FINAL PROGRAM

SEMI-THERM®

SEMI-THERM 38

The 38th Annual Thermal Measurement, Modeling and Management Symposium

March 21 - 25, 2022

38

WWW.SEMI-THERM.ORG

Your choice of Short Courses – included with your registration

Session One - Liquid Cooling Session
Session Two - Current Topics in Thermal Management
Session Three - Two-Phase Cooling
Session Four – Thermal Interface Materials
Session Five - Data Center
Session Six – Emerging Technologies

Keynote Presentation - Andy Delano, Microsoft Corporation
"Innovations in Thermal Management of Electronic Devices"

Welcome Reception 5:30 - 6:30 March 21

Career Trajectory Panel
Moderator: Jim Wilson, Raytheon
Panel Members:
Alfonso Ortega, Villanova University
Adriana Rangel, Cisco
Claire Wemp, Dupont
Ross Wilcoxon, Collins Aerospace

Embedded Tutorial - Mark Wisniewski, Laird
"Designing Thermal Interface Materials for Manufacturability and Ease of Use"

How to Presentation – Rajat Mittal, Meta Reality Labs
"Consumer Electronics Thermal Design with Leakage Power"

Thermi Award Presentation
Dr. Sreekant Narumanchi, National Renewable Energy Laboratories
"Advanced Power Electronics and Electronic Machines For Electric-Drive Mobility Operations"

Harvey Rosten Award
Sujay Singh, ON Semiconductor, Andras Vass-Varnal, Siemens, Joe Proulx, Siemens
"Measuring the RthJC of Power Semiconductors Using Short Pulses"

All programming subject to change

Welcome to SEMI-THERM 38!

Marcello Del Valle,
Infinera

Dear Colleagues,

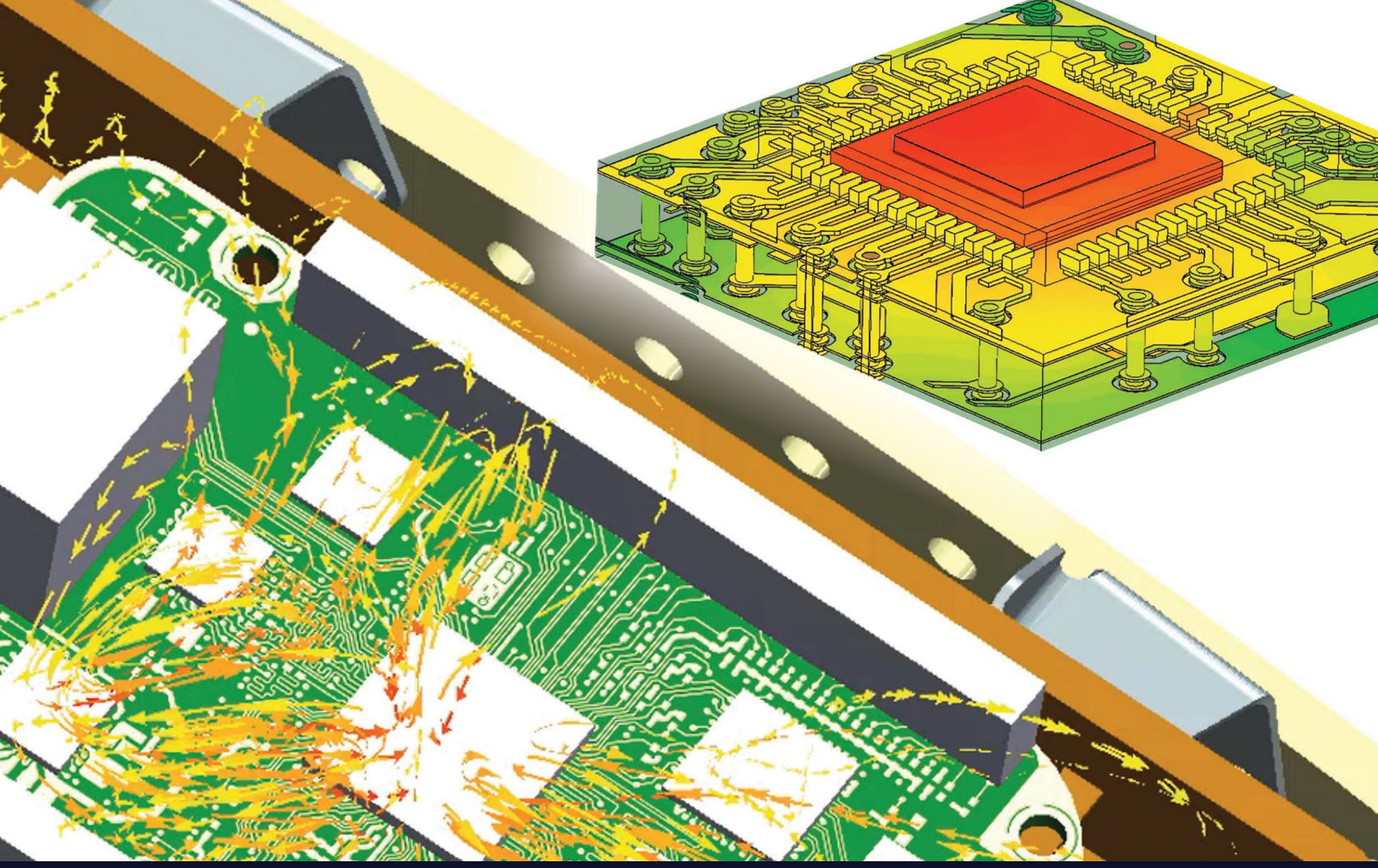
It is my pleasure to welcome you to SEMI-THERM 38 annual conference dedicated to thermal design, thermal management as well as measurement of semiconductor systems and components. After 2 hard years of not being able to see each other in person. The day has come, to reunite our thermal community in San Jose again. On behalf of the entire program committee, I want to thank you all for your constant support and help during the past two years.

Our program committee led by Dr. Joshua Gess, Oregon State, has worked hard and under extremely difficult conditions to put together a comprehensive program that adheres to SEMI-THERM's mission of providing a platform for discussion on the latest advancements in thermal management for both industry professionals and members of academia. The program this year consists of 4 Short courses, 25 Technical papers, 2 Luncheon speeches, Vendor Workshops, 2 days of SEMI-THERM exhibits, awards sessions including THERMI, Harvey Rosten as well as Thermal Hall of Fame Award and our Panel session on Maximizing Early Career Trajectory. For this year's keynote speech, we have the pleasure to have with us Dr. Andy Delano from Microsoft presenting on Innovations in Thermal Management of Electronic Devices. As has been tradition in prior years, all short courses are offered free of charge as part of the full technical conference pass. The courses are offered the first day of SEMI-THERM on Monday, March 21th including morning and afternoon sessions.

I would like to thank all those who participated in the publication review process and organization of SEMI-THERM 38. In particular, Joshua Gess, Oregon State, and Alex Ockfen, Facebook, our Program Chair and Vice Program Chair who have worked hard putting together the technical program and auxiliary programs. Their tireless work has made possible the organization of the current edition of SEMI-THERM, overcoming the difficulties and uncertainties that the Covid era imposed.

Organizing a conference such as SEMI-THERM would not be possible without the experienced leadership provided by Ross Wilcoxon, Collins Aerospace and George Meyer, Celsia Technologies. Thank you both for your constant support of the SEMI-THERM 38 program committee. Lastly, I want to give all my appreciation to Bonnie Crystall, Denise Rael, and Robert Schuch for their tireless support provided during the creation of this years' SEMI-THERM symposium. It would be impossible to have our beloved conference without them as corner stones.

I hope all of you have a great experience in this year's conference, not just by the quality of the great presentations you will see during the week, but also by re-connecting with old friends and colleagues and making new connections with leaders in the thermal management and electronics cooling community.



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SEMI-THERM 38

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Jim Wilson	Raytheon
Winston Zhang	Novark

SEMI-THERM 38 Chair Persons

General Chair

Marcelo del Valle, Infinera

Dr. Marcelo del Valle is a Staff Hardware Development Engineer for the Optical Modules Group at Infinera Corporation. Before joining Infinera, he worked as Staff Thermal Engineer at ZT systems where he designed cooling solutions for rack mounted servers . Additionally he worked as a Thermal Mechanical Engineer at Intel corporation where he developed air and liquid cooling solutions for the Omni-Path HPC network equipment product line. Dr. Del Valle holds a B.S.M.E from Universidad de Santiago, Chile, a M.S.M.E. from University of Nevada, Reno and a Ph.D. in Mechanical Engineering from Villanova University. He has worked extensively in experimental measurements in the thermal sciences for more than 10 years. He has published and presented extensively in problems arising from thermal management of electronics, spanning from the chip/module to the facility level, single and two-phase cooling, and thermal management in energy systems.

Program Chair

Dr. Joshua Gess, OSU

Dr. Joshua Gess is an Assistant Professor at Oregon State University (OSU) in Thermal Fluid Sciences. He was recognized as a 2019 Outstanding Student Branch Counselor for his leadership of OSU Overclocking, a student group focused on applying thermal management principles learned in the classroom to competitive computer overclocking. Dr. Gess was the winner of 2020 ASME K-16 Early Faculty Career in Thermal Management Award. He is the Competition Chair for the annual ASME K-16 and IEEE EPS co-sponsored Student Design Challenge where students from around the world submit their best heat sink designs made with Additive Manufacturing. Dr. Gess is also the coach of the OSU Rolling Beavers Wheelchair Basketball team and a former MVP of the Auburn University Wheelchair Basketball Team.

Program Vice Chair

Alex Ockfen, Meta

Alex Ockfen is a simulation engineer at Meta (formerly Facebook), providing technical leadership for thermal and structural design of consumer electronics products. He held previous positions at Raytheon where he obtained experience in thermal management and electronics cooling of a wide range of aerospace and defense applications. He has more than 10 journal and conference publications, is an inventor on multiple patents, is a professional mechanical engineer, and is currently serving as vice program chair of the SEMI-THERM conference.

Short Courses

Monday, March 21, 2022

These short courses provide practical, interactive training on a variety of specific skills on topics ranging from thermal design & modeling to system level validation testing. Some are designed for those who are relatively new to thermal management. As such, they focus on basic concepts and techniques. Other classes are meant for seasoned thermal engineers wanting to gain deeper insight into best-in-class tools and practices.

Short Course 1: 8:00 a.m. – 10:00 a.m. **San Jose**

The Role of Intellectual Property in Protecting Semiconductor Innovation

Instructors: Neil A. Steinberg, Principal, Patent Strategy Group and Dinesh N. Melwani, Partner, Bookoff McAndrews, PLLC

The field of intellectual property extends across the boundaries of business, technology, innovation, and law. Intellectual property is the backbone of the world economy and it plays a vital role in supporting and protecting investment and innovations in the semiconductor industry. Following an overview of the different forms of intellectual property, this course will focus on U.S. Patents, their impact in the semiconductor industry, what they protect and how they are acquired, important considerations when evaluating inventions, and best practices when it comes to inventorship, ownership, and prior art.

Neil Steinberg has over three decades of experience in patent application preparation and prosecution, litigation, U.S. and international portfolio development and commercialization of technological innovations - in both the law firm and corporate capacities. Over the past 20 years, Mr. Steinberg has dedicated himself to working with small and medium size emerging companies. He combines his intellectual property expertise, engineering background and business experience to design and implement innovative and effective strategies, allowing his clients to obtain and capitalize on patents through programs tailored to achieving his client's objectives. As former Vice President of Intellectual Property and General Patent Counsel at Rambus Inc., Mr. Steinberg was responsible for company-wide intellectual property matters, including strategic patent acquisition, patent and technology licensing and global patent enforcement. Prior to joining Rambus, Mr. Steinberg was Assistant General Patent Counsel in the Semiconductor Division of Samsung Electronics Co., Ltd., where he initiated and executed worldwide patent licensing and litigation relating to semiconductor products and processes. Mr. Steinberg earned his B.S. in Electrical Engineering, with honors, from Rochester Institute of Technology. He earned a JD, cum laude, from Suffolk University Law School. Mr. Steinberg is a Registered U.S. Patent Attorney, admitted to practice before the U.S. Patent and Trademark Office. He is a member of the District of Columbia Bar, and the Bar of the Court of Appeals for the Federal Circuit.

Dinesh N. Melwani takes a holistic approach to developing patent strategies for clients. IAM Patent 1000 describes him as a "diligent, responsive, and perceptive patent attorney who demonstrates a keen eye for the most successful prosecution approaches." Similarly, Managing IP also found that Dinesh is known as "one of the best and most energetic attorneys." He is recognized for a keen focus on advancing the business goals of clients in the United States and abroad. To that end, Dinesh implements strategies that not only solve a client's immediate need, but also position and protect his client's business evolution and growth. His practice includes client counseling; efficiently managing, growing, and protecting worldwide patent

continued

Short Courses

portfolios; reissuing patents to cover new competing technologies; negotiating patent licenses; conducting IP due diligences to support investment and acquisitions; challenging patents at the PTAB; and advising on patent litigation matters. Dinesh also devotes a significant portion of his time to leading BoMc's diversity efforts and mentoring attorneys through his involvement in organizations such as the Leadership Council on Legal Diversity, American Bar Association, and PTAB Bar Association.

Short Course 2a: 10:15 a.m. – 12:15 p.m. **San Jose**

Fundamentals of Acoustics

Instructor: David Nelson

A brief practical introduction to the science of acoustics. We'll de-mystify this topic by discussing the physics of sound waves in air and vibration waves in solids along with human perceptual phenomena, fundamental concepts (frequency, amplitude, sound power, sound pressure), proper terminology, filtering, frequency-weighting (e.g., dBA), and basic decibel math. Audio demonstrations feature prominently. No mathematics beyond logarithms.

Short Course 2b: 1:30 p.m. – 3:30 p.m. **San Jose**

Fundamentals of Noise Control

Instructor: David Nelson

A brief practical introduction to noise control engineering. We'll cover typical acoustical criteria, fundamental noise control strategy including source- path- and receiver noise control, prioritizing what to work on first, basic sound propagation, and applied decibel math. No mathematics beyond logarithms.
[Presumes attendance at Fundamentals of Acoustics or equivalent]

Short Course 2c: 3:30 p.m. – 5:30 p.m. **San Jose**

Example Noise Control Applications

Instructor: David Nelson

Three practical applications will illustrate how the fundamentals of Acoustics and Noise Control can be used to provide insight and predict outcomes where noise is important.

- Noise emission from a fan-cooled rack product
- Worker noise exposure inside a data center housing fan-cooled racks and support equipment
- Neighborhood sound levels due to rooftop chillers atop a nearby data center

No mathematics beyond logarithms.
[Presumes attendance at Fundamentals of Acoustics or equivalent]
[Presumes attendance at Fundamentals of Noise Control or equivalent]

David Nelson has a BS ME Dept (Acoustics) from MIT '81, MSE (Acoustics), UT Austin '84, Acoustics Lab Director '85-'94 Senior Consultant '94-'98, Principal Consultant, Nelson Acoustics '98-present. Expertise in low-noise design, sound quality, and fan noise.

Short Courses

Short Course 3: 8:00 a.m. – 12:15 p.m. **Carmel**

The Thermal Comfort Considerations for Electronics Cooling and Design
Instructors: Dr. Mark Hepokoski and Craig Makens

ASHRAE defines thermal comfort as "that condition of mind that expresses satisfaction with the thermal environment." While engineers and designers are familiar with the thermal safety and compliance standards required in their industry, thermal comfort is often less well understood and treated as an afterthought in the design process, especially in the consumer electronics device industry. However, thermal comfort should be considered early in any product development process. Not only are thermal comfort thresholds often lower than their safety counterparts, but thermal comfort-related misses can hinder the success of a design due to factors such as poor product reviews.

Temperature differences are commonly observed between people and the objects they interact with daily. The human body is often cooler than commercial electronic items such as laptops or mobile phones. If the heat flux resulting from immediate and/or prolonged contact with an electronic device negatively impacts thermal comfort, satisfaction with the product will consequently also be negatively affected. In light of this, the importance of comfort in the consumer electronics industry is only expected to become more important as people become more directly coupled with their electronics devices. This is being observed in the wearables industry where devices such as smartwatches, virtual reality, and augmented reality products are entering the market.

Thermal comfort is a highly complex phenomenon that depends on factors including personal preference, local environment, geographical location, product use case, product type, user interface, geometry, and material to name a few. The wide range of contributing factors results in a large variation in thermal comfort metrics and indicators, including temperature, heat flux, and skin wettedness. Given both the importance and complex nature of thermal comfort in electronics design, a logical process is needed to design for thermal comfort. Successful design for thermal comfort typically requires a combination of user testing and comfort modeling to enable data-driven design decisions. This course provides a detailed overview of thermal comfort-focused test methods and modeling technologies that should be considered and employed in a modern consumer electronics product development process.

Mark Hepokoski is the Chief Scientist and Chief Technology Officer (CTO) at ThermoAnalytics. He has developed a wide array of heat transfer modeling algorithms for the TAITherm family of commercial heat transfer CAE tools. Dr. Hepokoski's research is heavily focused on the development of techniques for coupling simulation tools with physical measurement devices. During his tenure as a Principal Investigator of human thermo-physiology and thermal comfort projects, he has accumulated almost two decades of experience developing a complex thermal model of the human body that is widely used in the automotive industry for developing comfort-focused climate control technology. Dr. Hepokoski received his B.S. in Engineering Science and Mechanics from Virginia Tech. He also holds an M.S. degree in Mechanical Engineering and a Ph.D. in Mechanical Engineering-Engineering Mechanics from Michigan Technological University.

Craig Makens is the VP of Business Development & Partnerships at ThermoAnalytics, and is responsible for the go to market strategy. He works closely with academic and commercial strategic partners to support customer needs with development and deployment of integrated solutions. He has also worked directly with many major commercial and defense clients to help them incorporate new simulation technology in their product design processes. Mr. Makens received his B.A. in Chemistry and Business Administration from Hope College and his M.B.A. from Marquette University.

Short Courses

Short Course 4: 1:30 p.m. – 5:30 p.m. **Carmel**

Photonic and Metamaterial Control of Radiative Heat Transfer

Instructor: Aaswath P. Raman

Nanostructures and microstructures that have deliberately-introduced features below the wavelength of light they're interacting with can exhibit exquisite tailored control of how light is transmitted, absorbed and emitted. The fields of nanophotonics and metamaterials have emerged over the last thirty years, building on this promise with a range of remarkable capabilities not attainable with conventional materials. More recently, a range of breakthroughs have highlighted how photonic and metamaterial strategies can control thermal emission and radiative heat transfer. This course will provide an introduction to nanophotonics and metamaterials, and their application to controlling radiative heat transfer. Fundamental theoretical frameworks will be introduced, along with a survey of their application to control the spectral and directional characteristics of radiative heat transfer, as well as emerging applications enabled by these advances. Near-field radiative heat transfer will also be discussed in the context of photonic structures that can suppress or enhance this mode of radiative heat transfer.

Aaswath P. Raman is Assistant Professor of Materials Science and Engineering at UCLA. His expertise is in nanophotonics and metamaterials, and their control of radiative heat transfer. He is known for his pioneering work in radiative cooling and has
received numerous awards, including the Sloan Research Fellowship, the DARPA Young Faculty Award and the MIT Technology Review Innovator Under 35 (TR35)

SEMI-THERM®

SUBMIT A PAPER FOR SEMI-THERM 39!

As you further develop a technique or application, consider documenting it for the thermal community. SEMI-THERM 39 will begin accepting abstracts during the summer (deadline is September 15, 2022). We welcome your submissions! Visit us at www.SEMI-THERM.org. SEMI-THERM 39 is March 13th-17th, 2023 – be there!

Schedule of Events

Monday March 22, 2022

8:00 a.m. – 5:30 p.m. — **San Jose, Carmel**
Short Courses

Short Course 1: 8:00 a.m. – 10:00 a.m. — **San Jose**
The Role of Intellectual Property in Protecting Semiconductor Innovation
Neil A. Steinberg, Principal, Patent Strategy Group and Dinesh N. Melwani, Partner, Bookoff McAndrews, PLLC

Short Course 2a: 10:15 a.m. – 12:15 p.m. — **San Jose**
Fundamentals of Acoustics
Instructor: David Nelson

Short Course 2b: 1:30 p.m. – 3:30 p.m. — **San Jose**
Fundamentals of Noise Control
Instructor: David Nelson

Short Course 2c: 3:30 p.m. – 5:30 p.m. — **San Jose**
Example Noise Control Applications
Instructor: David Nelson

Short Course 3: 8:00 a.m. – 12:15 p.m. — **Carmel**
The Thermal Comfort Considerations for Electronics Cooling and Design
Instructors: Dr. Mark Hepokoski and Craig Makens

Short Course 4: 1:00 p.m. – 5:30 p.m. — **Carmel**
Photonic and Metamaterial Control of Radiative Heat Transfer
Instructor: Aswath P. Raman

3:30 p.m. – 6:30 p.m. — **Bayshore Foyer**
Attendee Registration

5:30 p.m. – 6:30 p.m. — **Bayshore Foyer**
Welcome Reception

6:30 p.m. – 8:00 p.m. — **San Martin**
Program Committee Meeting

Tuesday, March 22, 2022

7:00 a.m. – 6:00 p.m. — **Bayshore Foyer**
Attendee Registration

7:00 a.m. – 7:45 a.m. — **Monterey**
Speakers' Breakfast (March 22 Speakers, Session Chairs and Co-Chairs only)

8:00 a.m. – 8:10 a.m. — **Donner, Siskiyou**
Opening Remarks: Marcelo del Valle, Infinera

Schedule of Events

8:10 a.m. – 9:10 a.m. **Donner, Siskiyou**
Session 1: Liquid Cooling Session
Session Chair: Marcelo del Valle, Infinera

8:00 a.m. – 8:30 a.m.
Single-Phase Immersion Cooling Performance in Intel Servers with Immersion Influenced Heatsink Design
Suchismita Sarangi, Eric D. McAfee, Drew G. Damm, Jessica Gullibrand, Intel Corporation

8:30 a.m. – 8:50 a.m.
Computational Analysis of Changing Wavelength and Amplitude Effect on Bottom Rib and Side Rib Wavy Microchannel Heat Sinks
Ty Kieger, San Jose State University

8:50 a.m. – 9:10 a.m.
Parametric Study of Fluid Flow and Heat Transfer an Microchannel Heatsink Embedded with Semi-Circular Cavities for Thermal Management of Microelectronics Chips.
Rohit Bariki, Dinumol Varghese, Bobby Mathew, United Arab Emirates University

Continued

Keynote

Tuesday, March 22, 2022
9:10 a.m. – 10:10 a.m.

Innovations in Thermal Management of Electronic Devices

Andy Delano, Microsoft Corporation

Surmounting the challenges and limitations encountered in any endeavor requires innovation. While the word "innovation" currently enjoys a positive connotation in the field of technology development, one simply has to recall that "innovate" is defined as "to make changes to something established" to understand why innovation is challenging on multiple fronts.
For not only do we have to discover how to see past our own limitations, we also have to convince our colleagues for the need to change and follow through with the necessary leadership to actually incur change. Our field of thermal engineering is full of many great examples of innovation. In this presentation I will take us on an inspiring tour of some of my favorite innovations in thermal engineering, and I will also discuss some perspectives on techniques for successful innovation.

Andy Delano leads the Microsoft Surface team's thermal architectural and technology efforts. Prior to joining Microsoft in 2012, Andy managed the thermal R&D team within Honeywell's electronic materials division developing and launching highly successful products for the electronics packaging industry. Andy started his career in 1998 as a thermal engineer at Hewlett-Packard designing server and workstation thermal systems. While at HP, Andy was also an adjunct professor at CU and taught heat transfer, thermodynamics, and thermal systems design between 1999 and 2005. Prior to his career, Andy obtained his Ph.D. in mechanical engineering from Georgia Tech in 1998, and his thesis was on a single pressure absorption refrigerator originally patented by Albert Einstein. During the first part of his graduate studies, Andy also worked on the design and production of the 1996 Olympic Torch and spent 6 weeks traveling with the torch relay.

How-To Presentation

Tuesday, March 22 5:00 p.m. - 6:00p.m.
Donner

Consumer Electronics Thermal Design with Leakage Power

Presenter: Rajat Mittal

This course presents an analysis approach to predict equilibrium thermal state with leakage power in consumer electronics (CE) devices . Impact of different ambient conditions and design changes is analyzed through the lens of this approach. Also discussed, are a few case studies that highlight the significance of this approach in facilitating correct design decisions for CE devices.

Rajat Mittal is a Lead Thermal Architect at Meta Reality Labs. Prior to joining Meta, he worked at Amazon Lab 126, Qualcomm, and Intel, where his work spanned thermal design of consumer electronics products, microelectronic chips, and packages. Rajat has 17 US patents and 250+ citations. Rajat has an MBA from Haas, UC Berkeley, a Master's in Mechanical Engineering from University of Minnesota-Twin Cities and a B.Tech. from Indian Institute of Technology (IIT) Kharagpur, India.

Schedule of Events

9:10 a.m – 10:10 a.m. — **Donner, Siskiyou**
Keynote: Innovations in Thermal Management of Electronic Devices
Andy Delano, Microsoft Corporation

10:10 a.m. – 10:30 a.m. — **Bayshore Ballroom Foyer**
Break

10:30 a.m. – 12:30 a.m. — **Donner, Siskiyou**
Session 2: Current Topics in Thermal Management
Session Chair: Lieven Vervecken, Diabatix nv

10:30 a.m. – 10:50 a.m.
Advantages of Two-phase, Pool-boiling, Cold-plate Evaporator: Based on a Unique Structure of Fins and Wick
Shahar Belkin, ZutaCore

10:50 a.m. – 11:10 a.m.
Identifying Performance Limits for Single Phase Liquid Cooled Cold Plates using an Improved Effectiveness-NTU Model
Al Ortega, Villanova University

Continued

Luncheon Speaker

Tuesday, March 22

Bletchley Park: Enigma, Ultra, and the Making of Colossus

Presenter: Dave Saums

The development of what has become known as "signals intelligence" traces back to crude beginnings during World War I, in the United Kingdom. As the dark clouds of political and military moves began to turn into signs of impending winter storms in the late 1930s, efforts were made in the UK, France, and in Poland to begin to more seriously decipher diplomatic and military codes being used by the German government. Similar code-breaking activities were taking shape in the United States in very crude form, and in Germany and Japan. In Poland, a small team of so-called codebreakers had focused on the Enigma code being used by the German government for both diplomatic and military purposes and that team made a striking decision that had enormous implications for the outcome of World War II. The British government, having set up a rudimentary codebreaking office twenty years earlier, moved very slowly to develop a more focused effort to break these diplomatic codes. As September 1939 turned the world again to war, the need for tools and methods to crack both diplomatic and military codes became absolutely critical. A small staff was assigned and this small team moved into an old Victorian family estate in Bletchley Park, less than an hour from London by train. The "Special Relationship" that still exists today between the United Kingdom and the United States grew directly from these seeds of human activity and cooperation. This presentation will outline the breaking of the German Enigma code (which became a series of different codes, used by different armed forces services), which produced what as titled as top-secret "Ultra" information about German military plans, locations of ships and submarines and battle groups, and how these first mechanized codebreaking machines were devised.

This presentation will focus on the technologies employed and short descriptions of hardware developed, as precursors to the modern age of digital computing – but will also illustrate the human contributions to preventing the destruction of the modern democratic world in the 1940s. The connections to technology in today's world rose from what would otherwise have been the ashes of defeat.

Bletchley Park today is an astounding museum of both technical detail and human achievement – the opening chapters in what has become the computing world that we live in today.

Dave Saums has thirty-nine years of technical marketing, product development, and business development experience with advanced thermal materials, thermal components, and twophase liquid cooling systems. Dave has operated a consulting firm focused on thermal materials and components for fourteen years, in addition to twenty-five years' experience with thermal component and materials manufacturers.

Schedule of Events

Tuesday, March 22, 2022

11:10 a.m. – 11:30 a.m.
CTE-Matched Thermal Composites: Overview and Update
Dave Saums, DS&A LLC

11:30 a.m. – 11:50 a.m.
Transient Methods to Shorten Time Thermal Measurements
Sujay Singh, Onsemi

11:50 a.m. – 12:10 p.m.
Device-Skin Tissue Heat Transfer
Francesco Collela, Exponent

12:10 p.m. – 12:30 p.m.
Electroluminescent Cooling by LEDs as a Potential Next-Generation Solid-State Cooling Solution
Aaswath Raman, UCLA

12:30 p.m. – 1:50 p.m. **Oak**
Luncheon
Luncheon Speaker: Dave Saums, DS&A LLC

1:30 p.m. – 6:00 p.m. **Sierra, Cascade**
Exhibits Open

1:50 p.m. – 2:00 p.m.
Break

2:00 p.m. – 3:00 p.m. **San Jose, Santa Clara**
Vendor Workshops Parallel Sessions:
Siemens
Indium

3:00 p.m. – 4:00 p.m. **San Jose, Santa Clara**
Vendor Workshops 2:
Ansys
ZutaCore

4:00 p.m. – 5:00 p.m. **San Jose, Santa Clara**
Vendor Workshops 3:
Fujipoly

5:00 p.m. – 6:00 p.m.
How To Course: Leakage Current in Thermal Design
Presenter: Rajat Mittal, Meta

6:00 p.m. – 7:15 p.m. **Oak**
Dinner

7:30 p.m. – 9:00 p.m. **Donner**
Panel Discussion: Maximizing Early Career Trajectory
Jim Wilson – Moderaor
Panelists: Ross Wilcoxon, Al Ortega, Adriana Rangel, Clair Wemp

Panel Discussion: Career Trajectory

Tuesday, March 22, 2022
7:30 p.m. – 9:00 p.m.
Bayshore Ballroom, Donner

Moderator: Jim Wilson, Raytheon

Panel Members:
Alfonso Ortega, Villanova University
Adriana Rangel, Cisco
Claire Wemp, Dupont
Ross Wilcoxon, Collins Aerospace

The Career Trajectory panelists will share their insight on how to build a successful career in the electronics cooling industry.
Each panelist will be asked to address the question:
"What do you know now that you wish you had been told when you started your career?"
The goals of these presentations are to inform, entertain and stimulate active discussion with the attendees.

Schedule of Events

Wednesday, March 23, 2022

7:00 a.m. – 6:00 p.m. — **Bayshore Foyer**
Attendee Registration

7:00 a.m. – 7:45 a.m. — **Monterey**
Speakers' Breakfast (March 23 Speakers, Session Chairs and Co-Chairs only)

8:00 a.m. – 8:10 a.m. — **Donner, Siskiyou**
Opening Remarks: Jim Wilson, Raytheon

8:10 a.m. – 9:10 a.m. — **Donner, Siskiyou**
Thermi Award Recipient Presentation
Advanced Power Electronics and Electric Machines for Electric-Drive Mobility Applications
Dr. Sreekant Narumanchi, National Renewable Energy Laboratory

9:10 a.m. – 10:10 a.m. — **Donner, Siskiyou**
Session 3: Two-Phase Cooling
Session Chair: George Meyer, Celsia, Inc.

Continued

Schedule of Events

Wednesday, March 23, 2022

9:10 a.m. – 9:30 a.m.
Evaluation of Cooling Capacity of Refrigeration System with Limited Charge of R-290
Alan Jones, Arne Wolf, Sang Muk Kwark, Laird Thermal Systems

9:30 a.m. – 9:50 a.m.
Generative Design and Experimental Validation of a Two-Phase Heat Sink
Lieven Vervecken, Joris Codd, Roxane Van Mellaert, Joao Miranda, Diabatix NV

9:50 a.m. – 10:10 a.m.
Comparison of Two Designs of an Impingement Two-phase Cooling Cold Plate Intended for High Heat Flux in Data Center
Najmeh Fallahtafti, Cong Hiep Hoang, Yaser Hadad, Srikanth Rangarajan, Scott Schiffres, Bahgat Sammakia, Binghamton University

10:10 a.m. – 10:30 a.m. **Bayshore** **Foyer**
Break

10:30 a.m. – 12:30 p.m. **Donner, Siskiyou**
Session 4: TIMs
Session Chair: Jason Strader, Laird Technologies, Inc.

10:30 a.m. – 10:50 a.m.
Optimized Dispensing of Thermal Interface Materials: Issues and Progress
Xuefeng Lin, Laird Thermal Systems

10:50 a.m. – 11:10 a.m.
Measuring Change in Thermal Performance of Multi-layer Laminates after Reliability Testing
Claire K. Wemp, DuPont Silicon Valley Technology Center

11:10 a.m. – 11:30 a.m.
Characterization of Thermal Interface Materials for Power Electronics Application
Andras Vass-Varnai, Siemens Digital Industries Software

11:30 a.m. – 11:50 a.m.
Thermal Management Device with Boiling Driven Heat Spreader
Hyunmuk Lim[1], Dong Hwan Shin[2], Gwang Hoon Rhee[3], Seung M. You[4], and Jungho Lee[1]
[1]Ajou University, [2]Korea Institute of Machinery and Materials, [3]University of Seoul, [4]University of Texas at Dallas

11:50 a.m. – 12:10 p.m.
Application of JESD51-14 to BGS Package Styles
Robin Bornoff, Siemens Digital Industries Software

12:10 p.m. – 12:30 p.m.
Liquid Hybrid Metal TIMS
Milos Lazic, Indium

12:30 p.m. – 1:50 p.m. **Oak**
Luncheon
Luncheon Speaker: Lieven Vervecken, Diabatix

Continued

THERMI PRESENTATION
Wednesday, March 23, 2022

THERMI Award

Each year, SEMI-THERM honors a person as a Significant Contributor to the field of semiconductor thermal management. The THERMI award is intended to recognize a recipient's history of contributions to crucial thermal issues affecting the performance of semiconductor devices and systems.
The voting body of past THERMI winners and the current year General Chair are pleased to present the 2021 THERMI Award to:

Dr. Sreekant Narumanchi
National Renewable Energy Laboratory

Advanced Power Electronics and Electric Machines for Electric-Drive Mobility Applications

Electronics, power electronics, and electric machines are becoming important for an array of mobility/transportation, renewable energy and energy efficiency applications. In this presentation, I will provide an introduction to NREL and my Group. Then, I will describe some challenges and opportunities for power electronics, electric machines and electric drives for mobility applications in particular. After that, I will give a brief overview of my Group's research activities in these areas.

Schedule of Events

Wednesday, March 23, 2022

1:30 p.m. – 6:00 p.m. — **Sierra, Cascade**
Exhibits Open

1:50 p.m. – 2:00 p.m.
Break

2:00 p.m. – 3:00p.m. — **San Jose, Santa Clara**
Vendor Workshops 4:
Siemens
CPC

3:00 p.m. – 4:00 p.m. — **San Jose, Santa Clara**
Vendor Workshops 5:
Future Facilities
Cool IT

5:30 p.m. – 6:30 p.m. — **Bayshore Ballroom**
Exhibitor Reception

Luncheon Speaker
Wednesday March 23

Another day at the office: combining AI, CFD, and Belgian beer

Presenter: Lieven Vervecken, Diabatix

The majority of people do not really know what it is and the word highly overstates the technology, but Artificial Intelligence (AI) has made its entry and it is here to stay. Logically, it was only a matter of time before AI found its way into the field of Computational Fluid Dynamics (CFD). The possibilities with this combination seem endless, but are they really? Which challenges are we facing and how can we overcome them? In this talk I share some of our experiences when working with some of the largest companies in the world with one of the newest technologies in the world.

Lieven Vervecken is co-founder and CEO of Diabatix nv where he is responsible for the general management and the overall vision and strategy of the company. Diabatix is a Belgian technology scale-up specialized in generative design for cooling components that helps multinationals all over the world to push the boundaries in thermal design. Before devoting his work full-time to Diabatix, Lieven completed two master's degrees in engineering and a PhD in the field of Computational Fluid Dynamics from the University of Leuven. Lieven is an experienced speaker at national and international conferences, and former lecturer at the University of Leuven. He is passionate about the limitless possibilities of combining engineering with artificial intelligence technology and takes every opportunity to expand his knowledge in this field.

Thursday March 24, 2022 12:30 p.m.

The 2021 Harvey Rosten Award

Sponsored by Mentor, a Siemens business

For Outstanding Work in the Field of Thermal Analysis of Electronic Equipment:

Measuring the RthJC of Power Semiconductor Components Using Short Pulses



Sujay Singh, Andras Vass-Varnai, Joe Proulx

Sujay Singh received his Ph.D. degree in physics from The State University of New York at Buffalo, Buffalo, NY, USA, in 2016. Sujay started his career at Fairchild Semiconductor as a Thermal Characterization Reliability Engineer in 2015. He is currently a Senior Principal Reliability Engineer at ON Semiconductor. He is involved in the new product development, environmental testing, lifetime testing, and lifetime modeling of silicon and wide-bandgap power devices. He has authored or coauthored over 20 journal/conference publications. He serves as a peer-reviewer for Physical Review, Applied Physics Letters, and the Journal of Applied Physics. His current research interests include electronic and thermal transport in micro/nanoscale, semiconductor device packaging, reliability, failure analysis, and resistive switching.

Andras Vass-Varnai obtained his MSc and PhD degrees in electrical engineering at the Budapest University of Technology and Economics. He started his professional career at the MicReD group of Mentor Graphics as an application engineer in 2007. Andras worked most for over 10 years as a product manager, supporting development projects, such as the DynTIM or the Powertester instruments. Before starting his current role as a global business development manager in Siemens, Andras worked out of Seoul, Korea, supporting the Asian business activities. He is working out of Chicago IL currently, with dedicated focus on the US market growth. His main topics of interest include thermal management of electric systems, advanced applications of thermal transient testing, characterization of TIM materials and reliability testing of high-power semiconductor devices.

Joe Proulx, Senior Consultant Engineer for Siemens, Mentor Graphics Corporation and Flomerics since 2005, specializing in thermal and fluid flow analysis. Over 25 years of experience as a thermal engineer in the industry. Extensive computational fluid dynamics (CFD) experience for electronics cooling analysis, and more than 10+ years specializing in thermal transient test measurement for thermal characterization of semiconductors and reliability assessment. Several patents pending in package thermal modeling and validation subjects and regularly contribute to IEEE & SAE conference papers for power electronics reliability and electronics thermal simulation subjects.

The Harvey Rosten Award

The Award is for outstanding work, recently published or in the public domain, which advances the analysis or modeling of thermal or thermomechanical effects in electronic equipment or components, including experiments aimed specifically at the validation of numerical models. The award is in the form of a plaque and a $1000 cash prize. The Award was established by the family and friends of Harvey Rosten, to commemorate his achievements in the field of thermal analysis of electronics equipment, and the thermal modeling of electronics parts and packages. The Award is made annually to encourage innovation and excellence in these and closely related fields.

The recipient is selected by the Selection Committee, made up of eminent practitioners in the electronics-thermal field. The criteria for selection are that the work: represents an advance in thermal analysis or thermal modeling of electronics equipment or components, including experiments aimed specifically at validating numerical models; demonstrates clear application to practical electronics design; demonstrates insight into the physical processes affecting the thermal behavior of electronics components, parts and systems; is innovative in embodying this understanding in either thermal analysis or thermal modeling; takes a pragmatic approach.

Schedule of Events

Thursday, March 24, 2022

7:00 a.m. – 12:00 p.m. — **Bayshore Foyer**
Attendee Registration

7:00 a.m. – 7:45 a.m. — **Monterey**
Speakers' Breakfast (March 24 Speakers, Session Chairs and Co-Chairs only)

8:00 a.m. – 8:10 a.m. — **Donner, Siskiou**
Opening Remarks
Ross Wilcoxon, Collins Aerospace

8:10 a.m. – 9:10 a.m. — **Donner, Siskiyou**
Session 5: Data Center
Session Chair: Ross Wilcoxon, Collins Aerospace

8:10 a.m. – 8:30 a.m.
Air Cooling Server Conversion to Two Phase Immersion Cooling and Thermal Performance Results
Javier Avalos Garcia, Oscar del Rio, Oscar Farias, Intel Corp.

8:30 a.m. – 8:50 a.m.
Characterization of Parallel and Opposed Control Dampers to Observe the Effect on Thermal Mixing of Air Streams in an Air-Cooling Unit
Pavan Kaulgud, Ashwin Siddarth, Vibin Shalom Simon, Dereje Agonafer, University of Texas at Arlington

8:50 a.m. – 9:10 a.m.
Subzero System Heating for Outdoor Applications
Rich Ewy, Steve Langanke, Intel Corp.

9:10 a.m. – 10:10 a.m.
Embedded Tutorial: Designing Thermal Interface Materials for Manufacturability and Ease of Use
Mark Wisniewski , Laird

10:10 a.m. – 10:30 a.m. — **Bayshore Ballroom Foyer**
Break

10:30 a.m. – 11:50 p.m. — **Donner, Siskiyou**
Session 6: Emerging Technologies
Session Chair: Dave Saums, DS&A LLC.

10:30 a.m. – 10:50 p.m.
Manufacturing of Integrated Thermal Management Solutions Using Friction Stir Channelling Derived Process
Vito Di Pietro[1], Joao Gandra[1], Alan Clarke[1], James Hockaday[2], Richard Law[2], 1TWI Ltd, [2]Newcastle University

Continued

Embedded Tutorial

Thursday, March 24, 2022

9:10 a.m. – 10:10 a.m.

Designing Thermal Interface Materials for Manufacturability and Ease of Use

Mark Wisniewski, Laird

Designing high end thermal interface material for performance is only one interface materials can be applied by the end customer is a key design consideration. As applications have changed and become more sensitive to certain conditions, the design of the TIMs have had to change as well to ensure the user has a good experience. As part of improving the manufacturability automation is becoming more popular and new automation methods have been developed. Today's materials must account for both manual application and application by machine automation.

Mark Wisniewski is the Product Director for Laird's Thermal Materials business. He has a BS in Chemical Engineering and an MBA degree from Case Western Reserve University in Cleveland Ohio.

Mark has led the Thermal Materials business globally since he joined Laird in 2007. In his role Mark is responsible for the global growth and profitability of the business as well as the success of the R&D roadmap.

Mark's background prior to Laird includes 16 years of direct manufacturing experience making him a strong advocate of Designing for Manufacturing.

SEMI-THERM® 38

Mechanical & Aerospace Engineering
The University of Texas at Arlington

UNIVERSITY OF TEXAS ARLINGTON

We are proud to sponsor:

The SEMI-THERM Educational Foundation
Thermal Hall Of Fame

Lifetime Achievement Award

Presented To

David Saums

In Recognition of Significant Contributions
to the Field of Electronics Thermal Management

Dave Saums has forty-four years of technical marketing, product development, and business development experience with advanced thermal materials, thermal components, and two-phase liquid cooling systems. Currently operating a consulting firm focused on thermal materials and components for nineteen years, Dave also has twenty-five years' experience working for manufacturers of thermal components and thermal materials.
A Fellow of the Society, for IMAPS, Dave holds B.S. and M.B.A. degrees from Clarkson University in New York.

Schedule of Events

Thursday, March 24, 2022

10:50 p.m. – 11:10 p.m.
Oscillating Heat Pipe Thermal Performance and Stability Limits
Ross Wilcoxon[1], Joe Boswell[2], Bruce Drolen[2], [1]Collins Aerospace, [2]Thermavant Technologies

11:10 p.m. – 11:30 p.m.
Thermal and Hydraulic Characterization of a Double-sided Cold Plate Used in AI Systems
Azita Soleymani, Electronic Cooling Solutions

11:30 p.m. – 11:50 p.m.
PCM Infiltrated Metal Foam Based Advanced Passive Heat Exchangers
Burhan Ozmat[1], Metodi Zlatinov[2], Denver Schaffarzick[2],
[1]OZER Advanced Technologies, [2]ERG Aerospace Corporation

11:50 p.m. – 12:30 p.m. **Oak and Fir**
Thermal Hall of Fame Recipient Presentation - Dave Saums, DS&A, LLC

12:30 p.m. – 1:50 p.m. **Oak**
Awards Luncheon
Alex Ockfen, Meta, Marcelo del Valle, Infinera

2:30 p.m. – 6:00 p.m. **San Jose**
TAB meeting

4:00 p.m. – 5:00 p.m. **San Jose**
STEF BOD meeting

6:00 p.m. – 7:15 p.m.
Post ST committee meeting

Friday, March 25, 2022

8:00 a.m. – 4:00 p.m. **San Martin**
JEDEC JC 15 Meeting
Thermal Characterization Techniques for Semiconductor Packages Activities within JC-15's scope include the standardization of thermal characterization techniques, both testing and modeling, for electronic packages, components, and materials for semiconductor devices.

EXHIBITOR LISTINGS

Alpha Novatech, Inc. **404**

Alpha Novatech, Inc. is your partner for Thermal Solutions. We offer a wide variety of standard heat sinks and accessories. Our product line includes natural convection, forced convection, and active heat sinks. We also offer various attachment methods and hardware for almost any application. In addition, we can offer free heat sink thermal simulations. Standard or custom heat sinks in prototype to production quantities Quick and easy customization without NRE fees. Standard parts are carried in stock. Lead time for custom parts of 1-2 weeks is possible for initial quantities.
www.alphanovatech.com

Binghamton University S3IP **403**

S3IP brings together teams of experts from industry and academia to address pressing real-world problems in the systems integration and manufacturing of electronics. Our research centers focus on topics related to electronics packaging, flexible electronics, heterogeneous integration, energy-efficient electronic systems and energy harvesting and storage. Binghamton University, the premier public university in the Northeast, is home to S3IP, a New York State Center of Excellence. Our PhD-level staff members and affiliated faculty, in 6 constituent research centers and 9 laboratories, are ready to assist companies in New York State and beyond with collaborative problem solving. As a result of our combined efforts, our industry partners have reported over $1.5 billion of economic benefit.
https://www.binghamton.edu/s3ip/index.html

Ansys **502**

If you've ever seen a rocket launch, flown on an airplane, driven a car, used a computer, touched a mobile device, crossed a bridge, or put on wearable technology, chances are you've used a product where Ansys software played a critical role in its creation. Ansys is the global leader in engineering simulation. We help the world's most innovative companies deliver radically better products to their customers. By offering the best and broadest portfolio of engineering simulation software, we help them solve the most complex design challenges and engineer products limited only by imagination. Visit www.ansys.com for more information.
www.ansys.com

CEJN North America **509**

CEJN North America, the Quick Connect Solution Provider, delivers couplings and solutions for your liquid cooling needs. Our Leak-Free, Non-Drip coupling series offers high flow and minimal pressure drop; and Blind Mating options range from DN 3 to DN 19. CEJN's new UltraFlow Series features an extremely high flow combined with an unequalled low pressure drop. Customized solutions are also available. At CEJN, we develop our products for a future in liquid cooled data centers.
Contact us: PHONE: 847-263-7200, by email: customer.service.usa@cejn.com, or via www.cejn.us.

EXHIBITOR LISTINGS

Celsia

Celsia specializes in custom heat sink design and manufacturing using liquid two-phase devices: heat pipes and vapor chambers. Through its US headquarters and Taiwan design & production facility, the company's goal is to deliver fast, affordable, and reliable thermal solutions for the most demanding applications including high density electronics, performance CPU / GPU, amplifiers, HBLEDs, ASICS, and rugged systems. In recent years, Celsia has shipped over 2.5 million thermal assemblies to a global custom base in the telecommunications, computer, test equipment, defense, laser, and medical markets.
https://celsiainc.com/

CPC **505**

CPC thinks beyond the point of connection to help protect valuable electronics. Designed specifically for liquid cooling applications, rugged couplings withstand long periods of connection yet disconnect reliably without drips.
https://www.cpcworldwide.com/

CoolIT

CoolIT Systems specializes in scalable liquid cooling solutions for the world's most demanding high-performance computing environments. In the desktop enthusiast market, CoolIT provides unparalleled performance for a range of gaming systems utilizing its patented split flow technologies. Through its modular, Direct Liquid Cooling technology, Rack DLC™, CoolIT enables dramatic increases in rack densities, component performance and power efficiencies. CoolIT partners with the global IT OEM leaders and Cloud Service Providers to provide the most efficient and reliable liquid cooling solutions. Together, CoolIT and its partners are leading the way for widespread adoption of efficient high-density and high-performance computing.
https://www.coolitsystems.com/liquid-lab-2/

Electronics Cooling Magazine

Electronics Cooling magazine has been providing a technical data column since 1997 with the intent of providing you, the readers, with pertinent material properties for use in thermal analyses. We have largely covered the most common materials and their associated thermal properties used in electronics packaging.
ITEM Media publishes a portfolio of digital and print magazines within the electronics industry. Our titles are available in a variety of electronic and printed media formats, including digital magazines, e-newsletters, social media feeds, forums, content marketing tools and printed magazines.
https://www.electronics-cooling.com/

EXHIBITOR LISTINGS

elementsix™
DE BEERS GROUP

Element Six **405**

Element Six (E6), part of the De Beers Group, is a world leader in the development and production of synthetic diamond solutions.

Since 1959, E6's focus has been on engineering diamond materials to unlock innovative applications, including thermal management, optics, quantum and sensing.

Chemical vapour deposition (CVD) diamond is used as a thermal heat spreader to manage the huge power densities (>4 kW/cm2) associated with modern semiconductor devices, underpinning the exponential demand in internet bandwidth. Thanks to a thermal conductivity up to x10 higher than other solutions, diamond acts as the perfect platform to mount devices on. For example, gallium nitride power amplifiers mounted on diamond can be optimised to drop junction temperatures by >30%.

Our patented technology places us at the forefront of synthetic diamond innovation, enabling us to deliver competitive advantage to our customers through diamond-enabled solutions.

Find out more are e6.com and contact us at ustechnologies@e6.com

www.e6.com

Electronic Cooling Solutions inc

2344B Walsh Avenue, Building F, Santa Clara, CA 95051 (408) 738-8331

Electronic Cooling Solutions **501**

Electronic Cooling Solutions Inc. (ECS)

ECS, founded in 1998, was formed with the vision of providing the best thermal management consulting services to the industry world-wide. This vision continues to be the driving force for the company and its team.

Based in the heart of Silicon Valley, ECS has established a reputation for high-quality and cost-effective solutions for its clients. Members of the team bring a combination of design, simulation, and experimental skills to the table required to address the thermal design issues faced by our clients. We have clients and business relationships throughout the United States as well as internationally, and work with some of the biggest names in the electronics industry.

Overview

ECS provides thermal design services to companies in the electronics industry. We are vested in thermal design for automotive, telecommunications, computing, networking, medical, automotive, and consumer products. We also have thermal design experience for avionics, military equipment, solar and alternative energy systems. Our capabilities include datacenter, room, system, board, and package level thermal analysis and design.

https://ecooling.com/

EXHIBITOR LISTINGS

Fujipoly America Corp **408**

Fujipoly is a world leader in the manufacture of Sarcon® Thermal Interface Materials, which are used to help keep sensitive electronic components cool by eliminating the air gap between the component and heat sink. Our products range in thermal conductivity from 1.0m watt/m-K to 17 watt/m-K, offering some of the lowest thermal resistance in the industry. Our product line-up consists of soft Gap Filler Pads, Conformable Putties, Form-In-Place Gap Fill Materials, as well as custom and standard die-cut thin film materials. Our wide range of material types, coupled with the widest range of thermal conductivity, allows us to meet most design criteria. Fujipoly has nine locations in North America, Europe, and Asia making it easy for us to assist our customers at the local level.
www.fujipoly.com

Future Facilities **402**

6SigmaET is a thermal modeling tool that uses advanced computational fluid dynamics (CFD) to create accurate models of electronic equipment. Designed specifically for the electronics industry, our software ushers in unparalleled intelligence, automation and accuracy to help you meet your requirements and to help you overcome thermal design challenges.
Thermal simulation is a key element of the engineering design process. Our software enables you to create and solve models quickly, verify electronic designs before manufacturing, and optimize the best thermal performance while reducing your time to market. This level of intelligence and automation enables designers to spend more time on design, and less time on software operations.
https://www.6sigmaet.info/software/features/

USA Hongfuhan Technology Co. **508**

Shenzhen Hongfuhan Technology Co., Ltd. was established in 2008, after 13 years of development, Hongfuhan Technology has formed four core businesses: thermal management, automation equipment, precision die-cutting, and metal processing.
From the perspective of industrial chain operation, the company continues to integrate industrial resources and deepen integrated operation, relying on mature equipment manufacturing and metal processing technology, and focuses on solving customers' core demands of stable supply, cost reduction, and risk control. Hongfuhan Technology always adheres to the core values of "humanity, technology, and learning", take the market as the guide, technology as the support, honesty, and trustworthiness as the fundamental criterion, continuously improves the technical strength, and is committed to becoming a trustworthy solution provider. The Company was listed on the GEM on October 20, 2021.
https://www.hongfuhan.cn/

EXHIBITOR LISTINGS

Indium Corporation **500**

Indium Corporation is a premier materials manufacturer and supplier to the global electronics, semiconductor, thin-film, and thermal management markets. Products include solders and fluxes; brazes; thermal interface materials; sputtering targets; indium, gallium, germanium, and tin metals and inorganic compounds; and NanoFoil®. Founded in 1934, Indium has global technical support and factories located in China, Malaysia, Singapore, South Korea, the United Kingdom, and the USA.

For more information about Indium Corporation, visit www.indium.com or email abrown@indium.com. You can also follow our experts, From One Engineer To Another® (#FOETA), at www.facebook.com/indium or @IndiumCorp.

www.indium.com

LISAT **401**

LISAT, manufacturer of Thermal Interface Material & EMI products. HQ in U.S., LISAT have operations in Asia. In U.S., we provide Thermal Management Solution to customers & work with R&D Engineers at Design Centres. We provide technical support & samples to our customers to test our materials. Our Asia operations provide manufacturing, converting, technical & sales to customers' worldwide. Our products : TIM Pad, Insulator, Silicon Free TIM, Gel, Grease, Mylar, Graphite, Conductive Plastic, Conductive Elastomer, Fabric-Over-Foam, Microwave Absorbing Material, Metal Finger Stock, EMI Shielding Solution, Switching Power Supply, Desktop & Wall Mount Adaptor, Metal Core PCB, Ceramic PCB. Email alan@lisat.net

https://lisat.net/

Novark Technologies

Novark's team of highly skilled experts and nearly 1000 employees focus on the custom design, development, and manufacturing of Novark's three product families. Novark supports thermal solutions in a wide variety of markets, including PC, telecom, industrial power, servers, data centers, transportation, LED Lighting, and many more. Novark also supports scientific research at many universities, and frequently supplies materials and prototypes to researchers.

https://www.novarktechnologies.com/

EXHIBITOR LISTINGS

Schlegel Electronic Materials **407**

Schlegel Electronic Materials is a trusted industry leader and pre-eminent manufacturer of thermal interface materials.

The OpTIM® thermal interface materials by Schlegel offer a wide range of thermal performance and physical properties and can resolve even the most challenging thermal problems. As a result, designers use our TIMs widely for demanding applications, including advanced microprocessors, high-speed memory modules, micro heat pipe assemblies, and LED lighting.

OpTIM thermal interface materials include:

- Gap Fillers
- Conductive
- Phase Change
- Thermal Grease
- Insulator
- Thermal Putty

Schlegel is also proud to introduce TimSorb Hybrid Thermal / EMI Absorber to tackle the Increased demand for thermal management.

See product catalog for more details: https://www.flipsnack.com/schlegelemi/optim-thermal-interface-material-product-catalogue/full-view.html

Contact our expert team:
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1600 Lexington Ave
Suite 236A
Rochester, NY 14606
Tel: +1 585-643-2000
E: schlegelemi.na@schlegelemi.com
www.schlegelemi.com

Shin-Etsu MicroSi, Inc. **409**

Shin-Etsu MicroSi is the leader in Thermal Interface Material, and we have developed an extensive line of Molding Compounds, Encapsulents, Silicon and Epoxy coatings along with die Attachment Materials. The quality of our thermal interface material is among the most advanced in semiconductor manufacturing and has a wide range of use in thermal interface material applications. Some of which include thermal gels and grease, phase change materials, and high hardness silicone rubber pads. Shin-Etsu products are delivered globally to many major and minor companies involved in the fabrication process of electronics and microelectronics.

www.microsi.com

EXHIBITOR LISTINGS

Siemens Digital Industries Software **507**

Simcenter simulation and test solutions support you in developing a thermal digital twin. Learn how Siemens Digital Industries Software can help you achieve digital transformation goals.

Simulation: Simcenter includes a range of leading electronics cooling software, CAD-embedded CFD opportunities, and multi-physics analysis tools to support a wider range of engineering user skill and experience demographic, from analyst to designer. Find out how you can accelerate thermal, thermo-mechanical and electrothermal analysis workflows and better incorporate MCAD and ECAD complexity.

Test: Simcenter Micred semiconductor package thermal characterization hardware supports accurate measurement of thermal metrics, calibration for highest transient thermal simulation fidelity, through to power electronics reliability testing and manufacturing quality assessment solutions.

You are also invited to discover Simcenter solutions in further domains such as electromagnetics, acoustics, vibration, structural analysis, and more.

www.siemens.com/simcenter

Stäubli **400**

Stäubli, a leading global manufacturer of quick-release coupling systems for use in IT/liquid cooling will be exhibiting at Semi-Therm this year. Our products have been designed for perfect integration in installations such as data centers or super computers. Stäubli North America has more than 200 employees supporting Connectors, Robotics, and Textiles customers. The company's North American headquarters is in Duncan, South Carolina. Stäubli has a global workforce of over 5,500 employees, 14 production sites across the globe, and is supported by a comprehensive distribution network in 50 countries worldwide.

www.staubli.com

Thermal Engineering Associates **501**

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.

https://www.thermengr.net/

ThermAvant Technologies **503**

ThermAvant Technologies, LLC designs, develops and delivers custom thermal solutions to improve size, weight, performance and/or costs of advanced energy and technology platforms. The leading provider of Oscillating Heat Pipe products, ThermAvant also offers custom Cold Plates, Ejector Refrigerators, and Design & Engineering services.

https://www.thermavant.com

EXHIBITOR LISTINGS

ThermoAnalytics **406**

ThermoAnalytics provides thermal solutions for complex vehicle engineering simulation. Our software, TAITherm, is the industry's most complete and flexible thermal modeling software, one that can predict the full range of temperature distribution in your product or system. TAITherm can model a variety of thermally sensitive components including transient brakes, underhood, exhaust and underbody simulation, HVAC, cabin, battery packs for HEV/EV, and more. ThermoAnalytics' rapid transient thermal analysis can couple to FEA and CFD software, a key component to an efficient design process. Our software is commonly used in the automotive, aerospace, heavy vehicle, and railway industry. ThermoAnalytics also offers advanced consulting services with our engineering teams that specialize in thermal, CFD, infrared simulation and testing.

https://thermoanalytics.com/

ZutaCore **506**

ZutaCore is a direct-on-chip, waterless, two-phase, liquid cooling technology company that unlocks the power of sustainable cooling. By dissipating heat at the source, ZutaCore's HyperCoolTM cuts the cooling power infrastructure needed from the server to the data center. Eliminating the risk of IT meltdown and engineered for low-flow and low-pressure allows for light, compact design and high densities. Coupled with on-demand and closed-loop features, HyperCool maximizes cooling efficiencies, guaranteeing consistent performance in any climate and location. The ZutaCore solution is a complete hardware system enhanced by an optional software-defined-cooling (SDC) platform. The result – the data center shrinks, scarce energy, water, land and construction resources are saved, CAPEX and OPEX are slashed, return on investments (ROI's) are accelerated, and real estate assets are maximized. Designed by a veteran team in Israel and enabled by 14 patent-pending innovations, HyperCool is a near plug-and-play system.

https://zutacore.com/