SEMI-THERM® TTW

SEMI-THERM® Thermal Technologies Workshop 2022

Microsoft Corporation Conference Center

Redmond, Washington USA

FINAL PROGRAM

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November 8 - 10, 2022

All Workshop Technical Sessions, Exhibits, and Dining:

Microsoft Corporate Campus, Bldg. 33, Rainier Room

16070 NE 36th Way, Redmond WA 98052

www.SEMI-THERM.org

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SEMI-THERM® 39

The 39th Annual Thermal Measurement, Modeling and Management Symposium
March 13th - 17th, 2023
Thermal Innovations that Make the World's Technology Cool
San Jose, California at the Doubletree by Hilton
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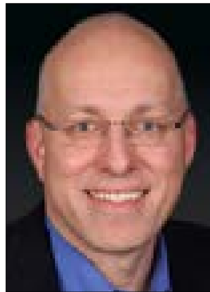
Tuesday November 8, 2022

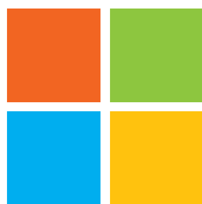
Tuesday Keynote

Data Centers Today… and What Can We Expect Tomorrow...



Christian Belady
Vice President and Distinguished Engineer at Microsoft

Christian Belady is a seasoned veteran managing Datacenter/Infrastructure Development at global scale. He has developed one of the largest data center footprints in the world. He is currently the Vice President of Cloud Infrastructure Strategy and Architecture for Microsoft's Cloud Infrastructure Organization



Microsoft

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Tuesday November 8, 2022

8:45 a.m. - Opening Remarks, Dave Saums, DS&A LLC

9:00 a.m. - Session Chair: Dave Saums, DS&A LLC

Keynote Presentation: Data Centers Today… and What Can We Expect Tomorrow...
Christian Belady, Microsoft Corporation

10:00 a.m. - Evaluation of TIMs in Single- and Two-phase Liquid Immersion Systems
Dave Saums, DS&A LLC

10:30 a.m. - Break

Mobile and Medical Devices
Session Chair: Nader Nikfar, Qualcomm Technologies, Inc.

11:00 a.m. - Acoustic Simulation
Andy Delano, Microsoft Corporation

11:30 a.m. - Best Practices Measuring Mobile Device/User Thermal Interactions
Rick Burke, Thermetrics Inc.

12:00 p.m. - Evaluating Burn Risk from Smartwatch Battery Failure During Exercise
Timofey Golubev, ThermoAnalytics

Continued

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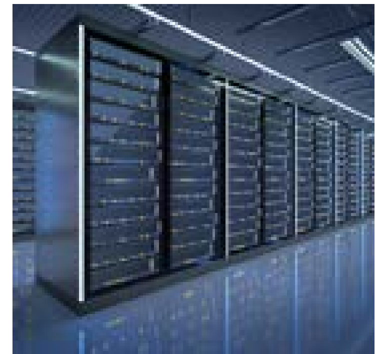
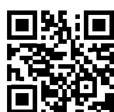

Durable Coatings



CONNECT WITH THE **HENKEL TEAM IN BOOTH #18**

Henkel

Tuesday November 8, 2022

12:30 p.m. - Lunch

Technology Development and Modeling
Session Chair: Devin Pellicone, Advanced Cooling Technologies, Inc.

2:00 p.m. - BCI-ROM Mapping for Variable Die Power Density Fast Transient Temperature Response
John Wilson, Siemens Digital Solutions
Co-author: Byron Blackmore, Siemens Digital Solutions

2:30 p.m. - Expermental and Numerical Investigation of Thermal Hotspot Effects in 3D ICs
Dayananda Swamy Kattimani Math**, Binghamton University, SUNY
Co-authors: Srikanth Rangarajan, Baghat Sammakia; Binghamton University, SUNY

3:00 p.m. - Thermal Management for Electric Machines
Kathryn Kirsch, Raytheon Technologies Research Center
Co-authors: Kim Saviers, Jagadeesh Tangugu; Raytheon Technologies Research Center

3:30 p.m. - Break

Advanced Thermal Interface Materials
Session Chair: Margaret Chen, Qualcomm Technologies

4:00 p.m. - Evolution of Solder TIMs for Next Generation HPC Packages
Tim Jensen, Indium Corporation

4:30 p.m. - Highly Efficient Heat Dissipation Solution for Optical Transceiver
Tho Nguyen, Henkel Corporation
Co-author: Siyao He, Henkel Corporation

5:00 p.m. - A New High Viscosity Liquid Metal Paste for Thermal Management
Miloš Lazić , Indium Corporation

5:30 p.m. - Dinner

Advanced Thermal Interface Materials
Session Chair: Leila Choobineh, Microsoft Corporation

7:00 p.m. - Applications for Liquid Metal Encapsulated Elastomers as TIM2
Dylan Shah, Arieca Inc.

7:30 p.m. - Bonded Liquid Metal (BLM™) TIM to Simplify Liquid Metal TIM Applications in CPU/GPU Cooling
Himanshu Pokharna, Deep Materials Inc.

Wednesday Keynote

Thermal Energy Storage:
An Enabling Technology for High-power Electronic and Photonic Devices

Dr. Darin James Sharar
Thermal Sciences and Engineering Team Lead, DEVCOM Army Research Laboratory

High-power electronics, RF amplifiers, and laser photonic devices are theoretically capable of unlimited on-time, however, high heat fluxes combined with limited maximum device temperatures prevent prolonged operation. Continuous air, liquid, and vapor compression cooling can be scaled-up to handle high thermal loads but the additional size, weight and power (SWaP) required for such scaled-up thermal management systems makes these approaches impractical. Instead, pulse power operation modes coupled with transient thermal management approaches are being adopted to balance high-power needs with platform considerations. This talk describes recent work at the Army Research Laboratory (and collaborators) using phase-change thermal energy storage (TES) materials to store and release thermal energy in active and passive cooling architectures. We show that the phase change enthalpy can increase package thermal capacitance, and resultant on-time, by nearly an order-of-magnitude with no moving parts and minimal size, weight, and volume penalty. Moreover, the combination of TES and pulse power operation lowers the time-averaged thermal load on a system primary coolant loop in active cooling architectures. This, in turn, reduces the overall thermal management power consumption and enables a reduction in the size of ancillary components (fluid reservoirs, radiators, fans, heat exchangers, and pumps). These completely-passive and combined passive-active thermal management approaches provide a powerful tool for balancing capability and practicality.

Dr. Darin James Sharar is recognized for pioneering research which has enhanced thermal technology programs critical to the U.S. Army and the Department. His research resulted in the discovery of the use of metallic solid-state phase-change materials to exploit multifunctional solid-solid thermal energy storage materials to enable transient high payloads. Dr. Sharar's leadership and expertise in research and development, coupled with inspiring the next generation of scientists, have greatly advanced the Department's mission.

Thank you to our Student Stipend Sponsor

Wednesday November 9, 2022

8:45 a.m. - Opening Remarks, Dave Saums, DS&A LLC

9:00 a.m. - Keynote Presentation:
Thermal Energy Storage: An Enabling Technology for High-power Electronic and Photonic Devices
Darin Sharar, Army Research Lab/DEVCOM

10:00 a.m. - Development Update on CTE-Matched Rigid Thermal Composites and Materials
Dave Saums, DS&A LLC

10:30 a.m. - Break

Single-Phase Liquid and Liquid Immersion Technologies
Session Chair: Bill Maltz, Electronic Cooling Solutions Inc.

11:00 a.m. - Numerical and Experimental Investigation of Fin Distribution and Spreading Thickness on Thermal Performance for 1P/2P Liquid Cold Plate for Non-Uniform Power
Najmeh (Diana) Fallahtafti**, Binghamton University/SUNY
Co-author: Bahgat Sammakia, Binghamton University/SUNY

11:30 a.m. - Air Versus Single-phase Liquid Cooling Performance
Guy Wagner, Electronic Cooling Solutions Inc.

12:00 p.m. - Alternative Component Materials to Enhance Performance and Reliability in Liquid Cooling
Elizabeth Langer, CPC

12:30 p.m. - Lunch

2:00 p.m. - Panel Discussion: The Metaverse and Implications for Electronic Systems
Adriana Rangel, Cisco Systems; Guy Wagner, Electronic Cooling Solutions Inc.

Continued

** Student Abstract Competition Winner

Thank you to our Major Sponsor

Wednesday November 9, 2022

3:30 p.m. - Break

Two-Phase Active Liquid Cooling Technologies
Session Chair: Herman Chu, Celestica Inc.

4:00 p.m. - Characterization of Contamination Extracted from Cabling in Immersion Cooling
Phil Tuma, 3M EMMD, Electronic Liquids Business Unit
Co-authors: Joshua Hemelgarn, Tyler Matthews; 3M EMMD

4:30 p.m. - Pumped Single-phase Versus Two-phase Cooling for Power Electronics Applications
Devin Pellicone, Advanced Cooling Technologies, Inc.
Co-authors: Derek Leaman, Andy Slippey, Advanced Cooling Technologies, Inc.

5:00 p.m. - Two-phase Thermal Management Achievements and Challenges for Directed Energy Laser Systems
Aleks Shepsis, Lockheed Martin, Laser and Sensor Systems

5:30 p.m. - Dinner

Passive Two-Phase Technologies
Session Chair: Herman Chu, Celestica Inc.

7:00 p.m. - Disruptive New Two-Phase Cooling Technologies
Winston Zhang, Novark Technologies Inc.
Co-authors: Jackson Marcinichen, John Thome; JJ Cooling, Zurich

7:30 p.m. - Gravity Independence of Meter Scale Oscillating Heat Pipes for Passive Heat Transport
Corey Wilson, ThermAvant Technologies LLC

8:00 p.m. - Acoustic Noise Reduction - A Constructal Law Approach
Yazdan Razi, San Jose State University, Aerospace Engineering
Co-authors: Kittinan Maliwan, Thailand; Xin Mao, Cisco Systems

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Thursday November 10, 2022

Thursday Keynote

"Communications in Thermal Engineering"

Andy Delano, Director, Thermal Technology Development, Surface Products

Thermal Engineering depends entirely on communication. To control temperature, the transfer of thermal energy relies on adequate communication between the solid, gas, and liquid materials present in our designs. In the case of a breakdown in the thermal communication path, the resulting loss of temperature control can be catastrophic. While engineering effective and reliable communication of thermal energy is an exhaustively discussed topic, creating, and maintaining effective and reliable communications between the engineers themselves and their related colleagues is sometimes overlooked, and the resulting communication breakdown can range from mildly annoying to completely disastrous. I chose to pursue technology and science partially because the scientific method seemed to provide a precise method for communicating over what non-scientific fields had to offer. However, over time it became apparent that science does not yet hold all the answers and practicing this other side of communications is also critical. Over the last ten years I have taken a personal and professional interest in this other side of communications, and I will present the highlights of what I have learned and how it has helped me improve my communication style.

Andy Delano is Director, Thermal Technology Development, Surface Products. Previously the thermal lead on Surface Pro 4 and 5, he also led the Microsoft Surface Culture of Learning Thermal team, managing cross organizational collaboration and knowledge sharing among all of Microsoft's thermal engineers.

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Thursday November 10, 2022

8:45 a.m. - Opening Remarks, Guy Wagner, Electronic Cooling Solutions, Inc.

9:00 a.m. - Keynote Presentation:
Communications in Thermal Engineering
Andy Delano, Microsoft Corporation

10:30 a.m. - Break

Battery and Power Module Thermal Challenges
Session Chair: Kathryn Kirsch, Raytheon Technologies Research Center

11:00 a.m. - Packaging Optimization of a Silicon Carbide Power Module
Farid Soroush, Apple, Inc.

11:30 a.m. - Holistic Battery Safety Design
Will Walker, KULR Technology

12:00 p.m. - Calculating Thermal Design Power for Mobile Consumer Electronics
Alex Ockfen, Meta Platforms Inc.

12:30 p.m. - Lunch

Two-Phase Pumped Dielectric Liquid Cooling
Session Chair: Dave Saums, DS&A LLC

2:00 p.m. - Recent Progress and Current Research Challenges for Cooling of Dynamic Thermal Loads in Military and Airborne Systems
Mark Spector, Office of Naval Research

2:30 p.m. - Development of a Pumped Refrigerant Two-phase Liquid Cooling System for Nvidia DGX Station A100
Joe Marsala, Durbin Group Inc.

3:00 p.m. - Pumped Hybrid Two-phase Cooling System for High Heat Flux Electronics
Elizabeth K. Seber, Advanced Cooling Technologies, Inc.
Co-authors: Michael C. Ellis, Mohammad Reza Shaeri, Massoud Kaviany, Advanced Cooling Technologies, Inc.

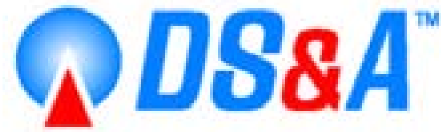
3:30 p.m. - Advanced Cooling for Next Generation ICs
Bharath Krishnaraman, Microsoft Corporation
Co-author: Husam Alissa, Microsoft Corporation

4:00 p.m. - Closing Remarks, Dave Saums, DS&A LLC

EXHIBITOR LISTINGS

CPC

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.



DS&A

DS&A LLC was founded in 2002 to provide experienced technical and business analysis and strategy development to assist manufacturers with identifying development opportunities and requirements for advanced thermal materials, components, and systems, including:

- Highly specialized and focused industry segment and requirements analyses for new product development;
- Thermal materials testing and characterization guidance for ASTM D 5470-17 thermal resistance and thermal conductivity test stands, custom thermal test die, and thermal test vehicles;
- Identification and characterization of industry market segments and specific thermal challenges and application requirements for:
- Advanced thermal materials
- CTE-matched composites for semiconductor packaging
- High-temperature-capable thermal materials
- Pumped two-phase dielectric liquid cooling
- Discussions with leading industry contacts for EV inverters, battery packs and energy storage, power semiconductors, advanced processors, and related industry segments.

Dave Saums, Principal
Amesbury MA USA
Tel: +1 978 479 7474 Email: dsaums@dsa-thermal.com
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Deep Materials Inc.

Deep Materials is a one-stop-shop for your toughest thermal challenges. We offer the highest performance thermal management design services and solutions for a variety of systems. Our technically advanced Loop Thermosyphons carry significantly more heat over longer distances with lower thermal resistance than the traditional heat pipes.

The increased functionality and miniaturization of devices have heightened the need for superior thermal management technologies on all fronts. Additionally, component temperature reduction ensures higher performance, user safety, extends device lifetime/reliability and, boosts customer satisfaction.

Electronic Cooling Solutions Inc.

Ever-increasing power density drives the need for high-quality and cost-effective thermal management resource. Electronic Cooling Solutions is that resource. We use state-of-the-art simulation and measurement tools and employ design and analysis methodologies that can be scaled to address emerging thermal challenges. This leads to a better thermal design. Electronic Cooling Solutions, Inc. is committed to providing thermal management expertise to the electronics industry. We strive to provide our customers with complete solutions, tailored to meet their technical requirements, so that their business goals will be achieved in a timely and cost-effective manner. www.ecooling.com

EXHIBITOR LISTINGS

HERMETIC SOLUTIONS GROUP
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HERMETIC SOLUTIONS GROUP, LLC

Hermetic Solutions Group is the premier global supplier of specialty interconnects, hermetic packaging, and engineered components and services. Comprised of industry leading brands - Hi-Rel Group, Cristek Interconnects, Inc., Sinclair FilConn, Litron, PA&E, and Zet-Tek Manufacturing, we offer a comprehensive solution for hermetic packages, specialty connectors, cable assemblies, headers, lids, windows, thermal management materials, vacuum products, preforms, and laser systems and services. We make our customers' lives easier by providing them every solution needed to enable and protect sensitive electronics in critical applications and harsh environments. And while our customers are at the center of everything we do, we recognize that it is our employees that make it all happen, and we are proud of that fact. With over 1,000 employees located in eleven facilities across three countries, we like to say that we are unconventional, thoughtful, and always willing to go the extra mile – not only for our customers but for our employees too. For more information contact info@hermeticsolutions.com

Indium Corporation

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.

Henkel is a global leader in thermal management, adhesives and protection materials. In the Data & Telcom sectors, Henkel provides multiple solutions for heat dissipation, structural integrity and device protection to raise reliability and performance. Our award-winning BERGQUIST® brand thermal gels, durable microTIM coatings, GAP PAD® thermal interface materials (TIMs) and phase change TIMs are enabling the design of next-generation high-power 5G telecom and compute-intensive data center technologies. Learn more at www.henkel-adhesives.com or visit our team in booth #18.

Novark Technologies, Inc.

Novark Technologies, Inc. was founded in 2004 in Shenzhen, China, and quickly became a recognized name in the thermal management industry. Novark first established itself as a qualified supplier of heat pipes to support the development of tier-one high-tech companies such as Microsoft, AMD, Sony, and Toshiba, then branched out into heat sinks and cold plates. Novark became known for their cost-effective and high-quality manufacturing processes and their agility in response to customer needs.

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. www.novarktechnologies.com

EXHIBITOR LISTINGS

SEKISUI POLYMATECH AMERICA CO., LTD

Sekisui Polymatech is a global supplier of electronic components. We specialize in solving heat, moisture, vibration, water, and other custom challenges for our consumer electronics customers.

ThermAvant Technologies

ThermAvant Technologies is the world's leading oscillating heat pipe (OHP) provider: designing, modeling, and manufacturing thermal-mechanical structures embedded with OHP technology for compact, high power density opto-electronic, and power-energy systems. ThermAvant also offers custom cold plates, traditional heat transfer devices, and design & engineering services.

ThermAvant Technologies filed its first patent in 2007 and began to apply for research and development grants. We were awarded our first grant in 2009 and spent the next six years demonstrating oscillating heat pipe's ultra-high thermal conductance, reliable manufacturing, and predictive models. In 2017, ThermAvant designed, manufactured, and delivered OHP thermal straps for the ASETS-II spaceflight experiment led by the Air Force Research Laboratory Space Vehicles Directorate (AFRL/RV). These OHPs operated successfully aboard the X-37B space plane for 780 days. Since then, ThermAvant has grown OHP sales to aero-defense customers by more than 50% per year.

In 2018, R&D World selected ThermAvant and AFRL as the winners of the most technologically significant new product in the materials/mechanical category.

Today, ThermAvant is the first and only AS9100/ISO9001 certified manufacturer of oscillating heat pipe thermal solutions for the aero-defense and high-technology industries. And our team of researchers, engineers, and technicians continuously innovate new thermal-mechanical solutions for private party and government customers.

ThermoAnalytics

ThermoAnalytics is an employee-owned company with its headquarters in Michigan's scenic Upper Peninsula. ThermoAnalytics (TAI) is a global thermal, fluid-flow, and infrared modeling software developer. ThermoAnalytics software products and services help engineers in organizations worldwide to optimize product concepts early in the design process, enabling them to significantly improve product quality while reducing product development time and cost.

ThermoAnalytics provides software and services to both commercial and government customers. Over the years, we have pioneered thermal analysis tools and technology used in automotive, architecture, aerospace, defense, manufacturing, and textiles. Though the company has grown and continued to drive innovation in its two decades in business, we remain committed to mastering thermal management challenges by applying the most sophisticated technology to identify design challenges and opportunities earlier, faster, more reliably, and at a lower cost.

Over 25 years of experience has contributed to the evolution of their software, serving industries such as automotive, aerospace, architecture, defense, textiles, and manufacturing. Applications include underhood models, exhaust and underbody simulation, HVAC, cabin, transient brakes, battery packs for HEV/EV, electronics, and other thermally sensitive components. For more information, go to www.thermoanalytics.com.

Thermal Technologies Workshop 2023

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