13. Packaging and Heterogeneous Integration for Automotive Electronics and Advanced Characterization of EMCs

Course Leader: Przemyslaw Gromala – Robert Bosch GmbH

Course Description:
Demand for more advanced packaging technologies is growing rapidly in the automotive, avionics and energy industries. Today, electronic components developed for the consumer market are simultaneously used in harsh environments. Advanced packaging and heterogeneous integration are major contributors to the most innovative ideas, new products, and services. These electronic components are composed of many different materials. Stress due to a mismatch in coefficient of thermal expansion (CTE) between adjacent materials is one of the main causes of reliability problems (e.g., warpage, delamination, fatigue, aging). In addition, these materials are subject to aging during long-term use. Numerical simulations are used to accelerate the development process. This course will discuss the details of how a simulation driven design allows for the efficient development of innovative electronic components and systems. You will be able to learn what is needed to select optimal materials, how to perform material characterization and modeling. I will demonstrate how to quantitatively predict the stress state in design element using multi-domain simulations. Finally, I will present the application of AI/ML techniques to create a digital twin of an electronic control module.

Course Outline:
1. Introduction
2. Selection of the material
3. Curing shrinkage
4. Coefficient of thermal expansion
5. Linear viscoelastic properties
6. Modeling of linear viscoelastic behavior
7. Nonlinear viscoelasticity
8. Fracture test and implementation
9. Thermal aging
10. Digital Twin
11. Summary

Who Should Attend: Engineers and technical managers who are already involved in the material characterization and modelling, numerical modelling, process engineers and PhD students who need fundamental understanding or broad overview.

Przemyslaw Gromala is a simulation senior expert at Robert Bosch GmbH, Automotive Electronics in Reutlingen. Currently leading an international simulation team and FEM verification lab with the focus on implementation of simulation driven design for electronic control modules and multi - chip power packaging for hybrid drives. His research activities focus on virtual pre-qualification techniques for development of the electronic control modules and multi-chip power packaging. His technical expertise includes material characterization and modeling, multi-domain and multi-scale simulation incl. fracture mechanics, verification techniques, prognostics and health management for safety related electronic smart systems. Prior to joining Bosch Mr. Gromala worked at Delphi development center in Krakow, as well as at Infineon research and development center in Dresden. He is an active committee member of the IEEE conferences: ECTC, EuroSimE, ICEPT; ASME: InterPACK. Active Committee member of EPoSS – defining R&D and innovation needs as well as policy requirements related to Smart Systems Integration and integrated Micro- and Nano systems. He holds a PhD in mechanical engineering from Cracow University of Technology in Poland.