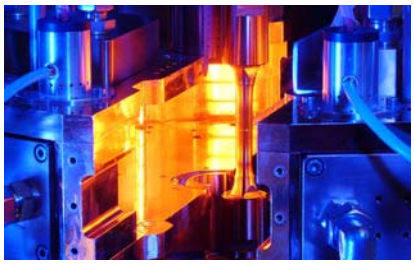
Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Handout

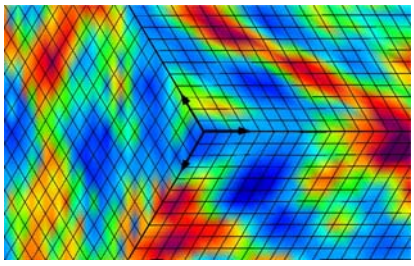
Experimental and Numerical Methods

The demand for shorter development cycles for new components and technical products requires accelerated and accurate determination of material properties. With this background our research activities aim to making high performance materials for air- and space applications more predictable. Therefore, experimental and numerical methods are combined and further developed. The typical workflow starts with characterizing the material by means of microscopic analysis and (micro)mechanical tests on the microstructure level, which includes features from nanometer up to centimeter scale. Using this experimentally achieved data numerical models are developed. With these models the behaviour of laboratory specimens and generic components under realistic loading conditions is simulated, and the calculations are validated with the respective laboratory tests. Special non-standard test facilities are developed and manufactured in-house, for example test rigs for thermo mechanical fatigue testing of internally cooled specimens, which represent gas turbine blades for aero engines.

Thermal mechanical test facility for high temperature materials



Simulation of local strains on microstructure level in a mechanically loaded multi-phase material



Actual research topics:

- Close-to-reality testing of materials for aero engines
- Methods for time efficient lifetime assessment (acceleration of thermal mechanical testing, monitoring of damage parameters)
- Methods for determining material properties, especially for complex material systems such as coating systems
- Modeling of material behavior of materials and material transitions under mechanical, thermal, and thermal mechanical loading conditions
- Multiscale-modelling of complex material systems with hierarchical structure

Topics under development:

- Implementation of mathematical optimization methods in numerical modeling of materials
- Hybrid experimental-numerical Methods for efficient determination of materials data

Research and development is carried out in close cooperation with the departments of the DLR Institutes of Materials Research and Structures and Design as well as with partners from industry, small and medium sized enterprises, research centers, and universities.

Our offer:

- Consulting
- Collaboration in joint research and development projects
- Contract research
- Supervision of Bachelor-, Master- and PhD-theses

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