



(( 28<sup>th</sup> INTERNATIONAL WORKSHOP  
Thermal Investigations of ICs and Systems ))

SEPTEMBER 28-30, 2022 | DUBLIN, IRELAND

# PROCEEDINGS 2022

→ WELCOME

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PREFACE



**Lorenzo Codecasa**  
General Chair



**Bernhard Wunderle**  
Vice General Chair



**John Parry**  
Publicity Chair

WELCOME TO THERMINIC 2022!

This 28<sup>th</sup> edition of THERMINIC is again the main European event for academics and industry to share recent advancements in thermal challenges and solutions for electronics and microelectronics, including aspects of nano-scale heat transfer, thermal modelling, simulation of solid-state lighting as well as cooling issues of power electronics.

Following the workshops held in Grenoble (1995), Budapest (1996, 2000, 2007, 2012 and 2016), Cannes (1997 and 1998), Rome (1999), Paris (2001, 2011 and 2015), Madrid (2002), Aix-en-Provence (2003), Sophia Antipolis (2004), Belgirate (2005), Nice (2006), Rome (2008), Leuven (2009), Barcelona (2010), Berlin (2013), Greenwich (2014), Amsterdam (2017), Stockholm (2018), Lecco (2019) and two online workshops (2020, 2021), THERMINIC is taking place in Ireland for the first time. It is exciting to return to a fully in-person workshop after such a challenging time.

The 28th THERMINIC Workshop once again features a strong technical program, with 37 oral and 37 poster presentations organized in 10 oral sessions and 2 poster introduction sessions. More than 130 conference delegates from 23 countries are joining us this year.

This program booklet has been designed as a navigator for your THERMINIC 2022 participation. It includes all the sessions, presentations, and evening events to help make the most of your stay in Dublin. Note that the days have been color-coded for easier handling.

We are delighted to welcome three distinguished representatives from academia and industry as keynote speakers at THERMINIC 2022. John R. Thome (JJ Cooling Innovation Sàrl, formerly EPFL Lausanne), Johannes van Es (Royal Netherlands Aerospace Centre) and Justin A. Weibel (Purdue

University) will showcase current trends and discuss the role of end-to-end thermal fluid design, novel electronics cooling concepts including additive manufacturing, and thermal management for a wide range of applications.

We also have a great evening program planned. The drinks reception on Wednesday evening will be hosted in Trinity College Dublin in the Atrium, adjacent to its historic Dining Hall. This is just a short walk from the venue, through the Trinity College campus. Trinity’s president Provost Dr Linda Doyle is looking forward to welcoming you there. The visit and dinner in the Guinness Storehouse on Thursday night promises to be a true highlight of the Workshop.

We are picking up the initiative of turning THERMINIC into a “green” event, not only by reducing our workshop’s environmental impact, but also by sponsoring the purchase of an acre of bogland here in Ireland to offset the participants’ carbon footprint. Our thanks go to the authors for their presentations and posters, as well as to the members of the scientific committee for soliciting and selecting the right mix of contributions. We are also very grateful to our industry sponsors and exhibitors for their support of THERMINIC 2022.

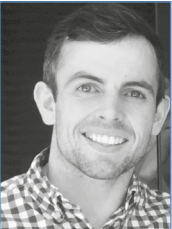
Last not least, we would like to thank the teams from Trinity College Dublin and mcc Agentur für Kommunikation for all their help in the organisation of THERMINIC 2022.

We look forward to an inspiring three days with you at THERMINIC 2022 in Dublin.

**Dr. Tim Persoons**  
Program Chair



**Tim Persoons**  
Program Chair



**Michael Gibbons**  
Program Co-Chair



**Rocco Lupoi**  
Program Co-Chair



**Anthony Robinson**  
Program Co-Chair

Wednesday, September 28, 2022

Welcome

🕒 9.30 am – 9.40 am  
Tim Persoons, Trinity College Dublin

Keynote I:

🕒 9.40 am – 10.20 am  
**Experiences of Applying Passive Micro-Two-Phase Cooling to Electronics (Thermosyphons and Pulsating Heat Pipes)**  
Prof. (Emeritus) John R. Thome  
Chair: Anthony Robinson, Trinity College Dublin

Coffee Break

🕒 10.20 am – 10.40 am

Session 1.1: Power Electronics

🕒 10.40 am – 11.40 am

Poster introductions I

🕒 11.40 am – 12.10 pm

Lunch and Poster Session

🕒 12.10 pm – 1.30 pm

Session 1.2: Convective Single-Phase Cooling

🕒 1.30 pm – 2.50 pm

Vendor session 1

🕒 2.50 pm – 3.20 pm

Coffee Break

🕒 3.20 pm – 3.40 pm

Session 1.3: Packaging

🕒 3.40 pm – 5.00 pm

Walk to Trinity College

🕒 5.10 pm – 5.30 pm

Welcome Reception: The Atrium, Trinity College

🕒 5.30 pm – 7.30 pm



SESSION 1.1

Session 1.1:  
Power Electronics

🕒 10.40 am – 11.40 am

➔ Session Chair: Bernhard Wunderle, TU Chemnitz (DE)

**10.40 am Development of a Realtime Physics Based Digital Twin for Online MOSFET Condition Monitoring in PV Converter Applications**  
Leander Van Cappellen<sup>1,3,4</sup>, Martijn Deckers<sup>2,4</sup>, Omid Alavi<sup>1,3,4</sup>, Michael Daenen<sup>1,3,4</sup>, Johan Driesen<sup>2,4</sup>  
<sup>1</sup>IMO-IMOMECE, Hasselt University, Diepenbeek, Belgium; <sup>2</sup>KU Leuven Electa ESAT/ELECTA, KU Leuven, Heverlee, Belgium; <sup>3</sup>imec, Heverlee, Belgium; <sup>4</sup>EnergyVille, Genk, Belgium

**11.00 am Digital Twin Validation and Thermal Control Aspects in a Power Conversion Module**  
Wendy Luiten  
WLC, Netherlands

**11.20 pm Reliable Force Field Potential for Thermal Transport in AlN**  
Simon Christopher Fernbach<sup>1</sup>, Elke Kraker<sup>1</sup>, Natalia Bedoya-Martínez<sup>1</sup>, Egbert Zojer<sup>2</sup>  
<sup>1</sup>MCL, Leoben, Austria; <sup>2</sup>TU Graz, Graz, Austria





Poster Introductions I

🕒 11.40 am – 12.10 pm

➔ Session Chair: Vadim Tsoi, Huawei Technologies Sweden AB (SE)

**01 Thermal Management with Through Glass Vias for Next Generation Photonic Packages**  
Parnika Gupta  
*Tyndall National Institute, Cork, Ireland*

**02 Determining the Contribution of Spatial Sub-Regions to Structure Functions**  
Lorenzo Codecasa<sup>1</sup>, Vincenzo d'Alessandro<sup>2</sup>, Antonio Pio Catalano<sup>2</sup>,  
Ciro Sognamillo<sup>2</sup>, Dario D'Amore<sup>1</sup>  
*<sup>1</sup>Politecnico di Milano, Milano, Italy; <sup>2</sup>University Federico II, Naples, Italy*

**03 Thermal Disturb TCAD Simulation of Phase Change Memory Device**  
Roberto Simola<sup>1</sup>, Paul Devoge<sup>1</sup>, Philippe Boivin<sup>1</sup>, Stephan Niel<sup>1</sup>, Roberto  
Gonella<sup>1</sup>, Andrea Redaelli<sup>2</sup>  
*<sup>1</sup>STMicroelectronics, France; <sup>2</sup>STMicroelectronics, Italy*

**04 Thermal Performance of Miniature Vapour-Compression Refrigeration System for CPU Thermal Management**  
Fazeel Mohammed Naduvilakath Mohammed<sup>1,3</sup>, Michel Lebon<sup>2</sup>, Gerard  
Byrne<sup>1</sup>, Gemma Murray<sup>1</sup>, Sara Battaglioli<sup>1,3</sup>, Anthony James Robinson<sup>1,3</sup>  
*<sup>1</sup>Department of Mechanical Engineering, Trinity College Dublin, Ireland;  
<sup>2</sup>Nexalus Ltd, Cork, Ireland; <sup>3</sup>CONNECT, Dunlop Oriel House, Trinity College,  
Dublin, Ireland*

**05 An Analysis of the Energy Infrastructure in Generic Data Centres**  
Younis Osama Abdelsalam<sup>1</sup>, Tim Persoons<sup>2</sup>, Sajad Alimohammadi<sup>1,2</sup>  
*<sup>1</sup>Technological University Dublin - City Campus, Dublin, Ireland; <sup>2</sup>Trinity  
College Dublin, Dublin, Ireland*

**06 Accelerating the Thermal Transient Testing by a Novel Temperature Sensitive Parameter Calibration Method Based on I-V Characteristic Measurement**  
Sándor Ress<sup>1,2</sup>, Zoltán Sárkány<sup>2</sup>, Gábor Farkas<sup>2</sup>, Márta Rencz<sup>1,2</sup>  
*<sup>1</sup>Budapest University of Technology and Economics, Budapest, Hungary;  
<sup>2</sup>Siemens DI SW STS, Budapest, Hungary*

**07 Model Order Reduction of a Nonlinear Model of an Electronic Component: Application to a Microchip Activated by 4 Sources**  
Fatme Mustapha<sup>1,2</sup>, Valentin Bissuel<sup>1</sup>, Frédéric Joly<sup>2</sup>, Olivier Quéméner<sup>2</sup>  
*<sup>1</sup>Thales Global Services SAS, Conflans-Sainte-Honorine, France; <sup>2</sup>Laboratoire  
de Mécanique et d'Energétique d'Evry, Evry,France*

**08 Additively Manufactured Lattice Structure Heat Sink for Railway Power Electronics Liquid Cooling**  
Ahmad Batikh<sup>1</sup>, Jean-Pierre Fradin<sup>1</sup>, Antonio Castro Moreno<sup>2</sup>  
*<sup>1</sup>ICAM Toulouse, Toulouse, France; <sup>2</sup>IRT Saint Exupéry Toulouse, Toulouse,  
France*

**09 Thermal Modeling of Embedded Microscale Channel Structures Realized in Heterogeneous Packaging**  
György Bognár, Gábor Takács, Péter Gábor Szabó  
*Budapest University of Technology and Economics, Budapest, Hungary*

**10 Experimental Study on the Thermohydraulic Performance of Oil-Cooled Heat Sinks for Power Electronics**  
Jana Rogiers<sup>1,2</sup>, Ilya T'Jollyn<sup>1,2</sup>, Thomas Schoonjans<sup>1,2</sup>, Jasper Nonneman<sup>1,2</sup>,  
Michel De Paepe<sup>1,2</sup>  
*<sup>1</sup>Ghent Universtity, Ghent, Belgium; <sup>2</sup>FlandersMake@UGent corelab EEDT-MP,  
Ghent, Belgium*

POSTER  
INTRODUCTIONS I

- 11

**Acoustic Noise Insulation for Air-cooled Data Centre Hard Disk Drive Enclosures: Effect on Thermal Management**

Sahan Wasala<sup>1</sup>, Lon Stevens<sup>2</sup>, Raye Sosseh<sup>3</sup>, Tim Persoons<sup>1</sup>

<sup>1</sup>*Trinity College Dublin, Dublin, Ireland;* <sup>2</sup>*Seagate US LLC, Longmont, USA;* <sup>3</sup>*Seagate US LLC, Shakopee, USA*
- 12

**Comparison of Different Formulations for The Dual-Phase-Lag Heat Conduction Model**

Artur Sobczak, Grzegorz Jablonski, Marcin Janicki

*Lodz University of Technology, Lodz, Poland*
- 13

**SPICE Model Extension to Simulate the Transient Coupled Electro-Thermal Behaviour for Several Power Electronic components on System Level - Modelling Approach and Experimental Validation**

Gregor Wiedemann, Ralph Schacht

*Brandenburgische Technische Universität Cottbus-Senftenberg, Cottbus, Germany*
- 14

**Application of L  v  que Analogy to Open Cellular Solids**

Sanjeet Kumar, Sripriya Ramamoorthy, Shankar Krishnan

*Department of Mechanical Engineering, Indian Institute of Technology, Bombay, India*
- 15

**Flow-through Porous Finned Heat Sinks with Helmholtz Resonators for Combined Heat Dissipation and Tonal as well as Broadband Noise Reduction**

Akshay Wagh, Harshavardhan Ronge, Radhika Choudhary, Shankar Krishnan, Sripriya Ramamoorthy

*Department of Mechanical Engineering, Indian Institute of Technology, Bombay, India*

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**Towards Quieter Air-cooling Systems: Rotor Self-noise Prediction for Axial Cooling Fans**

Wenguang Zhao, Sahan Wasala, Tim Persoons

*Trinity College Dublin, Dublin, Ireland*
- 17

**Noise Attenuation Through Optimised Acoustic Metamaterials: A Low Form Factor Design for Targeted Noise Reduction**

Oluwaseyi Ayotunde Ogun, John Kennedy

*Trinity College Dublin, Dublin, Ireland*
- 18

**Design and Characterization of a Sealed Hybrid-cooled High Performance Computing Server**

Michel Lebon<sup>1</sup>, Sara Battaglioli<sup>1,2,3</sup>, Richard Jenkins<sup>1</sup>, Ian Parry<sup>4</sup>, Anthony Robinson<sup>1,2,3</sup>

<sup>1</sup>*Nexalus, Nexalus, Ireland;* <sup>2</sup>*Dep. of Mechanical, Manufacturing & Biomedical Engineering, Trinity College Dublin, Dublin, Ireland;* <sup>3</sup>*CONNECT Centre, Dunlop Oriel House, Trinity College Dublin, Dublin, Ireland;* <sup>4</sup>*OCUK Ltd, Newcastle-under-Lyme, UK*

SESSION 1.2 – 1.3

Session 1.2: Convective Single-Phase Cooling

🕒 1.30 pm – 2.50 pm

➔ Session Chair: Wendy Luiten, WLC (NL)

- 1.30 pm

**High Heat Flux Removal by Water Jet Impingement using 3D Printed Nozzles**

Ram Gopal Varma Ramaraju<sup>1</sup>, Mohammad Passandideh Fard<sup>1,2</sup>,  
Sanjeev Chandra<sup>1</sup>

<sup>1</sup>University of Toronto, Canada; <sup>2</sup>Ferdowsi University of Mashhad, Iran
- 1.50 pm

**Parametric Investigation of Inlet Pressure and Diffuser Angle Impact on Adjustable Air Amplifier Performance**

Eoin Hendrikus Oude Essink<sup>1,2,3</sup>, Tim Persoons<sup>2,3</sup>, Sajad Alimohammadi<sup>1,2,3</sup>

<sup>1</sup>Technological University Dublin, Dublin, Ireland; <sup>2</sup>Trinity College Dublin, Dublin, Ireland; <sup>3</sup>MaREI, SFI Research Centre for Energy, Climate and Marine, Environmental Research Institute, Cork, Ireland
- 2.10 pm

**Heat Transfer Enhancement In A Minichannel Due To Asymmetric Sinusoidal Pulsating Flows**

Parth S. Kumavat<sup>1</sup>, Sajad Alimohammadi<sup>2</sup>, Seamus M. O’Shaughnessy<sup>1</sup>

<sup>1</sup>University of Dublin, Trinity College, Dublin, Ireland; <sup>2</sup>Technological University Dublin, Dublin, Ireland
- 2.30 pm

**Experimental Investigation of the Heat Transfer Characteristics Associated with Dual Jet Cooling**

Paula Jane Murphy<sup>1</sup>, Sajad Alimohammadi<sup>2</sup>, Séamus O’Shaughnessy<sup>1</sup>

<sup>1</sup>Trinity College Dublin, Dublin, Ireland; <sup>2</sup>Technological University Dublin, Dublin, Ireland

Session 1.3: Packaging

🕒 3.40 pm – 5.00 pm

➔ Session Chair: Peter Gabor Szabo, Budapest University of Technology and Economics (HU)

- 3.40 pm

**Tiny Power Box - Thermal Investigations for Very High Power Density Onboard Chargers**

Christian Mentin, Ismail Recepi, Philip Matzick

Silicon Austria Labs, Graz, Austria
- 4.00 pm

**Accelerated Stress Testing and Failure Analysis of Thermal Greases**

Bernhard Wunderle<sup>1</sup>, Daniel May<sup>1</sup>, Jörg Arnold<sup>1</sup>, Mohamad Abo Ras<sup>2</sup>

<sup>1</sup>TU Chemnitz, Chemnitz, Germany; <sup>2</sup>Berliner Nanotest & Design GmbH, Berlin, Germany
- 4.20 pm

**A Novel Integrated Cooling Packaging for High Power Density Semiconductors**

Amin Salim Obaid Al-Hinaai<sup>1,2</sup>, Cyril Butty<sup>1</sup>, Till Huesgen<sup>2</sup>, Daniela Meyer<sup>3</sup>, Richard Zeitler<sup>3</sup>

<sup>1</sup>Electronics Integration Laboratory, University of Applied Sciences Kempten, Kempten, Germany; <sup>2</sup>: Univ Lyon, CNRS, INSA Lyon, Université Claude Bernard Lyon <sup>1</sup>, Villeurbanne, France; <sup>3</sup>: CeramTec GmbH, Plochingen, Germany
- 4.40 pm

**Analysis of the Thermal Behavior of a Li-Ion Pouch Battery Cell – Part I: Finite-Element Simulation Including the Entropic Coefficient**

Marcello Iasiello<sup>1</sup>, Francesco Piccirillo<sup>1</sup>, Nicola Bianco<sup>1</sup>, Luigi Pio Di Noia<sup>2</sup>, Pierluigi Guerriero<sup>2</sup>

<sup>1</sup>Dept. of Industrial Engineering, University Federico II, Naples, Italy; <sup>2</sup>Dept. of Electrical Engineering and Information Technology, University Federico II, Naples, Italy

Thursday, September 29, 2022

Keynote II:

⌚ 8.40 am – 9.20 am

Advances in Two-Phase Cooling of Power Electronics and the Role of 3D-printed Components

Johannes van Es

Session 2.1: Thermal Materials and Reliability

⌚ 9.20 am – 10.20 am

Coffee Break

⌚ 10.20 am – 10.40 am

Session 2.2: Advanced Manufacturing

⌚ 10.40 am – 11.40 am

Poster Introductions II

⌚ 11.40 am – 12.10 pm

Lunch and Poster Session

⌚ 12.10 pm – 1.30 pm

Session 2.3: Thermal Measurements and Characterisation I

⌚ 1.30 pm – 2.50 pm

Vendor Session 2

⌚ 2.50 pm – 3.10 pm

Coffee Break

⌚ 3.10 pm – 3.30 pm

Session 2.4: Thermal Measurements and Characterisation II

⌚ 3.30 pm – 4.50 pm

Coach The Alex -> Guinness

⌚ 6.45 pm – 7.15 pm

Visit and Conference Dinner in Guinness Storehouse

⌚ 7.30 pm – 11.00 pm

Coach Guinness -> The Alex

⌚ 11.00 pm – 11.30 pm



SESSION 2.1 – 2.2

Session 2.1: Thermal Materials and Reliability

🕒 9.20 am – 10.20 am

➔ Session Chair: Marcin Janicki, Lodz University of Technology (PL)

9.20 am Thermal Conductivity Measurements of Thermal Interface Materials Using the Bidirectional 3-Omega Method

Corinna Grosse-Kockert<sup>1</sup>, Mohamad Abo Ras<sup>1</sup>, Daniel May<sup>1,2</sup>, Alexandre Cremieux-Trives<sup>1</sup>, Florian Löffler<sup>1</sup>, Bernhard Wunderle<sup>2</sup>

<sup>1</sup>Berliner Nanotest und Design GmbH, Berlin, Germany; <sup>2</sup>Technische Universität Chemnitz, Chemnitz, Germany

9.40 am Crack Growth Prediction in High-Power LEDs from TTA, SAM and Simulated Data

Joseph Hermann<sup>1</sup>, Maximilian Schmid<sup>2</sup>, Gordon Elger<sup>1</sup>

<sup>1</sup>TU Ingolstadt, Ingolstadt, Germany; <sup>2</sup>Fraunhofer IVI, Ingolstadt, Germany

10.00 am Accelerated Stress Testing for High-Cycle Fatigue of thin Al Films on piezo-driven MEMS Cantilever

Nathanael Jöhrmann<sup>1</sup>, Chris Stöckel<sup>1,2</sup>, Bernhard Wunderle<sup>1,2</sup>

<sup>1</sup>TU Chemnitz, Chemnitz, Germany; <sup>2</sup>Fraunhofer ENAS, Chemnitz, Germany

Session 2.2: Advanced Manufacturing

🕒 10.40 am – 11.40 am

➔ Session Chair: Johannes van Es, Royal Netherlands Aerospace Centre (NL)

10.40 am FEM Analysis of 3D Printable Finned Metal Liquid Cold Plates for Semiconductor Power Modules

Paolo Cova<sup>1</sup>, Nicola Delmonte<sup>1</sup>, Davide Spaggiari<sup>1</sup>, Marco Portesine<sup>2</sup>, Federico Portesine<sup>2</sup>, Roberto Menozzi<sup>1</sup>

<sup>1</sup>University of Parma, Parma, Italy; <sup>2</sup>Poseico S.p.A., Genua, Italy

11.00 am Improving the Performance of Flat Heat Pipes by Exploiting Benefits of Additive Manufacturing

Davoud Jafari, Wessel W. Wits

University of Twente, Enschede, Netherlands

11.20 am Beyond Fourier Thermal Management at the Nanoscale

Paul Desmarchelier<sup>1</sup>, Efstratios Nikidis<sup>2</sup>, Joseph Kioseoglou<sup>2</sup>, Anne Tanguy<sup>3,4</sup>, Konstantinos Termentzidis<sup>1</sup>

<sup>1</sup>CNRS, CETHIL UMR5008, Université Claude Bernard Lyon, Villeurbanne, France; <sup>2</sup>Physics Department, Aristotle University of Thessaloniki, Thessaloniki, Greece; <sup>3</sup>Univ Lyon, INSA Lyon, CNRS, France; <sup>4</sup>ONERA, University Paris-Saclay, Chemin de la Hunière, Palaiseau, France

POSTER  
INTRODUCTIONS II

Poster Introductions II

🕒 11.40 am – 12.10 pm

➔ Session Chair: John Janssen, NXP Semiconductors (NL)

- 01

**Enhancement of an Open Compute Project (OCP) Server Thermal Management and Waste Heat Recovery Potential via Hybrid Liquid-cooling**

Sara Battaglioli<sup>1,2,3</sup>, Michel Lebon<sup>2</sup>, Richard Jenkins<sup>2</sup>, Jon Summers<sup>4</sup>, Jeffrey Sarkinen<sup>4</sup>, Anthony J. Robinson<sup>1,2,3</sup>

<sup>1</sup>Dep. of Mechanical, Manufacturing & Biomedical Engineering, Trinity College Dublin, Dublin, Ireland; <sup>2</sup>Nexalus Labs, Water St, Loughanalla, Castlepollard, Ireland; <sup>3</sup>CONNECT Centre, Dunlop Oriel House, Trinity College Dublin, Dublin, Ireland; <sup>4</sup>RISE, Research Institutes of Sweden, Luleå, Sweden
- 02

**Effects of Wetting Behaviours and Contact Resistance on Thermal and Rheological Characteristics of Thermal Interface Materials**

Julia Lucia Mayer<sup>1,2</sup>, Andreas Griesinger<sup>1</sup>, Norbert Willenbacher<sup>2</sup>

<sup>1</sup>DHBW Stuttgart, Stuttgart, Germany; <sup>2</sup>Karlsruher Institute of Technology, Karlsruhe, Germany
- 03

**Compact SPICE Models of Sub-100 nm FDSOI and FinFET Devices in the Wide Temperature Range (-269°C...+300°C)**

Konstantin O. Petrosyants<sup>1,2</sup>, Mamed R. Ismail-zade<sup>1</sup>, Lev M. Sambursky<sup>1,2</sup>

<sup>1</sup>National Research University Higher School of Economics, Moscow Institute of Electronics and Mathematics, Moscow, Russia; <sup>2</sup>Institute for Design Problems in Microelectronics of Russian Academy of Sciences, Moscow, Russia
- 04

**The Effect of Dimming Frequency on the Aging of Power LEDs**

János Hegedüs, Gusztáv Hantos, András Poppe, Máté Lukács, Bence Bodnár

Department of Electron Devices, Faculty of Electrical Engineering and Informatics, Budapest University of Technology and Economics, Budapest, Hungary

- 05

**Experimental Investigation of a Novel Direct Rotor Cooling Method for an Interior Permanent Magnet Synchronous Machine**

Jasper Nonneman<sup>1,2</sup>, Ieuan Evans<sup>1</sup>, Ilya T’Jollyn<sup>1,2</sup>, Steven Vanhee<sup>1,3</sup>, Michel De Paepe<sup>1,2</sup>

<sup>1</sup>Department of Electromechanical, Systems and Metal Engineering, Ghent University, Ghent, Belgium; <sup>2</sup>Flanders Make@UGent – Core lab EEDT-MP, Ghent, Belgium; <sup>3</sup>Dana Belgium NV, Brugge, Belgium
- 06

**Thermal Transient Testing Alternatives for the Characterisation of GaN HEMT Power Devices**

Zoltan Sarkany<sup>1</sup>, Mattia Musolino<sup>2</sup>, Alessandro Sitta<sup>2</sup>, Michele Calabretta<sup>2</sup>, Gabor Farkas<sup>1</sup>, Mark Nemeth<sup>1</sup>, Marta Rencz<sup>1</sup>

<sup>1</sup>Siemens DI SW STS, Budapest, Hungary; <sup>2</sup>STMicroelectronics S.p.A, Agrate Brianza MB, Italy
- 07

**J-Fraction Approach for Calculating Thermal Structure Functions**

Nils J. Ziegeler<sup>1</sup>, Peter W. Nolte<sup>2</sup>, Stefan Schweizer<sup>1,2</sup>

<sup>1</sup>Faculty of Electrical Engineering, South Westphalia University of Applied Sciences, Soest, Germany; <sup>2</sup>Fraunhofer Application Center for Inorganic Phosphors, Branch Lab of Fraunhofer IMWS, Soest, Germany
- 08

**Thermal Characterization Issues of LEDs during Reliability Testing**

János Hegedüs, Gusztáv Hantos, András Poppe, Máté Lukács, Bence Bodnár, Gyula Lipák

Department of Electron Devices, Faculty of Electrical Engineering and Informatics, Budapest University of Technology and Economics, Budapest, Hungary
- 09

**Mutual Thermal Couplings in Selected Networks with Power LEDs**

Krzysztof Górecki<sup>1</sup>, Przemysław Ptak<sup>1</sup>, Marcin Janicki<sup>2</sup>

<sup>1</sup>Gdynia Maritime University, Gdynia, Poland; <sup>2</sup>Politechnika Łódzka, Łódź, Poland
- 10

**Performance Analysis of Perovskite Solar Cell by Considering Temperatures Effect on Physical Parameters of the Absorber Layer**

Ahmad Halal<sup>1</sup>, Ahmed Issa Alnahhal<sup>1,2</sup>, Balázs Plesz<sup>1</sup>

<sup>1</sup>Budapest University of Technology and Economics, Budapest, Hungary; <sup>2</sup>University of Palestine, Ghazah, Palestine

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**Multi-Objective Evolutionary Optimization of Multi-node Network for Thermal Modelling of Electronic Package**

Eric Monier-Vinard, Najib Laraqi

*Paris Nanterre University, Paris, France*
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**Study of Two-phase Microchannel Heat Sink Fabricated by A.M. Technology**

Nan Chen<sup>1</sup>, Yunshui Chen<sup>2</sup>, He Zhao<sup>3</sup>

*<sup>1</sup>Advanced Liquid Cooling Technologies; <sup>2</sup>Airsys Cooling Technologies; <sup>3</sup>Airsys Singapore*
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**Including Transistor-level Hotspots in Standard Parameters and Models**

Patrick Elebert<sup>1</sup>, Xiaojie Xue<sup>2</sup>, Colm Heffernan<sup>1</sup>

*<sup>1</sup>Analog Devices, Inc., Limerick, Ireland; <sup>2</sup>Analog Devices, Inc., Wilmington, MA, USA*
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**Thermal-Electrical Model of Concentrated Photovoltaic-Thermoelectric Generator Combined System for Energy Generation**

Ahmed Issa Alnahhal<sup>1,2</sup>, Ahmad Halal<sup>1</sup>, Balazs Plesz<sup>1</sup>

*<sup>1</sup>Budapest University of Technology and Economics, Budapest, Hungary; <sup>2</sup>University of Palestine, Gaza Strip, Palestine*
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**Thermal-Hydraulic Characterization of Electronics Cooling Liquids: A Case Study of Jet Impingement Coldplate on Emulated CPU**

Gemma Murray<sup>1</sup>, Jonathan William Elliott<sup>1</sup>, Richard Jenkins<sup>2</sup>, Michel Thomas Lebon<sup>2</sup>, Gerard Bryne<sup>1</sup>, Anthony James Robinson<sup>1</sup>

*<sup>1</sup>Trinity College Dublin, Dublin, Ireland; <sup>2</sup>Nexalus Ltd., Cork, Ireland.*
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**Mass-Diffusivity Determination of Four Tropical Wood used in Benin**

Carlos Alain Houngbeme<sup>1</sup>, Armand Djossou<sup>1</sup>, Aristide Houngan<sup>1,2</sup>

*<sup>1</sup>Energy and Applied Mechanics Laboratory (LEMA); <sup>2</sup>Multidisciplinary Research Laboratory for Technical Education (LARPET) ENSET Lokossa, Brnin*

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**Failure Analysis by Infrared and Thermoreflectance Imaging Applied on Active Devices**

Daniel May<sup>1</sup>, Kenza Jbari<sup>3</sup>, Dominique Carisetti<sup>3</sup>, Ana Borta-Boyon<sup>3</sup>, Patrick Garabedian<sup>3</sup>, Afshin Ziaei<sup>3</sup>, Mohamad Abo Ras<sup>2</sup>, Bernhard Wunderle<sup>1</sup>

*<sup>1</sup>TU Chemnitz, Chemnitz, Germany; <sup>2</sup>Berliner Nanotest & Design GmbH, Berlin, Germany; <sup>3</sup>Thales Research, Palaiseau, France*
- 18

**Thermal Performance Analysis of a Pulsating Heat Pipe with a Long Adiabatic Section for Different Working Fluids**

Sauro Filippeschi<sup>1</sup>, Roberta Perna<sup>1</sup>, Mauro Mameli<sup>1</sup>, Maksym Slobodeniuk<sup>3</sup>, Luca Pagliarini<sup>2</sup>, Cyril Romestant<sup>3</sup>, Luca Cattani<sup>2</sup>, Vincent Ayel<sup>3</sup>, Fabio Bozzoli<sup>2</sup>

*<sup>1</sup>University of Pisa, DESTEC - Italy; <sup>2</sup>University of Parma; <sup>3</sup>Pprime Institute, CNRS – ENSMA – Universite de Poitiers*
- 19

**Measurements of the Thin Liquid Droplet Thickness by the Schlieren Method**

Yulia Peschenyuk<sup>1</sup>, Andrey Semenov<sup>1</sup>, Evgeny Shatskiy<sup>2</sup>, Gagik Ayvazyan<sup>3</sup>, Elizaveta Gatapova<sup>1</sup>

*<sup>1</sup>Kutateladze Institute of Thermophysics SB RAS, Novosibirsk, Russia; <sup>2</sup>Department of Mechanical, Manufacturing & Biomedical Engineering, Trinity College Dublin, Dublin, Ireland; <sup>3</sup>National Polytechnic University of Armenia, Yerevan, Armenia*



SESSION 2.3 – 2.4

Session 2.3: Thermal Measurements and Characterisation I

🕒 1.30 pm – 2.50 pm

➔ Session Chair: Lorenzo Codecasa, Politecnico di Milano (IT)

- 1.30 pm

**Void Detection in the Solder Layer between Power Semiconductor and PCB**

Nils Jahn, Martin Pfof

*TU Dortmund University, Dortmund, Germany*
- 1.50 pm

**Raman Thermometry Characterization of GeSbTe Based Phase Change Materials**

Akash Rajendra Patil<sup>1,2</sup>, Yannick Le-Friec<sup>2</sup>, Jury Sandrini<sup>2</sup>, Roberto Simola<sup>3</sup>, Philippe Boivin<sup>3</sup>, Emmanuel Dubois<sup>1</sup>, Jean-François Robillard<sup>1</sup>

<sup>1</sup>Univ. Lille, CNRS, Centrale Lille, Junia, Univ. Polytechnique Hauts-de-France, UMR8520 - IEMN – Institut d’Electronique de Microélectronique et de Nano-technologie, Lille, France; <sup>2</sup>STMicroelectronics, Crolles, France; <sup>3</sup>STMicroelectronics, Rousset, France
- 2.10 pm

**Experimental Three-dimensional Thermal Mapping of a GaN on RF-SOI Chip**

Isaac Haïk Dunn<sup>1</sup>, Elyes Nefzaoui<sup>1</sup>, Jérôme Loraine<sup>2</sup>, Imene Lahbib<sup>2</sup>, Georges Hamaoui<sup>1</sup>, Tuyen Duc Nguyen<sup>1</sup>, Brice Grandchamp<sup>2</sup>, Philippe Bas-set<sup>1</sup>, Gregory U’Ren<sup>2</sup>

<sup>1</sup>Univ Gustave Eiffel, CNRS, ESYCOM Lab, Champs-sur-Marne, France; <sup>2</sup>X-FAB France, Corbeil-Essonnes, France
- 2.30 pm

**A Laser Stimulated Transient Thermal Analysis of Semiconductors**

Hannes Schwan<sup>1</sup>, Maximilian Schmid<sup>2</sup>, Gordon Elger<sup>1</sup>

<sup>1</sup>Technische Hochschule Ingolstadt, Ingolstadt, Germany; <sup>2</sup>Fraunhofer IVI, Dresden, Germany

Session 2.4: Thermal Measurements and Characterisation II

🕒 3.30 pm – 4.50 pm

➔ Session Chair: Mohamad Abo Ras, Berliner Nanotest und Design GmbH (DE)

- 3.30 pm

**Thermo-electric Characterization of GST Materials for Smart Environment**

Gian Guido Gentili<sup>1</sup>, Misagh Khosronejad<sup>1</sup>, D’Asta Cristina<sup>1</sup>, Codecasa Lorenzo<sup>1</sup>, Squillantini Lorenzo<sup>1</sup>, Draghi Lorenza<sup>1</sup>, Nobili Luca<sup>1</sup>, Spagnolini Umberto<sup>1</sup>, Resteghini Laura<sup>2</sup>, Milani Angelo<sup>2</sup>, Mazzucco Christian<sup>2</sup>

<sup>1</sup>Politecnico di Milano, Milano, Italy; <sup>2</sup>Huawei Technology Italia
- 3.50 pm

**Concepts for High throughput LED Testing and High-speed Optical Transients of LEDs**

András Poppe<sup>1</sup>, János Hegedüs<sup>1</sup>, Gusztáv Hantos<sup>1</sup>, Péter Csuti<sup>2</sup>

<sup>1</sup>Department of Electron Devices, Faculty of Electrical Engineering and Informatics, Budapest University of Technology and Economics, Budapest, Hungary; <sup>2</sup>LightingLab Calibration Laboratory Ltd., Veszprém, Hungary
- 4.10 pm

**Analytical Modeling and Numerical Simulation of Nonlinear Thermal Effects in Bipolar Transistors**

Vincenzo d’Alessandro<sup>1</sup>, Ciro Scognamillo<sup>1</sup>, Antonio Pio Catalano<sup>1</sup>, Markus Müller<sup>2</sup>, Michael Schröter<sup>2</sup>, Peter Joseph Zampardi<sup>3</sup>, Lorenzo Codecasa<sup>4</sup>

<sup>1</sup>University Federico II, Naples, Italy; <sup>2</sup>TU Dresden, Dresden, Germany; <sup>3</sup>Qorvo, USA; <sup>4</sup>Politecnico di Milano, Milano, Italy
- 4.30 pm

**Analysis of the Thermal Behavior of Li-Ion Pouch Battery Cell – Part II: Circuit-based Modeling for Fast and Accurate Thermo-Electrochemical Simulation**

Antonio Pio Catalano<sup>1</sup>, Ciro Scognamillo<sup>1</sup>, Francesco Piccirillo<sup>2</sup>, Pierluigi Guerriero<sup>1</sup>, Vincenzo d’Alessandro<sup>1</sup>, Lorenzo Codecasa<sup>3</sup>

<sup>1</sup>Dept. of Electrical Engineering and Information Technology, University Federico II, Naples, Italy; <sup>2</sup>Dept. of Industrial Engineering, University Federico II, Naples, Italy; <sup>3</sup>Politecnico di Milano, Milano, Italy

Friday, September 30, 2022

Keynote III:

🕒 9.00 am – 9.40 am

Unlocking Thermal Constraints on Electronics Systems: Key to  
Revolutions in Transportation, Computing, and Communications

Prof. Justin A. Weibel

Session 3.1: Design and Simulation

🕒 9.40 am – 10.40 am

Coffee Break

🕒 10.40 am – 11.00 am

Session 3.2: Convective Two-Phase Cooling I

🕒 11.00 am – 12.40 pm

Lunch

🕒 12.40 pm – 1.40 pm

Session 3.3: Convective Two-Phase Cooling II

🕒 1.40 pm – 3.00 pm

Coffee Break

🕒 3.00 pm – 3.10 pm

Awards and Closing Remarks

🕒 3.10 pm – 3.30 pm

Chairs: Tim Persoons, Trinity College Dublin; John Janssen,  
NXP Semiconductors; Vadim Tsoi, Huawei

SESSION 3.1 – 3.2

Session 3.1: Design and Simulation

🕒 9.40 am – 10.40 am

➔ Session Chair: Marta Rencz, Budapest University of Technology and Economics (HU)

- 9.40 am

**Extraction of Thermal Models for Electromigration Analysis at Advanced Nodes**

Ron Martin<sup>1</sup>, Aravind Vadakkekoithuruthil<sup>1</sup>, Christoph Sohrmann<sup>1</sup>, Volkhard Beyer<sup>1</sup>, Avi Debnath<sup>2</sup>, Hendrik Mau<sup>2</sup>

<sup>1</sup>Fraunhofer IIS, Engineering of Adaptive Systems EAS, Dresden, Germany; <sup>2</sup>GlobalFoundries Dresden, Germany
- 10.00 am

**Sensitivity Analysis and Uncertainty Quantification of Data Processing Unit Thermal Model Dedicated for Micro-satellite Space Mission**

Artur Jurkowski<sup>1,2</sup>, Radosław Paluch<sup>1</sup>, Marcin Wójcik<sup>1</sup>, Adam Klimanek<sup>2</sup>

<sup>1</sup>KP Labs, Gliwice, Poland; <sup>2</sup>Silesian University of Technology, Gliwice, Poland
- 10.20 am

**Design Optimization of Micro-Thermoelectric Cooler for Thermal Management using Finite Element Simulations**

Rajvinder Kaur, Amit Tanwar, Parnika Gupta, N. Padmanathan, Peter O'Brien, Kafil Mahmood Razeeb

Tyndall National Institute, University College Cork, Cork, Ireland

Session 3.2: Convective Two-Phase Cooling I

🕒 11.00 am – 12.40 pm

➔ Session Chair: Michael Gibbons, Trinity Colleg Dublin (IE)

- 11.00 am

**Nucleate Pool Boiling Regimes Of Power Electronics Cooling**

Ilya T'Jollyn<sup>1,2</sup>, Jasper Nonneman<sup>1,2</sup>, Wim Beyne<sup>1</sup>, Michel De Paepe<sup>1,2</sup>

<sup>1</sup>Ghent University, Ghent, Belgium; <sup>2</sup>FlandersMake@UGent – Core lab EEDT-MP, Ghent, Belgium
- 11.20 am

**Simulation and Experimental Investigation of Single and Two-phase Cold Plate Using HFE 7100 with Discrete Heat Sources**

Ammar Osman, Yogendra Joshi

Georgia Institute of Technology, Atlanta, USA
- 11.40 am

**Numerical Simulations of Conjugate Heat Transfer Effects on Single- and Two-Phase Cooling via Multi-Microchannels Heat Sinks**

Mirco Magnini<sup>1</sup>, Federico Municchi<sup>2</sup>

<sup>1</sup>University of Nottingham, Nottingham, United Kingdom; <sup>2</sup>Colorado School of Mines, Golden, USA
- 12.00 pm

**Investigation of Groove Heat Pipe Embedded Cold Plate Design with Additive Manufacturing Technologies**

Vedat Yagci<sup>1,2</sup>, Murat Parlak<sup>1</sup>, Sertac Cadirci<sup>2</sup>

<sup>1</sup>ASELSAN INC- REHIS-Engineering Division, Ankara, Turkey; <sup>2</sup>Istanbul Technical University, Istanbul, Turkey
- 12.20 pm

**The Impact of Roughness Parameters on Laminar Convective Heat Transfer Applied to Additive Manufactured Minichannels**

Mohammadreza Kadivar<sup>1,2</sup>, David Tormey<sup>1,2</sup>, Gerard McGranaghan<sup>1,2</sup>

<sup>1</sup>Atlantic Technological University, Sligo, Ireland; <sup>2</sup>I-Form, The SFI Advanced Manufacturing Research Centre, Dublin, Ireland



SESSION 3.3

Session 3.3: Convective Two-Phase Cooling II

🕒 1.40 pm – 3.00 pm

➔ Session Chair: Justin Weibel, Purdue University (USA)

1.40 pm    **Evaluation of the Performance of a Magnetic Shuttle Micropump in a Two-phase Mechanical Pumping Loop**

Valeria Nico<sup>1</sup>, Barry O'Donovan<sup>2</sup>, Eric Dalton<sup>1</sup>  
<sup>1</sup>University of Limerick, Limerick, Ireland; <sup>2</sup>ASML, Leixlip, Ireland

2.00 pm    **Time-Resolved Measurement of Enhanced Phase Change by a Fiber in an Oscillating Two-Phase Plug Flow**

Nooshin Karami, Albert Tessier-Poirier, Alihossein Nikkhah, Etienne Leveille, Luc Frechette  
*Laboratoire Nanotechnologies et Nanosystèmes, LN2 CNRS, Université de Sherbrooke, 3IT (Institut Interdisciplinaire d'Innovation Technologique), Sherbrooke, QC, Canada*

2.20 pm    **Review on Flow Boiling Patterns in Microchannels**

Joseph J Widgington, Atanas Ivanov, Tassos G Karayiannis  
*Brunel University London, London, United Kingdom*

2.40 pm    **Immersion Cooling of Lithium-ion Batteries for Electric Vehicles**

Niall Patrick Williams, Séamus O'Shaughnessy  
*Trinity College Dublin, Dublin, Ireland*

**Awards & Closing Remarks**

🕒 3.10 pm – 3.30 pm

➔ Session Chairs: Tim Persoons, Trinity College Dublin (IE); John Janssen, NXP Semiconductors (NL), Vadim Tsoi, Huawei (SE)

CONTACT



CONFERENCE PROGRAM CHAIRS &  
LOCAL ORGANIZING COMMITTEE

Tim Persoons, Trinity College Dublin, Ireland  
Michael Gibbons, Trinity College Dublin, Ireland  
Anthony Robinson, Trinity College Dublin, Ireland  
Rocco Lupoi, Trinity College Dublin, Ireland

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Sara Doherty, Trinity College Dublin, Ireland

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