiaotong University, China
Shao-rong ZHOUIntel, China

Nozzle Track and CHF Prediction of Spray Cooling for Inclined Sprays

Yong-xian GUO, Jian-yuan JIA, Jian-tao CHANG and Huan-ling LIUXidian University, China
Shao-rong ZHOUIntel, China

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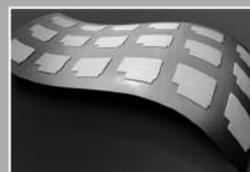


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PROGRAM

Boundary-Condition-Independent Reduced-Order Modeling of Complex 2D Objects by POD-Galerkin Methodology

Arun Prakash Raghupathy, Urmila Ghia and Karman Ghia
University of Cincinnati, USA
 William MaltzElectronic Cooling Solutions Inc., USA

Acoustics Management for Server Debug Validation Platforms

Arunima Panigrahy, Ying Feng Pang and Rahima Mohammed
Intel Corporation, USA

PARALLEL SESSION 11: **Poster Session II**

SESSION CHAIR: Rahima Mohammed, Intel, USA

11:30 Thermal Design Considerations of Air-Cooled High-Powered Telecommunication Cabinets

Feroz Ahamed Iqbal Mariam, Uthaman Raju, Veerendra Muly and Dereje AgonaferThe University of Texas at Arlington, USA
 Deepak Sivanandan and Mark Hendrix
CommScope Solutions Inc., USA

A Novel Copper Bead Heat Sink for Computer Cooling

Meng-Chang Tsai, Shung-Wen Kang and Chih-Hsien Lin
Tamkang University, Taiwan

Adaptive Multiple Cooling Surfaces Compact Thermal Model (CTM), and Boundary Condition Independent Multiple Heat Sources CTM

Patrick Tounsi, Jean-Baptiste Sauveplane, Jerzy Piotr Nowakowski, Francesc Madrid and Jean-Marie-Dorkel
CNRS; LAAS, France
 Patrick Tounsi and Jean-Marie-Dorkel
Université de Toulouse, France
 Jerzy Piotr NowakowskiUniversity of Naples "Federico II"; Naples, Italy

Theoretical Evaluation and Experimental Investigation of Microencapsulated Phase Change Materials (MPCM) in Electronics Cooling Applications

Pramod Chamorthy and Yogen Utturkar
GE Global Research Center, USA

Sub-Atmospheric Pressure Pool Boiling of Water on a Screen Laminate-Enhanced Surface

Alison Sloan, Sean Penley and R. A. Wirtz
University of Nevada Reno, USA

12:00 LUNCHEON

LUNCHEON SPEAKER

Renewable Oil Production – Harrison F. Dillon, Solazyme Inc.

1:30–6:30 Exhibits Open

2:00–4:00 Vendor Workshops

5:15–6:30 EXHIBITOR RECEPTION – **25th Anniversary**

LUNCHEON SPEAKER

Wednesday, March 18

Renewable Oil Production

Harrison F. Dillon

President & CTO, Solazyme Inc., South San Francisco, CA

Dr. Dillon is a co-founder of Solazyme. His scientific training in the field of microbial genetics began in the Microbiology and Immunology Department at Emory University. His later research, including X-ray crystallography and quantitative trait loci characterization, was performed under the direction of Dr. Jean-Marc Lalouel, a Howard Hughes Investigator and Professor of Human Genetics at the University of Utah, where Dr. Dillon received his Ph.D. in genetics.

Dr. Dillon formerly managed the biotechnology patent portfolio of the University of Utah in the University's Technology Transfer Office. Dr. Dillon received a J.D. cum laude from Duke University School of Law and is licensed to practice before the United States Patent and Trademark Office. He is a member of the State Bar of California and has worked as an Associate in the Biotechnology Group at Townsend and Townsend and Crew. Dr. Dillon has authored articles in scientific, business, and legal journals.

THERMI AWARD

Thursday, March 19

Yogendra Joshi, G.W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology

Yogendra Joshi is Professor of Mechanical Engineering, with a joint appointment in the School of Electrical and Computer Engineering at Georgia Tech. He is a founding Co-Director of the Consortium for Energy Efficient Thermal Management (CEETHERM), and serves as the Theme Leader for Thermal Management and Power Delivery for the multi-university DARPA/MARCO Interconnect Focus Center. He is the author or co-author of over one hundred journal articles and numerous conference papers. He is an elected Fellow of ASME and the American Association for the Advancement of Science. He has served as an academic advisor to forty eight graduate students. He served as Special Section Guest Editor for the IEEE Components and Packaging Technology journal.



PROGRAM

Thursday March 19

SESSION 12: Innovative Cooling

SESSION CHAIR: Hongyu Ran, Tessera, USA

- 8:00 Synthetic Jet Cooling Using Asymmetric Acoustic Dipoles**
Clemens J.M. Lasance, Celine Nicole, Ronald M. Aarts, Okke Ouweltjes and Gerben Kooijmanand
.....Philips Research Laboratories, the Netherlands
Ronald M. AartsEindhoven University of Technology, the Netherlands
Joris NieuwendijkPhillips (Retired)
- 8:20 Electrohydrodynamic (EHD) Cooled Laptop**
N. E. Jewell-Larsen, H. Ran, Y. Zhang, M. K. Schwiebert and K. A. HonerTessera, USA
A. V. MamishevUniversity of Washington, USA
- 8:40 Study of an LED Device with Vibrating Piezoelectric Fins**
H.K. Ma, B. R. Chen, H.W. Lan and K.T. Lin
.....National Taiwan University, Taiwan
C.Y. ChaoOutstanding Electronics Manufacturer Co., Ltd, USA, Taiwan
- 9:00 A Thermoelectric Air-Liquid Cooling System for Electronic Devices: Model, Performance and Analysis**
Dazhi Wang and Doug CraneBSST LLC, USA
- 9:20 Characterization of Fiber Accumulation Fouling in Fine Pitched Heat Sinks**
David A. MooreHewlett Packard, USA
- 9:40 THERMI AWARD: Significant Contributor**
Yogendra Joshi, Georgia Institute of Technology
- 10:20 BREAK**

PARALLEL SESSION 13: Thermal Interface Materials II

SESSION CHAIR: Dave Saums, DS&A LLC, USA

- 10:40 Impact of Temperature-dependent Die Warpage on TIM1 Thermal Resistance in Field Conditions**
Yizhang Yang, Zhen Zhang, and Maxat Touzelbaev
.....Advanced Micro Devices, Inc., USA
- 11:00 Interaction between TIM1 and TIM2 for Mechanical Robustness of Integrated Heat Spreader**
Andrew Kearney, Li Li and Sean Sanford
.....Cisco Systems, Inc., USA
- 11:20 Performance Characterization of Pressure Sensitive Adhesive Thermal Interface Materials**
Herman Chu and Anusha SelvakumarCisco Systems, Inc., USA
- 11:40 Flow-induced Spatial Non-uniformity and Anisotropy in Electrically Conductive Adhesives**
Brian Smith, Alexander Bonetti, Tobias Gnos and Bruno Michel
.....IBM, Switzerland

PARALLEL SESSION 14: Package Level Cooling

SESSION CHAIR: Heinz Pape, Infineon, Germany

- 10:40 Thermal Characterization of Package-on-Package (POP)**
Morris Bowers and Yeong J. LeeMotorola Inc., USA
Bennett JoinerFreescale Semiconductor, Inc., USA
Niranjan VijayaragavanSpansion Inc., USA
- 11:00 Decoupled Package-on-Package Thermal Characterization**
Jesse E. Galloway and Moody DreizaAmkor Technology, USA
- 11:20 Thermal Resistance Measurements of Interconnections, for the Investigation of the Thermal Resistance of a Three-Dimensional (3D) Chip Stack**
Keiji Matsumoto and Yoichi Taira
.....IBM Tokyo Research Laboratory, Japan
- 11:40 Thermal Design Optimization of a Package-on-Package**
Abhilash R. Menon, Saket Karajgikar and Dereje Agonafer
.....The University of Texas at Arlington, USA
- 12:00 AWARDS LUNCHEON**
Presentation of THERMI and Harvey Rosten Awards

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Harvey Rosten was a special friend to all of us at SEMI-THERM. On this our 25th anniversary, we continue to honor his legacy and great achievements by presenting this prestigious award to:

R. J. LINDERMAN, T. BRUNSCHWILER, U. KLOTER, H. TOY, B. MICHEL

for the following paper:

Hierarchical Nested Surface Channels for Reduced Particle Stacking and Low-Resistance Thermal Interfaces

presented at the 23rd SEMI-THERM Symposium in San Jose, CA, in March 2007

Ryan J. Linderman completed his B.S., M.S., and Ph.D. degrees at the University of Colorado at Boulder in Mechanical Engineering with a focus in MEMS electrostatic actuators. After finishing his research in Colorado he started a Post-doc position at the Swiss Federal Institute of Technology, ETH in Zurich Switzerland with Prof. Christofer Hierold's Micro and Nanosystems Chair where he helped secure funding and guide new Ph.D. students in their research of carbon nanotube and polymer MEMS projects. He then moved into corporate R&D with the IBM Zurich Research Laboratory in Switzerland working with the Advanced Thermal Packaging group studying thermal interfaces and oscillating flow liquid cooling systems. In 2008 he returned to the United States to pursue an interest in high concentration photovoltaics with the IdeaLab! startup, Energy Innovations, in Pasadena, California.

Thomas Brunschwiler joined IBM Research in 2001 and is currently a member of the advanced thermal packaging team at the IBM Zurich Research Lab in Switzerland.

Since 2003, he has focused his efforts on micro-scale heat transfer and improved high performance thermal interfaces with micro channel patterning. He has also demonstrated nature-inspired jet-impingement concepts.

Mr. Brunschwiler is currently pursuing his Ph.D. at the Technical University of Berlin, Germany in electrical engineering. In the context of his thesis, he focuses on exploring liquid cooling solutions for 3D chip stacks, in particular interlayer convective heat removal.

Urs Kloter was born in Männedorf, Switzerland. He received the Technician degree in mechanical engineering from the Berufsschule Zürich, Zürich, Switzerland, in 1974. After completing his diploma, he first worked as a Processing and Engineering Technician at Faselec, Zürich, and then at Gretag, Regensdorf, Switzerland, focusing on the development of optical thin-film filters. At the IBM Research Laboratory, Zurich, he first joined the Photonics Group, working on the development of tunable planar waveguide circuits, and later the Micro Contact Printing Group. As member of the Advanced Thermal Packaging

Team he contributed to fabrication of high-performance coolers and thermal interfaces. In the latter project he focussed on wafer and material processing as well as design and fabrication of hierarchical nested channel structures in diverse materials. He currently works in the model shop providing advanced cooling equipment for data centers with reduced emission.

Hilton Toy is a Semiconductor Process Integration Engineering Prof within the IBM Systems & Technology Group.

Mr. Toy joined IBM in 1982 and is currently working in the thermal and mechanical design group in East Fishkill, NY. Since 1990 he has been working in product development on module encapsulation and cooling solutions for electronic packaging.

Mr. Toy received his BS in mechanical engineering from Polytechnic Institute of NY and has co-authored several technical papers and holds 36 patents.

Bruno Michel is currently a manager of Advanced Thermal Packaging at the IBM Zurich Research Laboratory. In this role he works on scanning probe microscopy and its applications to molecules and thin organic films. Prior to this research, he introduced micro-contact printing and led an international industry project for the development of accurate large-area soft lithography for the fabrication of LCD displays.

Dr. Michel started the Advanced Thermal Packaging group at the IBM in 2003 in response to the needs of the industry for improved thermal interfaces and better miniaturized convective cooling. His current focal areas include microtechnology/microfluidics for nature inspired miniaturized tree-like hierarchical supply networks, hybrid liquid/air coolers, 3D packaging, and thermophysics to understand heat transfer in nanomaterials and structures. With the high-performance coolers he contributes to improved data-center efficiency and energy re-use in future green data-centers.

Bruno Michel received a Ph.D. degree in bio-chemistry/biophysics from the University of Zurich, Switzerland in 1988.



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SHORT COURSE #1 – TWO DAYS (9 AM - 5 PM; registration at 8:30 AM)

Sunday–Monday, March 15–16

Thermal Management from an Industrial Point of View

Presenters: Clemens Lasance and Wendy Luiten

High temperatures have a negative influence on performance, reliability and safety. Miniaturization and/or integration of more and more functionality in products cause a significant increase in power density and therefore higher temperature levels in electronic products. Additionally, the booming business of LED-based applications calls for a change in thermal management philosophy within the lighting business. Because early knowledge of potential thermally-related problems is imperative to reduce redesigns and time-to-market, thermal management should be integrated in the product design process at the earliest possible stage.

SHORT COURSE #2 – ONE DAY

Sunday, March 15 (9 AM - 5 PM; registration at 8:30 AM)

Engineering Analysis Methods Using Spreadsheets

Presenter: Ross Wilcoxon

This one day course focuses on providing the attendee with an understanding of how to set up a spreadsheet to generate and/or analyze engineering data. Beginning with an overview/review of spreadsheet fundamentals, the course will establish a methodology for creating and utilizing spreadsheets for easily identifying significant parameters in a data set. The basic concepts used to analyze existing data will be extended to allow spreadsheets to be used as fundamental analysis tools that can perform finite difference analysis, numerical integration, etc. The course will include four sub-sessions that will cover the following:

- Spreadsheet fundamentals overview
- Inputs/outputs through the use of forms, conditional formatting, effective charts, and simple macros
- Efficient methods for complex data analysis
- Using spreadsheets for engineering analysis for numerical integration, Monte Carlo analysis, etc.

SHORT COURSE #3 – TWO DAYS

Sunday–Monday, March 15–16 (9 AM - 5 PM; registration at 8:30 AM)

Compact Thermal Models for Microelectronics Cooling

Presenter: Professor M. Michael Yovanovich

This two day course will cover the development of accurate compact thermal, hydrodynamic and mechanical models for microelectronics cooling and thermal control applications.

The fundamentals of steady and transient conduction, internal and external natural convection, internal and external forced convection, and micro-contact mechanics will be reviewed.

SHORT COURSE #4 – ONE DAY

Monday, March 16 (9 AM - 5 PM; registration at 8:30 AM)

Spreadsheet-Based Thermal Analysis

Presenters: Ross Wilcoxon

This one day course will provide the attendee with a basic methodology for performing a range of thermal management analyses. One of the primary goals of this course will be to provide thermal analysts with a set of tools for doing preliminary work that may be done more quickly and effectively than it would be done with more complex finite difference or finite element tools. This course will include four sub-sessions that will cover the following:

- Overviews of basic thermal management concepts and spreadsheet fundamentals
- Thermo-fluid analysis of an air cooled electronics chassis
- Thermal analysis of a complex system with multiple thermal paths.
- General thermal analysis topics such as modeling transient behavior, Monte Carlo methods, etc.

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www.mayahtt.com

Fax 514-369-4200

Founded in 1982, MAYA HTT Ltd (MAYA Heat Transfer Technologies Ltd) is a leading supplier of advanced thermal and fluid flow analysis software, structural analysis software, mechanical vibration test data acquisition software and related training and consulting services in mechanical engineering.

MENTOR GRAPHICS – MECHANICAL ANALYSIS DIVISION

300 Nickerson Road
Marlborough, MA 01752 USA
508-357-2012
www.flomerics.com

Fax 508-357-2013

FLOTherm is a powerful 3D-CFD simulation software for thermal design of electronic components and systems. FLO/PCB is an analysis tool for thermal design of printed-circuit boards. T3Ster (Trister) is an advanced thermal tester for thermal characterization of semiconductor chip packages which uses smart implementation of the JEDEC static-test method JESD51-1.

METAL MATRIX CAST COMPOSITES

101 Clematis Avenue
Waltham, MA 02453 USA
781-893-4449
www.mmccinc.com

Fax 781-893-7230

Metal Matrix Cast Composites, LLC manufactures highly loaded MMC's using ceramic particulate and graphite fiber reinforcements in non-ferrous matrices. Our materials provide performance enhancements over traditional metal components that are unable to keep pace with emerging market demands.

MINTEQ INTERNATIONAL

640 N. 13th St.
Easton, PA 18042 USA
610-250-3398
www.pyrographite.com

Fax 610-250-3325

Minteq is the premier supplier of engineered refractory lining systems, metallurgical wire products, bulk calcium and calcium alloy products, refractory measurement systems, and advanced carbon products.

MOMENTIVE PERFORMANCE MATERIALS

22557 West Lunn Road
Strongsville, OH 44149 USA
440-878-5700
www.momentive.com

Fax 440-878-5928

Momentive Performance Materials offers a family of thermal management products for today's high power electronics, ranging from PolarTherm[®] boron nitride powders to highly-conductive TPG[®] thermal pyrolytic graphite materials and composites. PolarTherm boron nitride powders offer a unique combination of thermal, electrical, and mechanical properties that make them excellent candidates for use in a range of thermal management materials, including gap fillers and underfills, potting and molding compounds, silicone and other compliant pads, liquid encapsulants, and compounded thermoplastics. Highly-conductive TPG thermal pyrolytic graphite materials and TC1050[®] thermal cores offer solutions for high performance heat spreading and dissipation requirements. These passive technologies, exhibiting thermal conductivities from 2.5 to 4 times that of copper, can provide unique solutions for high performance heat spreading and dissipation needs. *PolarTherm, TPG, and TC1050 are trademarks of Momentive Performance Materials, Inc.

NOISE LIMIT, INC.

2154 Green Acres Lane
Morgan Hill, CA 95037 USA
650-450-6080
www.noiselimit.com

Fax 408-776-7693

Noise Limit Inc. was founded to create the next generation of high performance CPU-cooling solutions that are reliable, flexible and low noise. In confined spaces or over distances, the SILENTFLUX design has the unique ability to move large amounts of heat from a single or multiple sources without the aid of a mechanical pump. The patent-pending design uses an innovative lightweight hermetically-sealed aluminum tubing to cool electronic components for consumer-based systems, such as home entertainment and gaming machines, as well as custom implementations, such as workstations, servers, all-in-one computers and other small format PCs. Founded in 2000, Noise Limit is a privately held, venture capital funded company with offices in Cupertino, CA, USA, and Taipei, Taiwan.

2009 Exhibitor Listing

RADIAN HEATSINKS

2160 Walsh Avenue
Santa Clara, CA 95050 USA
408-988-6200 Fax 408-988-0683
www.radianheatsinks.com

Radian understands thermal design - as well as how to optimize manufacturing processes for your particular thermal needs. We know there are many different thermal problems, our experienced engineers and production specialists will work with you to find a solution to your thermal needs. We have a range of products from mini heatsinks to large CPU coolers. We also have several options to secure our heatsinks to your PC Boards: Ez Snap™ clips don't require that holes be drilled in your PC Boards and they reduce assembly cost at the board level by eliminating complex installations and special board modifications; our unique pressure sensitive hook designed Push Pins allows the heatsink to be easily secured to the PC Board; and our thermal tape which allows for easy, and fast heatsink placement.

SAINT-GOBAIN PERFORMANCE PLASTICS

717 Plantation St.
Worcester, MA 01065 USA
508-736-1489 Fax 508-852-3759
www.thermacool.saint-gobain.com

Heat is the enemy of performance in microprocessors and other electronic systems. Saint-Gobain Performance Plastics ThermaCool® thermal interface products are designed to efficiently manage heat build-up while keeping customer assembly costs to a minimum. The ThermaCool® product line - thermally conductive insulators and adhesive tapes, gap fillers and phase change materials - allows your components to perform at the upper limits of their operating range for longer periods of time. ThermaCool® gives you the freedom to push the envelope on your next-generation concepts without worrying about the impact on the manufacturing process.

SHIN-ETSU MICRO-SCI

10028 S 51st St.
Phoenix, AZ 85044 USA
480-893-8898 Fax 480.893.8637
www.microsi.com

Shin-Etsu MicroSi- Inc.- together with our parent company Shin-Etsu Chemical Co.- Ltd. represent world-class leadership in the development and manufacture of specialty materials for the semiconductor industries. Our product lines are specifically designed to address today's photolithography- packaging and flexible printed circuit requirements.

SOFTWARE CRADLE CO. LTD

493 Joshi Research Center, 3640 Colonel Glenn Hwy.
Dayton, OH 45435 USA
937-775-5202 Fax 937-775-5204
www.cradle-cfd.com

Software Cradle Co. Ltd. (Osaka, Japan), a leading developer and service provider of CFD software, is delighted to exhibit award-winning CFD software designed for design engineers as well as CFD experts. Established in 1984, Software Cradle offers a suite of CFD products consisting of SC/Tetra (general purpose, unstructured mesh CFD), STREAM (general purpose, structured mesh CFD), HEAT Designer (structured mesh CFD specialized for electronics cooling) and CADthru (CAD to CFD geometry translation). Software Cradle products are distributed and supported worldwide by its offices in Japan and North America (Cradle North America, Dayton, OH), and distributors throughout Asia, North America and Europe. In this conference, Cradle will mainly exhibit HEAT Designer which is used by majority of Japanese electronics companies that are utilizing CFD in their design process. Its outstanding operationability, fast and stable computation, ability to handle thousands of parts, flexibility and powerful postprocessor have been contributing to the innovation of Japanese electronics technologies. These traits enable users to import real CAD data and simulate as it is. Some of the users utilize 100 to 200 million meshes on windows platform. Please come and visit our booth or workshop to find out how HEAT Designer could maximize your work.

sp3 DIAMOND TECHNOLOGIES, INC.

2220 Martin Avenue
Santa Clara, CA 95050 USA
408-492-0630 Fax 408-492-0633
www.sp3inc.com

sp3 Diamond Technologies provides thin and thick-film diamond products and deposition services to companies world-wide with a focus on thermal management and diamond-on-silicon applications. The company also supplies Hot Filament CVD Reactors. sp3's corporate headquarters and thin-film diamond deposition facility are located in Santa Clara, California. sp3's thick-film facility, sp3 Ltd., is located in Calgary, Alberta, Canada.

SPECTRA-MAT, INC.

100 Westgate Drive
Watsonville, CA 95076 USA
831-722-4116 Fax 831-722-4172
www.spectramat.com

Spectra-Mat, Inc. (SMI) is a leading manufacturer of products for electron emission and controlled expansion thermal management material solutions for microelectronics. We have been in operation for over forty-five years and have built our businesses on our expertise in refractory metal technology.

THERMAL ENGINEERING ASSOCIATES

2915 Copper Road
Santa Clara, CA 95051 USA
650-961-5900 Fax 650-323-9237
www.thermengr.com

TEA is a company founded by Bernie Siegal, a 35+-year veteran and recognized technical leader in the semiconductor thermal field. The company's mission is to provide a central source for the products and services necessary for proper semiconductor thermal measurement and modeling and solutions to attendant thermal management problems. Through its own products and services, augmented by an extensive network of technical experts around the world, TEA can assist customers in finding solutions. The Tech Briefs and Hot Links pages provide useful information to those interested in semiconductor and electronics thermal issues. We welcome the opportunity to discuss your thermally-related measurement, modeling and/or management requirements.

THERMACORE

780 Eden Road
Lancaster, PA 17601 USA
717-569-6551 Fax 717-569-8424
www.thermacore.com

Thermacore, Inc. - is a manufacturer of custom thermal solutions including heat pipes, heat pipe assemblies, heat sinks, cold plates, pump liquid cooling systems, and heat exchangers for server, power, communications, medical, and military/aerospace applications.

THERMO COOL CORPORATION

6276 San Ignacio Avenue Ste. B
San Jose, CA 95119 USA
408-363-4000 Fax 408-516-9606
www.thermocoolcorp.com

Thermo Cool provides precision diverse cooling solutions that include Custom Extrusions, Pin Fins, Skived copper heat sinks, high aspect power heat sinks, heat pipes and bonded fin. We can also provide thermal analysis and design for custom applications.

2009 Exhibitor Listing

WOLVERINE TUBE, INC.

2100 Market St. NE
Decatur, AL 35609 USA
256-580-3662
www.microcooling.com

Fax 256-580-3519

Wolverine Tube, Inc. is a world-class manufacturer of copper and copper alloy tubes, fabricated components and assemblies, metal joining products, copper and copper alloy rod and bar products, as well as highly enhanced heat transfer tubes. Micro-Deformation Technology (MDT) is a patented machining process that was originally developed for the production of highly enhanced heat transfer tubes at Wolverines and has been adapted to efficiently process superior quality, low cost micro-channels. The MDT process can achieve a variety of channel depths, channel widths, fin shapes and angularity. MDT provides design engineers a unique, cost-effective alternative to create new components and expand available materials for thermal management hardware applications. With the capability of fabrication and assembly, Wolverine's China facility can build full cooling systems.

XCELAERO CORPORATION

814 Ricardo Ct.
San Luis Obispo, CA 93401 USA
877-925-2376
www.xcelaero.com

Fax 877-547-2660

Xcelaero Corporation is a design and manufacturing enterprise specializing in the production of world class fan and thermal management systems. Our unmatched aerodynamic design capabilities coupled with equally talented motor and electrical design enables our company to meet customer demands for increased performance and efficiency. Our goal for every product is to provide our customers with the most energy efficient, lightest weight and highest performance systems available on the market today. We are a US government certified small business with both commercial and defense market design experience. We have invested heavily in the people we employ and the tools we use to accurately model and iterate hardware and system designs before they are ever built. This proprietary design practice combined with our in house rapid prototyping capability and testing facility reduces iterative design work, compresses engineering development timelines and thus lower costs. The result is lighter, more capable systems that give large system integrators the flexibility to meet the most demanding system specifications. Xcelaero designs and produces both standard products that have a broad range of applications in electronics cooling and custom products to meet the demanding specifications of industrial and defense applications. Our customers range from large system integrators to commercial computing designers. In each case, our customers engage Xcelaero to solve their most difficult air movement issues be it electronics cooling, air handling or environmental control systems. Xcelaero strives to meet our customer's expectations in product performance, delivery and customer support. With facilities in San Luis Obispo, California; Albany, New York; and Houston, Texas, we can support customers regardless of their location.

2009 Vendor Workshop Schedule

Tuesday March 17, 2009

CONCURRENT SESSIONS

2:00 PM – 2:45 p.m.	Future Facilities (<i>Gold</i>)	Dow Corning Corporation (<i>Crystal</i>)
3:00 PM – 3:45 p.m.	Software Cradle Company (<i>Gold</i>)	Indium Corporation (<i>Crystal</i>)
4:00 PM – 4:45 p.m.	Mentor Graphics – Flotherm (<i>Gold</i>)	Innovative Research (<i>Crystal</i>)

Wednesday March 18, 2009

2:00 PM – 2:45 p.m.	Metal Matrix Cast Composites (<i>Gold</i>)
3:00 PM – 3:45 p.m.	Mentor Graphics – Teraled (<i>Gold</i>)

2009 Vendor Workshop Descriptions

CONCURRENT SESSIONS

Tuesday March 17, 2009

2:00-2:45

GOLD

Future Facilities

6SigmaET, The Next Generation CFD-Based Software for Thermal design in Electronics

Future Facilities announces the release of 6SigmaET, the next generation CFD based software for thermal design in electronics and the first major breakthrough for a thermal design tool in 10+ years!

6SigmaET features a highly efficient, 3rd generation modeling environment that significantly improves analysis-based thermal design from concept to final implementation. In addition, 6SigmaET, as a key module of the 6SigmaDC suite that supports the important trend toward integrated design of electronics and data centers.

The Future Facilities vendor session will demonstrate:

- The productivity advantages of 6SigmaET as a next generation tool for electronics design
- The advantage of design chain integration from the box to the room

Attend the Future Facilities vendor session and enter to win a Nintendo Wii. Three winners will be drawn on Wednesday, March 18th at the Future Facilities booth.

2009 Exhibitor Workshop Descriptions

Tuesday March 17, 2009

2:00-2:45

CRYSTAL

Dow Corning Corporation

Finding the Light At The End Of the MCP Tunnel; Challenges and Solutions For TIMs In A Multi-Chip Package

As today's electronics become more and more complex, design changes that boost device performance also provide job security and plenty of headaches for thermal engineers. This is especially true of multi-chip packages (MCP), where engineers must not only with high power densities, but also with die height offset and variable bond line thickness (BLT) caused by the MCP architecture. This workshop will provide valuable information on characterization of a thermal interface material (TIM) for MCPs with focus on the challenges of:

- TIM reliability during power cycling
- TIM Pump-out
- Excellent thermal performance at variable BLTs

Test results show that failure mechanisms such as pump-out can be exacerbated by conditions found in MCPs. Fortunately, there is a solution. With the right polymer and filler technology it is possible to formulate a TIM with a robust matrix to deal with these MCP architecture challenges. Join the team of experts from Dow Corning, a global leader in silicone technology, for an in depth look at the questions and answers for MCP TIMs.

Tuesday March 17, 2009

3:00-3:45

GOLD

Software Cradle Company

Verification of thermal distribution using Gerber data with Heat Designer (STREAM)

The accurate prediction of the operating temperatures of electronic components has been studied among engineers to meet the high level of requirements in today's product development. Such requirements include necessity of shortening the lead time and cost, severer thermal condition due to the favor to fan-less product, miniaturization of product, and tightly closed casing, and friendliness to environment including high energy efficiency.

Due to the intensive studies and researches of compact models of IC packages, the accuracy has been greatly improved. However, miniaturizing of components and increase in its power usage due to more powerful or sophisticated functions of the product make the accuracy of prediction even more important. In such a case, heat dissipated through PCB needs to be accurately predicted by considering the distribution of thermal conductivity of PCB rather than using anisotropic thermal conductivities with or without the consideration of wiring patterns.

In this presentation, an example of considering distribution of thermal conductivity on the PCB by utilizing Gerber data is introduced using STREAM - Heat Designer. This study proves the effectiveness of utilizing Gerber data and also addresses some cautions of using Gerber data.

2009 Exhibitor Workshop Descriptions

Tuesday March 17, 2009

3:00-3:45

CRYSTAL

Indium Corporation

Applications for Engineered Solders and Metal Thermal Interface Materials with Superior Thermal Performance Requirements

Amanda Hartnett, Jordan Ross
Indium Corporation
Clinton, NY

Solders and metal thermal interface materials (TIMs) have been implemented in high power device electronic systems as varied as power RF modules, insulated-gate bipolar transistors (IGBTs), light-emitting diodes (LEDs), and microprocessors. There are some materials used for their reliability and thermal performance which are common to all of these, and others which are unique to one or two. The devices in each of these market segments will be broken down into the individual interface levels that require TIMs. The popular solder and metal TIMS used at each level and in each device type will be discussed, along with the impact their integration has on the entire system's performance.

Metal Thermal Interface Materials and Solders for High-Power Applications

Amanda Hartnett, Jordan Ross
Indium Corporation
Clinton, NY

Solders have been used for over a decade to control heat dissipation in temperature-critical high-power devices. Recent technology advances, including miniaturization and increased power generation, have led to the adoption of these and other metal thermal interface materials (TIMs) in high-volume commercial, military, and medical products. Metal elements and alloys may be used as solders in the traditional sense with or without a flux to minimize thermal impedance or in their newly developed forms of compressible, phase change, or liquid metal TIMs. Between these four types of TIMs, products are available for devices with source operating temperatures from the cryogenic range up to 300°C.

Each type of metal TIM has been evaluated for thermal resistance. Reliability was also investigated for humidity treatment, thermal cycling, and power cycling. These three forms of metal TIMs will be compared and contrasted with each other, as well as with other commercially-available TIM materials.

2009 Exhibitor Workshop Descriptions

Tuesday March 17, 2009

4:00-4:45

GOLD

Mentor Graphics - FloEFD

FloEFD for Electronics; a CAD Friendly CFD Tool for Everyone
Byron Blackmore - Product Manager, Electronics Cooling Mentor Graphics -
Mechanical Analysis Division

As the leader in CFD software for electronics cooling for over 20 years with our flagship product, FloTHERM, we are finding that the industry is changing, and with it, so must our product offerings. The majority of engineers' needs will be covered with products such as FloTHERM.

However, for those who need to solve thermal problems in electronics enclosures containing complex, curvilinear geometry, including thin curved shells, a different approach is needed. Today we would like to introduce you to FloEFD for Electronics; a CAD friendly CFD tool for everyone.

We encourage you to stop by our booth or come to this informative demonstration for more information.

Tuesday March 17, 2009

4:00-4:45

CRYSTAL

Innovative Research, Inc.

MacroFlowTM – A Software Tool for Rapid Thermal Design of
Electronics Cooling Systems

Presenter – Kanchan M. Kelkar, Ph. D.

Innovative Research will present MacroFlow, an easy-to-use software based on the Flow Network Modeling (FNM) technique for rapid and accurate system-level thermal design. MacroFlow has an intuitive GUI, an extensive library of components with built-in correlations and vendor data, a powerful solution methodology, and comprehensive capabilities for examining results. MacroFlow fills the gap between limited hand calculations and expensive CFD analysis. Use of MacroFlow for up front thermal design results in significant productivity improvements and a substantially shorter design cycle. MacroFlow is widely used for thermal design of air- and liquid-cooling systems in all major computer, telecom, and defense electronics companies.

During the vendor workshop, a brief summary of the technique of Flow Network Modeling (FNM) will be first presented. This will be followed by an overview of the capabilities of MacroFlow and a discussion of the characteristics of the components in the library that are used to construct network representations of cooling systems. The process of constructing a network model, its computational solution, and display of results will then be demonstrated for a practical cooling system. Finally, models of various real-life electronics cooling systems will be demonstrated to illustrate the productivity benefits that MacroFlow offers in the thermal design process.

2009 Exhibitor Workshop Descriptions

Wednesday March 18, 2009

2:00-2:45

GOLD

Metal Matrix Cast Composites, Inc.

Wednesday March 18, 2009

3:00-3:45

GOLD

Mentor Graphics - TERALED

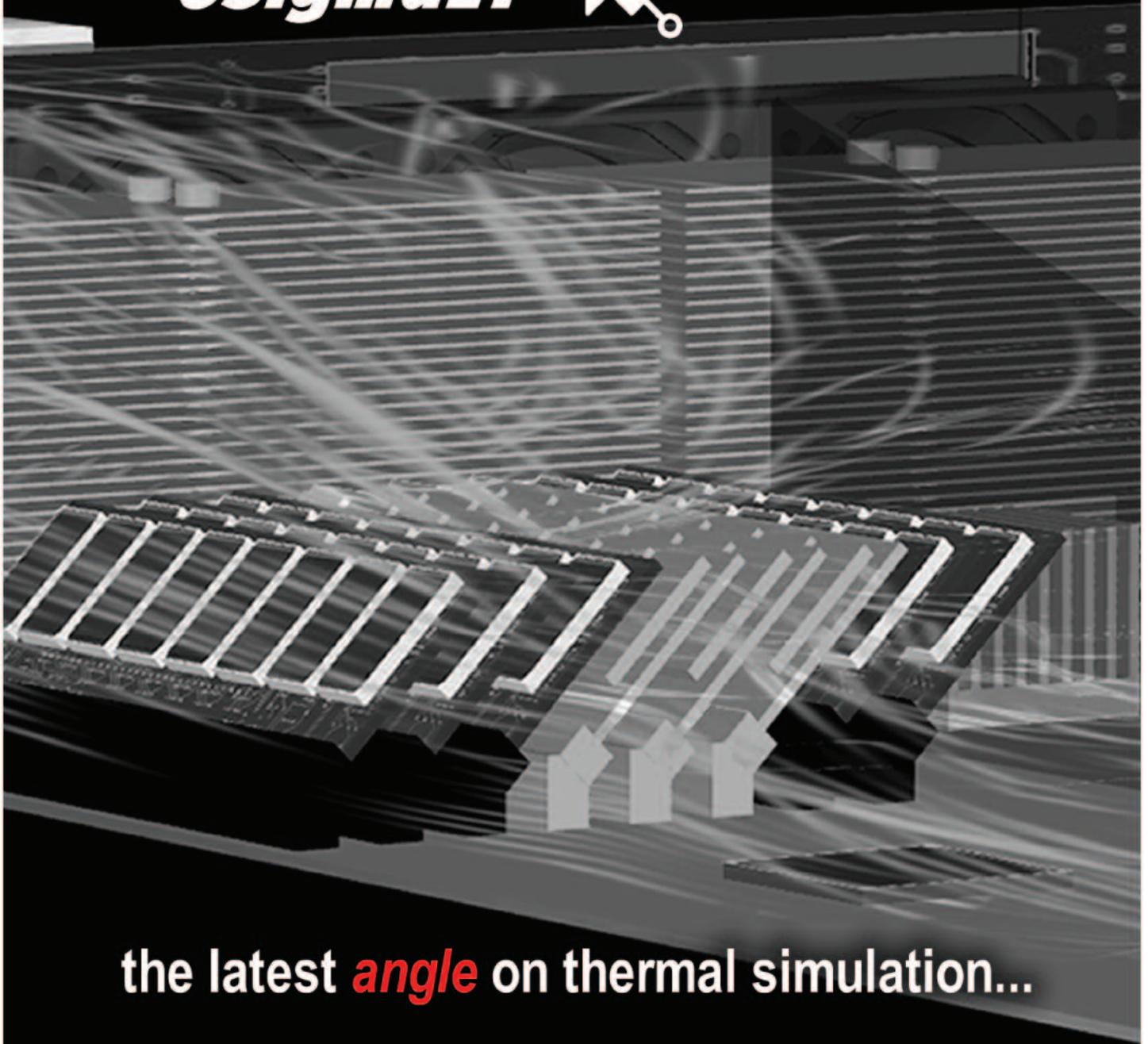
Characterization of LED-Based Lighting Solutions: Simulation,
Testing and Modeling.

Presenter: Andras Poppe, marketing manager

The workshop discusses tradeoffs between simulation and physical testing. Test based compact modeling for power LEDs is introduced. The need for correct models necessitates combined thermal and radiometric measurement of LEDs. Mentor Graphics' thermal testing tools, including the T3Ster (pronounced: tri-ster) thermal test equipment and the TERALED equipment specifically developed for LED testing will also be shown. A detailed example of an LED lamp will highlight the links between Mentor Graphics' CFD based simulation tools and thermal testing hardware solutions.

future facilities

6SigmaET



the latest *angle* on thermal simulation...

Future Facilities Inc.
2025 Gateway Place, Suite 110
San Jose, CA 95110

www.futurefacilities.com

email: info@futurefacilities.com

SEMI-THERM® 25

Twenty Five Years of Progress!

The year was 1983. Bernie Siegal of Sage Enterprises approached Bonnie Leigh Crystall and Walter Schuch, principals of C/S Communications Inc. about producing a premier event that would focus on thermal and temperature management. With Bernie Siegal's technical expertise and with show management/public relations veterans Crystall and Schuch the idea of SEMI-THERM was conceived. SEMI-THERM I was launched on December 10-12 1984 at the Hyatt Regency Hotel in Phoenix Arizona, and as they say, the rest is history! This team has been together for 25 years, bringing the industry the latest innovations in technology and products in semiconductor thermal measurement and management.

The philosophy of SEMI-THERM was to make it a premiere, first-class event in the field building friendships and ties that would stay the test of time and be the industry event foremost in the minds of attendees and exhibitors alike...the place to be for all those interested in thermal issues.

SEMI-THERM I had 8 exhibitors, all with their own exhibition suites. Fourteen papers were presented that first year. Charter Member Bob Simons of IBM won Best Paper, "Thermal Sensing and Control for a Large Scale Digital

Computer." And here's what the attendees said about SEMI-THERM I:

- "I am very pleased to have participated in what I see as the beginning of an extremely valuable information exchange."



Walter Schuch, Bonnie Crystall,
Bernie Siegal

- "Overall a well-run and informative conference."
- "Enjoyed and learned much."
- "A little too commercial."
- "Seminar was prompt and run very orderly. Nicely done."
- "By far the most important symposium and the highest quality attendees. The leaders in the industry were there!"
- "The need for standard methods is evident"
- This type of information exchange is vital for our field of study, as we are in a standardization/characterization phase. The next few years will be important years and SEMI-THERM will be a driving force in this technology.

Won't you please join us for our twenty-sixth year: Thank you all for your many years of support and service to the industry and the SEMI-THERM community.

Bernie Siegal, Bonnie Crystall and Walter Schuch

Please Join Us

SEMI-THERM® 26

Semiconductor Thermal Measurement and Management Symposium

March 21 – 25, 2010 • Fairmont Hotel • San Jose, California