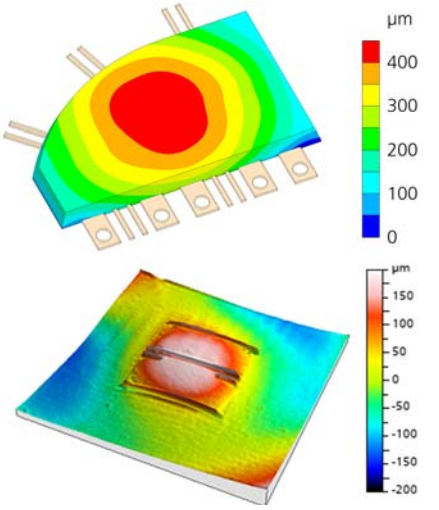
Fraunhofer IZM

FRAUNHOFER INSTITUTE FOR RELIABILITY AND MICROINTEGRATION IZM

TOPOGRAPHIC MEASUREMENTS



Top: Power module warpage investigated by simulations

Bottom: Warpage measurement of embedded DCB in PCB

Fraunhofer Institute for Reliability and Microintegration IZM
Gustav-Meyer-Allee 25
13355 Berlin, Germany

Contacts:
Topographic Measurements:
Saskia Huber
Phone: +49 (0)30 / 46403-117
saskia.huber@izm.fraunhofer.de

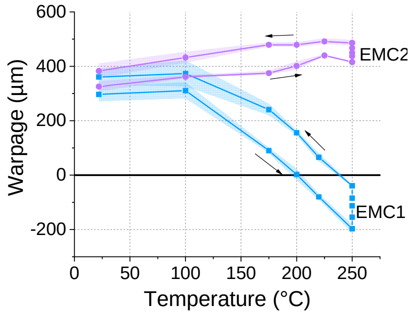
Finite Element Analysis:
Marius van Dijk
Phone: +49 (0)30 / 46403-7977
marius.van.dijk@izm.fraunhofer.de

Marketing
Georg Weigelt
Phone: +49 (0)30 / 46403-279
georg.weigelt@izm.fraunhofer.de

www.izm.fraunhofer.de

Topographic measurements and finite element simulations enables you to find optimal concepts for warpage control of your substrate or package.
Warpage effects of packages and substrates are one of the main challenges of system integration. The use of different materials having different characteristics (such as coefficient of thermal expansion and viscoelastic properties) as well as process related influences participate in warpage effects during and after production. The risk for reliability issues of the final product can be prevented or reduced significantly by combining material characterization, topographic measurements and finite element simulation.

Line Pattern Topography (LPT) measurements can be used to analyze components and systems. The warpage of the substrate can be analyzed under temperature load. Hereby the temperature load can be production or usage related.
Besides the observation of warpage effects, material or system change at certain temperatures can also be studied, indicated by a hysteresis.



Different warpage and hysteresis effects measured by means of LPT for two possible packaging materials

White light (WL) profilometry can be used to measure warpage as well as high resolution geometrical structures and roughness. The outstanding high out-of-plane resolution (up to 10 nm) combined with the great lateral field-of-view is characteristic for this device.

Key data:

- LPT measurement resolution: ≥5 µm
- LPT field of view: 150 x 150 mm²
- LPT temp. range: -50°C … +300°C
- WL measurement resolution: ≥10 nm
- WL field of view: 200 x 200 mm²
- WL temp. range: room temperature

Finite element analysis (FEA) allows us to model systems efficiently and rapidly to match the given application specifications. Thermal management, thermo-mechanical stress analysis as well as moisture diffusion and swelling simulations provide valuable information in order to predict and/or improve product behavior. The solutions are developed in close cooperation with our project partners and in consideration of all relevant project objectives (including product costs, reliability, electromagnetic conformity, power usage, and environmental footprint).

Combining topographic measurements and FEA can be used to calibrate the simulation models, increasing the accuracy. Via the so-called *reverse engineering technique* where measurements and numerical simulations are combined, complex material or system properties can be derived which cannot be characterized straightforward.