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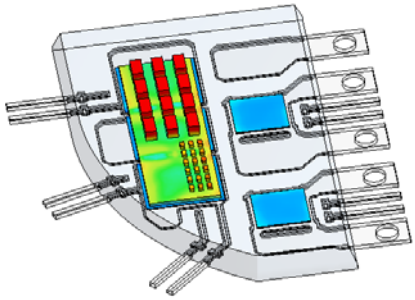
FRAUNHOFER-INSTITUTE FOR RELIABILITY AND MICROINTEGRATION IZM



Stress evaluation of power module

RELIABILITY ASSESSMENT BY NUMERICAL SIMULATION

Numerical simulation is a powerful method to support various steps of product design. In an early design stage it is used to compare different construction concepts, to optimize variable parameters or evaluate assembly processes. The effects of the choice of material, e.g. encapsulation material, can be compared well. The earlier simulation is introduced to the development process, the greater the saving of time and effort for prototyping and testing. Investigating developed products with the help of numerical methods throws light on emerging failures. For critical components, such as chip interconnects or wire bonds, which degrade during cycling, failure models can be employed to calculate their lifetime and ensure reliability for specific mission profiles.

In the case of power modules, high currents are transported and the thermal management has to be handled in order to avoid damage to the components. Simulation models help understand the thermal behaviour of the system and enable the evaluation of different cooling methods and determine the associated application limits.

The reasons for the failure of components are manifold. Simulation models can cover the effects of thermal or thermo-mechanical degradation, component fracture, moisture diffusion, mold delamination and electromigration. In the case of power electronic systems, also complex geometries have to be considered. Therefore, we employ powerful tools for

- Multi-Physics Simulation: coupled electrical, thermal, mechanical degrees of freedom as well as moisture diffusion and swelling
- Fluid Dynamics: flow simulation on component, module and system level coupled with heat transfer
- Optimization: stochastic sensitivity analysis, robustness evaluation and multi-objective optimization
- CAD: implementation of all established formats, quick modification and parameterization

Fraunhofer IZM combines simulation models with a broad range of characterization methods to obtain the necessary material data. Also, different analysis techniques and ways of testing are performed in the house, so that models can be calibrated and verified. These competencies and our knowledge in microelectronic technology, assembly and integration are the basis for valuable simulation models to achieve shorter development times and reliable products.

Web links / QR-Codes:

- Reliability assessment, testing and optimization
- Reliability assessment with FEM
- Thermal Management

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