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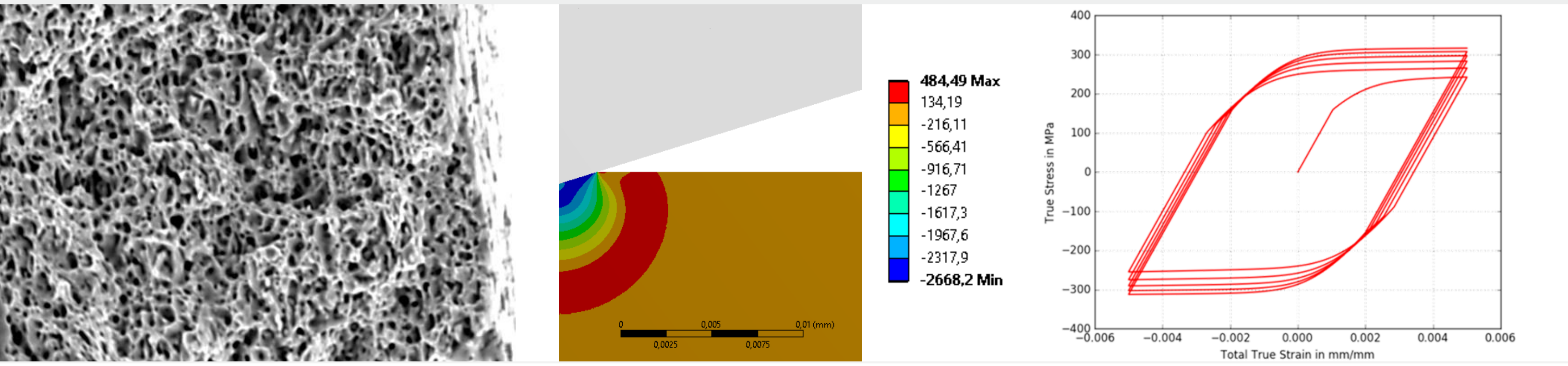
IISB

FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY IISB



1 ***Left:*** *Fracture surface of sintered Die-Attachment layer tested at 200°C,* ***Center:*** *FE-Simulation of principal stress field during a nanoindentation experiment,* ***Right:*** *Hysteresis loop for combined nonlinear isotropic-kinematic viscoplastic hardening material.*

MATERIAL CHARACTERIZATION AND MODELLING

FOR POWER ELECTRONICS APPLICATIONS

Application topics in the field of power electronics

- Get thermal and mechanical properties for Finite-Element-Simulations (FEM)
- Obtain best material design and combinations for a specific application
- Find optimal manufacturing parameters for processing of solder- and sinter-interconnections, casting compounds, base plates, housings, terminals, windings, dielectrics, and many further materials and components
- Understand process-lifetime-reliability-interactions for a product
- Improve lifetime and reliability of your packaging concepts

Research areas and services at Fraunhofer IISB

- In-situ temperature-dependent characterization of mechanical properties of electronic packaging materials including creep-, cyclic-, and fracture behavior
- Nanoindentation method for local analysis of material behavior and direct probing of samples in order to take the complete process history into account
- Modelling of nonlinear mechanical material behavior and further special material effects that can be implemented in the finite-element-code
- Ageing of packaging materials during accelerated lifetime or field tests: Investigation of microstructure evolution and effective mechanical behavior

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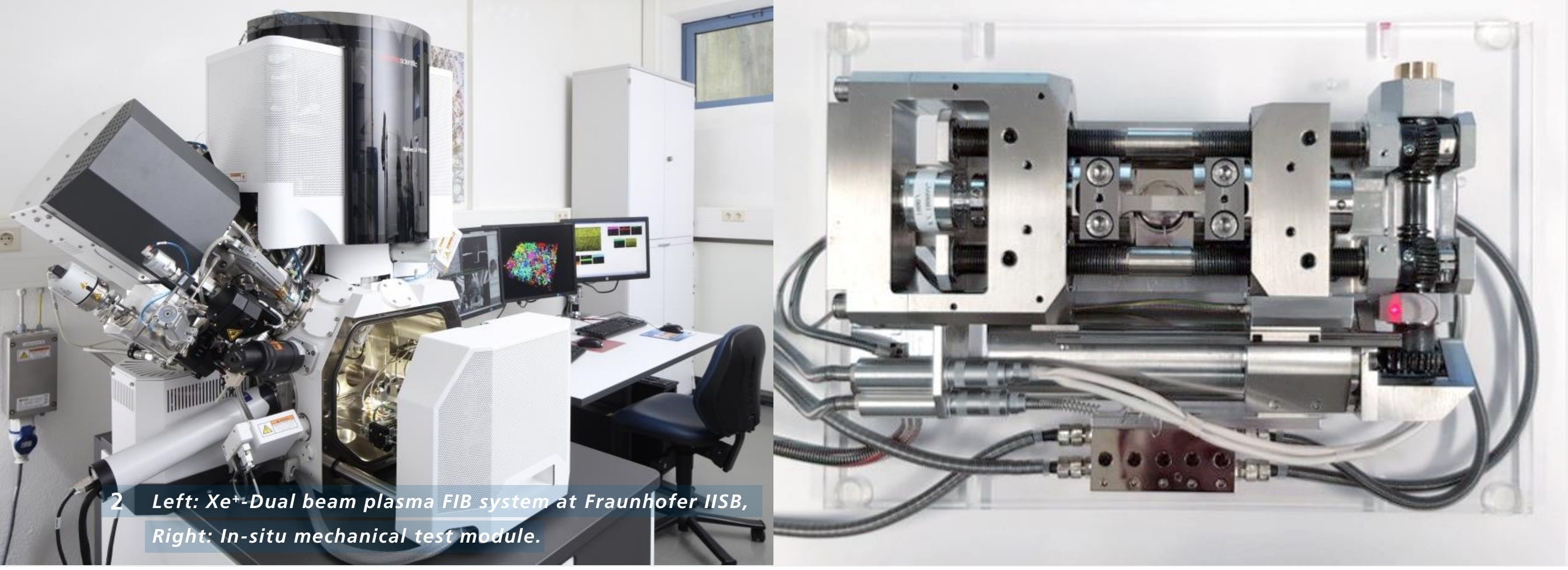


2 *Left: Xe⁺-Dual beam plasma FIB system at Fraunhofer IISB, Right: In-situ mechanical test module.*

1 Mechanical characterization

- In-situ mechanical testing: tension, compression, cycling, 4-pt.-bending, fracture mechanics
- Nanoindentation and nanoscratch testing
- Nanomechanical topography analysis
- Environmental temperature up to 500°C

2 Thermal characterization

- Simultaneous thermal analysis (DSC+TGA)
- Thermomechanical analysis: CTE

3 Optical characterization

- Optical (light) microscopy
- Dual beam Xe⁺-FIB/SEM

4 Structural/Chemical characterization

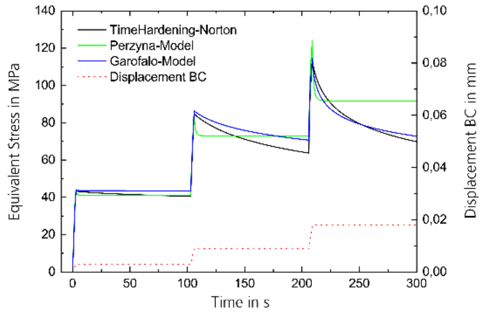
- Electron backscattering diffraction (EBSD)
- X-ray microanalysis (EDS)

5 Simulation methods

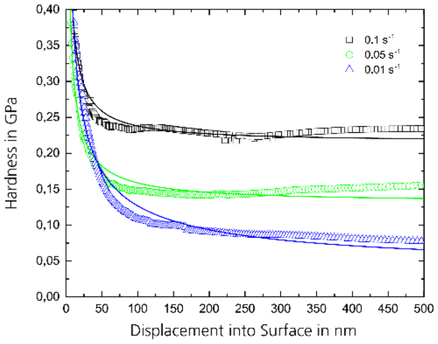
- Finite-Element-Method, Finite-Volume-Method
- Multiscale: Representative-Volume-Element analysis
- Inverse model parameter identification

6 Specimen development and preparation

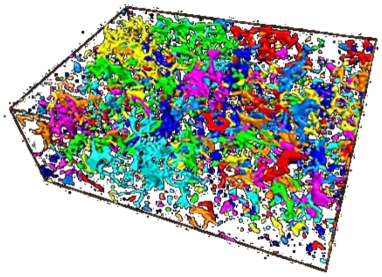
- All relevant electronic packaging technologies available
- Macroscopic to microscopic sample volumes
- Optimization of specimen design and manufacturing

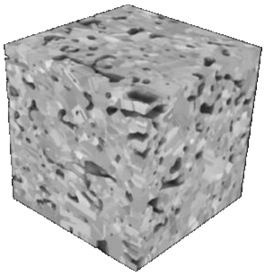


3 *Different model predictions for a multiple-hardening-relaxation test at elevated temperature.*



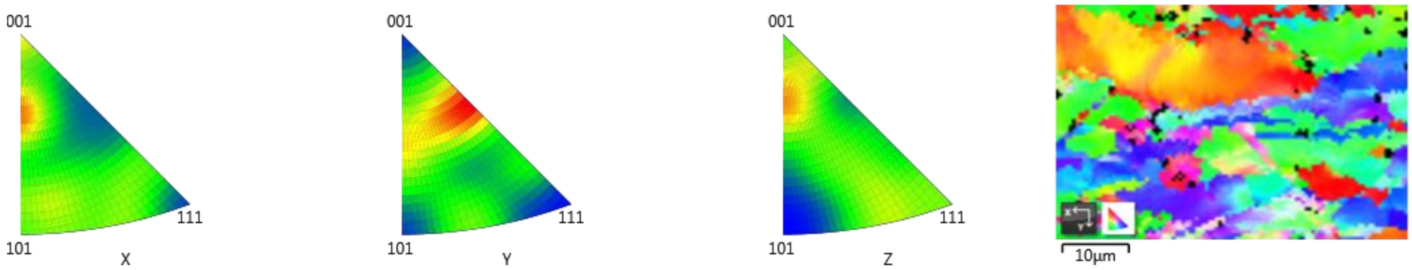
4 *Hardness versus displacement into surface from nanoindentation experiment and model predictions.*





5 ***Left:*** *3d-Pore network reconstruction of sintered silver interconnection obtained by FIB-tomography.*

6 ***Right:*** *Representative-volume-element for investigating microstructural impact on macroscopic behavior.*



7 ***Left:*** *Inverse pole figures of deformed copper from EBSD analysis,* ***Right:*** *Crystal orientation map of the same sample.*