

Thirty First Annual **SEMICONDUCTOR THERMAL MEASUREMENT, MODELING AND MANAGEMENT SYMPOSIUM**



IEEE COMPONENTS, PACKAGING AND
MANUFACTURING TECHNOLOGY SOCIETY

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PROCEEDINGS 2015

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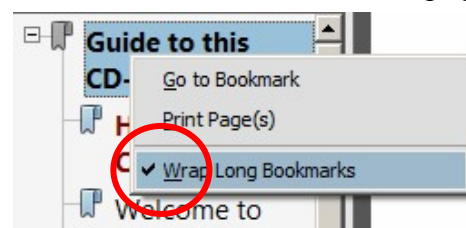
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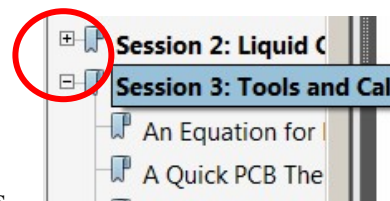
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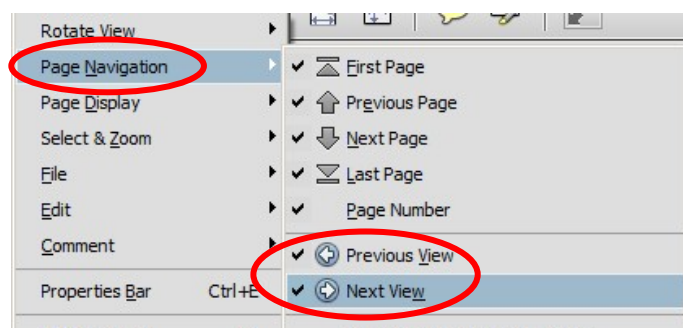
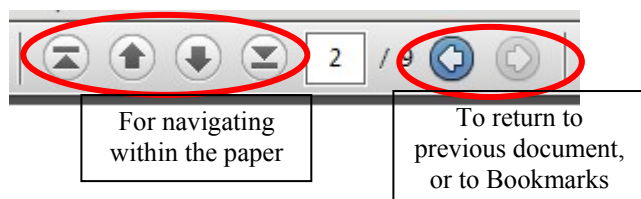


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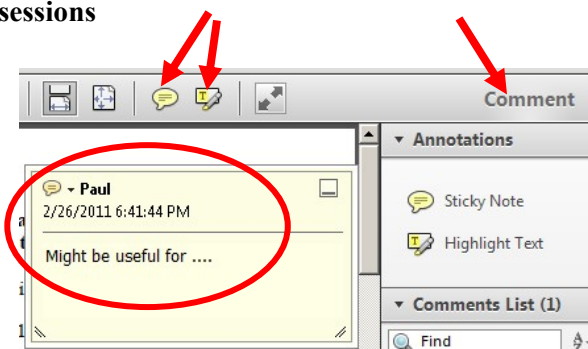
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THERMI Award Winner 2015

Each year, SEMI-THERM honors a person as a Significant Contributor to the field of thermal management. The THERMI award is intended to recognize a recipient's history of contributions to crucial thermal issues affecting the performance of electronic devices and systems. The voting body of past THERMI winners and current General Chair Peter Rodgers are pleased to present the 2015 THERMI award to:

**Christian Belady**

General Manager, Data Center Services
Microsoft Global Foundation Services

Christian Belady is the general manager of Data Center Services for Microsoft's Global Foundation Services (GFS) group. He is responsible for driving the strategy and delivery of server and facility development worldwide, including research, engineering, construction, and operations for Microsoft's data center portfolio. These data centers provide the foundational cloud infrastructure for over 200 Microsoft online and cloud services for consumers and businesses worldwide. Prior to joining Microsoft, Christian was a Distinguished Technologist for HP where he was responsible for driving the technology direction of HP's server products and their environments, as well as industry data center initiatives. In 2010, SearchData named Christian as one of "5 People who changed the data center" industry and helped drive innovative thinking and quantitative benchmarking in the field. With over 100 US patents and many international patents, Christian is an ASME and IMAPS Fellow and a founding member of ASHRAE's TC9.9, which is responsible for developing data center guidelines.

Christian holds engineering degrees from Cornell University (BS) and Rensselaer Polytechnic Institute (MS) and a business degree from the University of Texas at Dallas (MA) where he was honored with the 2010 Distinguished Alumni Award.

The Harvey Rosten Award for Excellence, 2014

Harvey Rosten Award winners are Jesse Galloway, Cameron Nelson and Phillip Fosnot



From left to right; Jesse Galloway, Cameron Nelson and Phillip Fosnot

Cameron Nelson received a Bachelor of Science in Mechanical Engineer from Arizona State University. He joined Amkor Technology in 2010 and now leads thermal simulation characterization as a Senior Thermal Engineer. Phillip Fosnot also received a Bachelor of Science in Mechanical Engineering from Arizona State University. He joined Amkor in 2012 and now supports simulation and experimental testing of electronic packages. Jesse Galloway has over 25 years in the electronic packaging industry. He manages the Thermal and Mechanical Characterization team at Amkor Technology in Tempe, Arizona.

Their paper from SEMI-THERM 2014, **Extracting TIM Properties with Localized Transient Pulses**, is included with this Proceedings, for your awareness.

SEMI-THERM TECHNICAL SHORT COURSES

Highly informative short courses were offered Sunday March 15 - Monday March 16, 2014. These outstanding technical courses are focused on the thermal sciences and are presented by leaders in the thermal field.

Short Course 1: Crash Course on Packaging Technologies and Thermal Design of ICs**Li Li, PhD, Distinguished Engineer, Cisco Systems****Herman Chu, Principal Engineer, Cisco Systems**

The course covers:

- Overview of various types of IC packages and their targeted application(s), advantages and limitations.
 - Describe the construction, materials and assembly processes associated with IC packages.
- Understand the influence of various package design parameters on the thermal, electrical and thermo-mechanical reliability performance of the package.
- Discussion of typical failure modes associated with IC packages and identify the common stress drivers.
 - Future IC packaging trends.

Short Course 2: Use of Flow Network Modeling (FNM) for Improving Productivity of Design of Electronic Cooling Systems**Kanchan M. Kelkar, Ph.D., Innovative Research, Inc.****Sukhvinder Kang, Ph.D., Aavid Thermalloy**

As the complexity and power density of electronics systems increase, there is an ever-increasing demand for methods and tools to improve the quality of the product and the productivity of the designers. The Flow Network Modeling (FNM) technique achieves this by focusing on the analysis of the interaction among the cooling components to determine system-level performance in a rapid and accurate manner. The short course will discuss the details of the FNM technique and illustrate its use in the thermal design process of air- and liquid-cooling systems.

The specific topics to be covered in the course are as follows:

- Overview of the FNM technique • Overall design process and role of Flow Network Modeling
 - Complementary use with CFD • Theoretical Basis of FNM
 - Construction of the flow network of a cooling system
- Overall flow and thermal characteristics of cooling components using loss factors from handbooks and measured data
 - Characteristics of commonly encountered components such as ducts/tubes, orifices, screens, heat sinks and cold plates, heat exchangers, fans and pumps
- Overall solution method for network analysis and results obtained
 - Practical Use of Flow Network Modeling
 - Use of hand calculations for analysis of an air cooling system
 - Use of spreadsheets for analysis of air and liquid-cooling systems
- Generalized flow network analysis of practical systems using the commercial software MacroFlow

Keynote Address

Flexible Data Center Design

Building a global network of efficient, large-scale data centers requires flexible designs to accommodate local conditions and constraints, while accommodating rapidly changing IT hardware and software requirements.

This presentation will discuss some of the approaches we've taken and how Google continues to improve data center efficiency.



Christopher G. Malone, PhD
Principal Engineer, Google, Inc.

Chris leads Google's Data Center Research and Development team, which is responsible for developing Google's next-generation data centers and IT hardware with a focus on efficiency, sustainability, and flexibility. Chris has authored numerous refereed technical papers, and has been granted over 100 US and international patents. He is involved with several industry groups and government agency initiatives focused on improving IT efficiency. Prior to joining Google, Chris was a senior technologist at Hewlett-Packard responsible for enterprise server thermal technology strategy.

Chris received his MS and PhD in Mechanical Engineering from the Massachusetts Institute of Technology.



ST31 Embedded Tutorial

Thermal Challenges of 2.5D and 3D Integration

Dr. Herman Oprins, IMEC

This embedded tutorial will present an overview of the thermal challenges of 2.5D (interposer) and 3D integration. The tutorial compares the thermal performance and thermal die-to-die coupling of single chip, 3D and 2.5D package configurations. The thermal impact of the inter die thermal resistance as well as the design and technological options of how to reduce this resistance will be discussed. The tutorial describes thermal test vehicles for uniform, hot spot and programmable power dissipation to emulate target applications. A short overview of modeling techniques and experimental validation approaches is included. Finally, the experimental and modeling analysis will be shown for the case study of a packaged memory-on-logic stack, which is one of the most likely applications of 3D integration.

About the Speaker

Dr. Herman Oprins is a senior research engineer at IMEC in Leuven, Belgium, where he is involved in the thermal experimental characterization, thermal modeling and thermal management of 3D system integration, electronic chip packages, GaN power transistors, photovoltaic modules and microfluidics. Dr. Oprins began his career at IMEC working on the development and modeling of an electrowetting assisted cooling technique. In that period he also worked on modeling and experimental projects in the field of thermal management of electronic packages. Oprins has authored and co-authored over 60 journal and conference papers and holds 2 patents. He holds M.Sc. and Ph.D. degrees in Mechanical Engineering from the K.U. Leuven, Belgium.

Luncheon Talk: “Application and Characterization of Soft Tissue Ablation by Radio Frequency”



Luncheon Abstract: “Radiofrequency (RF) ablation of soft tissue in biomedical application, to wit, atrial fibrillation has been well established. The ablation process thermally destroys tiny areas in the heart that are firing off abnormal electrical impulses causing atrial fibrillation. However use of RF ablation for renal artery denervation is a very recent technique and has revolutionized the treatment of refractory, drug-resistant hypertension. The renal denervation technique has also shown early promise in end stage renal disease (ESRD), and congestive heart failure (CHF) patients.

Design space involves key variables such as electrode shape and dimension, procedural contact impedance, apposition, residence time, and need for coolant circulation to minimize collateral tissue damage. All of these variables can be influenced by real-time detection of the thermal front progressing into the tissue. Hence real-time tissue damage sensing either through a parametric, predictive algorithm or by biochemical marker detection is of paramount importance. Few options will be discussed as an introduction to this topic.”

Bio: SYED FAIYAZ AHMED HOSSAINY

Syed Hossainy, PhD is a senior research fellow at Abbott Vascular. Syed has recently been the head of Abbott Vascular’s innovation incubator group (operating budget ~ \$4.5 MM /yr) with a Vision of “Targeted innovation optimizing short-term and long-term business growth options”.

The group has delivered 10 successful proof-of-feasibility projects completed and readied for advanced development between 2007-2013. Five of these became late-stage development projects. Successful development projects include Bioabsorbable Vascular Scaffold for peripheral vasculature, currently being tested clinically. Formulated and led technical strategy to advance Drug-eluting stent (DES) and Bioabsorbable Vascular Scaffold (BVS) clinical performance attributes. Syed’s technical contributions include:

- **Local Drug delivery:** Developed controlled release technology for combination drug-device application, specifically drug eluting stent (DES) and Bioabsorbable implant technology;
- **Mathematical model:** Developed predictive computational tools for DES application and local Pharmacokinetics; and BVS structure property and mechanical coupling with vessel
- **IP strategy:** Created IP strategy for the entire business unit by partnering with legal.
- **Patent awards:** Over 280 issued patents, Over 380 patents pending (listed in USPTO) in the area of cardiovascular implants, drug delivery, and Biomaterials application.

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