5. Characterization of Advanced EMCs for FO-WLP, Heterogeneous Integration, and Automotive Electronics

Course Leaders: Przemyslaw Gromala – Robert Bosch GmbH

Course Objective:

Epoxy-based molding compounds (EMCs) are widely used in the semiconductor industry as one of the most important encapsulating materials. For the advanced packaging technologies FO-WLP technologies and heterogeneous integrations, EMCs play a more significant role than for the conventional plastically encapsulated packages because of thin profiles and complex process conditions required for the advanced packaging technologies. In the automotive industry where demand for more advanced packaging technologies increases rapidly for autonomous and connected cars, EMCs are often used to protect not only individual IC components but also entire electronic control units (ECUs), or power modules.

The stress caused by the mismatch of the coefficient of thermal expansion (CTE) between EMCs and adjacent materials is one of the major causes of reliability problems (e.g., excessive warpage, delamination, BRL, etc.). During assembly or even operating conditions, EMCs are subjected to temperatures beyond the glass transition temperature. Around the glass transition temperature, EMCs exhibit significant volumetric and isochoric viscosity, which leads to nonlinear viscoelastic behavior. In contrast, at low temperatures, EMCs show linear viscoelastic behavior. This complex material characteristic in the full temperature range of interest renders the design of electronic devices a nontrivial task. The mechanical behavior of EMCs must be understood clearly to offer predictive simulation strategies, which has become an integral part of product development process.

This training will address details of such strategies, summarizes the required material characterization procedure, and closes with some representative examples.

Course Outline:

1. Introduction
2. Selection of the Material (Preliminary Qualitative Analysis)
3. Material Characterization
    a. Coefficient of Thermal Expansion
    b. Linear Viscoelastic Properties
    c. Viscoelastic Behavior in the Non-linear Domain
4. Quantitative FEM Analysis
5. 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.

Bio:

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 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.