Organisational Information

For registration please use the registration form which is available on the ECPE web page:

www.ecpe.org/events

Deadline for registration:

- **13 November 2018**

Participation fee:

- **€ 595,– *** for industry
- **€ 445,– *** for universities/institutes
- **€ 150,– *** for students/PhD students
  (copy of student ID requested)
  (limited number only)
  (optional dinner: € 50,- * extra fee)

  * plus 19 % VAT

- The participation fee includes dinner, lunches, coffee/soft drinks and a flash drive with the workshop presentations. Students/PhD students can book the dinner for an extra fee of € 50,- *
- A printed version of the workshop handout is available on request (€ 50,- *).
- With the confirmation of registration by email you are registered for the workshop and the invoice will be sent by post.
- Three participants from each ECPE member company free of charge. Allocation in sequence of registration.
- Further information (hotel list and maps) will be provided after registration and is available on the ECPE web page.
- In case of cancellation later than two weeks before beginning or non-attendance 50 % of the participation fee is payable.

Organisational Information

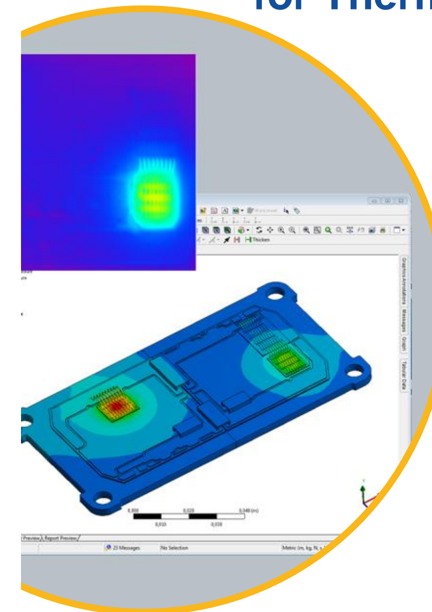
Organiser	ECPE e.V. 90443 Nuremberg, Germany www.ecpe.org
Chairmen	Prof. Dr. Uwe Scheuermann, Semikron Elektronik Prof. Dr. Bernhard Wunderle, TU Chemnitz
Organisation	Lena Somschor, ECPE e.V. +49 911 81 02 88 – 18 lena.somschor@ecpe.org
Venue	Maritim Hotel Nürnberg Frauntorgraben 11 90443 Nuremberg Germany +49 (911) 2363 0 info.nur@maritim.de www.maritim.de

ECPE
European Center for
Power Electronics e.V.

Programme

ECPE Workshop

The Future of Simulation in Power Electronics Packaging for Thermal and Stress Management



20 - 21 November 2018
Maritim Hotel
Nuremberg
Germany

in cooperation with

Cluster Leistungselektronik · SEMIKRON innovation+service · Technische Universität Chemnitz · EPE

ECPE Workshop

The Future of Simulation in Power Electronics Packaging for Thermal and Stress Management

20 - 21 November 2018

The progress in computing capacity allows today the simulation of realistic geometric models of power electronic assemblies but increasing model sizes will not be sufficient to enable the transition from relative estimations to realistic predictions. To improve the correspondence between FEM simulations and real measurements, the coupling of different physical domains within the simulation process is inevitable.

Thermo-electrical coupling

The first area of improvement is the realistic simulation of distribution of load current and thus the distribution of power losses on a chip and between parallel chips. In the past, thermal simulation assumed a constant loss density on a chip and on parallel chips. However, since on-state voltage at a defined current is a function of temperature, the losses will also vary in the presence of pronounced lateral temperature gradients. Thermo-electrical coupling is needed to include the interaction between temperature distribution and dissipated losses.

Thermo-mechanical coupling

The second area of improvement is the mechanical deformation of power modules or packages in operation. Assuming a stress-free condition at a fixed temperature does not reflect the complexity of power packages, since those are produced from sub-assemblies with different (thermal) process history. Even a leadframe transfer-mold device requires at least two assembly steps, the bonding of the chip on the lead frame and the subsequent mold process. Both processes will freeze in stress at different temperature levels, so that the package will suffer from inherent stress even at room temperature. Thermo-mechanical coupling allows to simulate the impact of different assembly steps on the package. However, a realistic simulation of the assembly process requires the knowledge of (rate-dependent) material parameters in the full temperature (and humidity) range to understand the thermo-mechanics of the chip-package-module interactions and to fully exploit the benefits of physics-of-failure-based lifetime modelling for reliability prediction. The determination of material data is a considerable challenge and requires a collaboration of industry and academia.

The ECPE Workshop is chaired by Prof. Uwe Scheuermann (Semikron) and Prof. Bernhard Wunderle (TU Chemnitz).
All presentations and discussions will be in English language.

Programme

Tuesday, 20 November 2018

09:30 Start of Registration / Welcome Coffee

10:00 Welcome, Opening
Thomas Harder, ECPE e.V.

10:10 Introduction, Motivation and Objectives of the Workshop
Uwe Scheuermann, Semikron (D)
Bernhard Wunderle, TU Chemnitz (D)

Session: Electro-thermal coupling

10:30 Fully Coupled Electro-Thermal Simulation of Temperature and Current Distribution in Power Devices
Uwe Scheuermann, Marina Montaine, Semikron (D)

11:00 SiC MOSFET based Power Modules Model
Daniela Cavallaro, Gaetano Bazzano, Alessandra Cascio, Antonio Grimaldi, , Alessandra Raffa
STMicroelectronics (IT)

11:30 Transient Coupled Electro-Thermal SPICE System Simulation Using the Example of a D²PAK Application
Ralph Schacht, Brandenburg Univ. of Technology (D)

12:00 Lunch

13:15 EM and Thermal Network Analysis in Power Module Packaging
Daohui Li, Xiang Li, Dynex Semiconductor (UK)

13:45 Thermal Modelling and Verification for an PCB Embedded Power Module
Arian Grams, Olaf Wittler, Fraunhofer IZM (D)

14:15 Simulation of current crowding in inverse diodes of low-voltage Si MOSEFTs at power cycling
Christian Schwalbe, TU Chemnitz

14:45 Coffee Break

Session: Materials

15:15 Modelling of the Mechanical Behaviour of Copper in Interconnect Structures of Electronic Packages
Steffen Wiese, Saarland University (D)

15:45 Accelerated Testing of Thermal Greases in Simulation & Experiment
Daniel May, Bernhard Wunderle, TU Chemnitz (D)

Panel Discussion

16:15 Material Data Management within the Power Electronics Community with Reinhold Bayerer (Physics of Power Electronics), Michele Calabretta (STMicro-electronics), Rainer Dudek (Fraunhofer ENAS), Markus Klinger (Robert Bosch), Ralf Schmidt (Siemens)

17:45 End of 1st Workshop Day

19:30 Dinner

Programme

Wednesday, 21 November 2018

08:30 Start of 2nd Workshop Day

Session: Thermo-mechanical coupling

08:30 Characterization of Materials and their Interfaces in a DBC Substrate for Power Electronics Applications
Cyril Buttay, INSA Lyon - Laboratoire Ampère (F)

09:00 Challenges for Material Characterization and Modelling for Thermo-Mechanical FE-Simulations
Sebastian Letz, Fraunhofer IISB (D)

09:30 Thermo-mechanical Simulations of the DBC to Baseplate Reflow Soldering Process
Pietro Botazzoli, Siemens (D)

10:00 Accelerated Testing of Sintered Die Attach Technology by Isothermal Bending Tests
Bernhard Wunderle, Jens Heilmann, TU Chemnitz (D)

10:30 Coffee Break

11:00 Reliability of Molded Power Packages and Changes of Material Properties During Operation and Test
Laurens Weiss, Infineon Technologies (D)

11:30 VHDL-AMS Thermo-mechanical Model for Coupled Analysis of Power Module Degradation in Circuit Simulation Environments
Alberto Castellazzi, Univ. of Nottingham (UK)

12:00 Interaction of Failure Mechanism in Power Electronics Modules
Benjamin Fabian, Sven Thomas, Heraeus (D)

12:30 Analyses on Transient Liquid Phase Interconnects
Rainer Dudek, Fraunhofer ENAS (D)

13:00 Lunch

Session: Generic and System Level Approaches

14:15 Reliability Simulation of Power Electronics: The Complexity of Multi Scale Modelling in both Space and Time, Uncertainty in Production Processes, Non Linear Materials and Damage Progress
Markus Klingler, Robert Bosch (D)

14:45 Holistic Approach to Power Module Design Using Multiphysics Simulations
Bertrand Bastien, Danfoss Silicon Power (D)

15:15 Design of a 1200 V, 100 kW Power Converter: How Good are the Design and Modelling Tools?
Thomas Lagier, Supergrid Institute (F)

15:45 Final Discussion

16:00 End of Workshop