



## Technical systems, software

### Computer-based procedures

- Finite element programs: ANSYS and COMSOL
- Kinetic models: In-house software KINCAL, DEBIND
- Databases for thermodynamics and material selection: Factsage, CES Selector
- Microstructure design: In-house software GEOVAL

### Material and component manufacture

- Mixers, grinders, dispersers
- Dry presses, extruders
- 3D printers: Binder-Jetting, stereolithography, In-house procedures
- Heat treatment furnaces: usable volumes 1 to 400 l
- Furnace gasses: hydrogen, fuel gas, inert gasses, air, overpressure, vacuum
- In-situ measurement procedures: dimensional analysis, weight changes, etc.
- Finishing/joining: 5-axis machining center, laser joining center

### Testing

- Non-destructive test procedures: computer tomography, ultrasonic testing, thermography, terahertz wave analysis
- Thermo-optical test procedures: mechanical, thermal, chemical, optical, electrical

## Please feel free to contact us:

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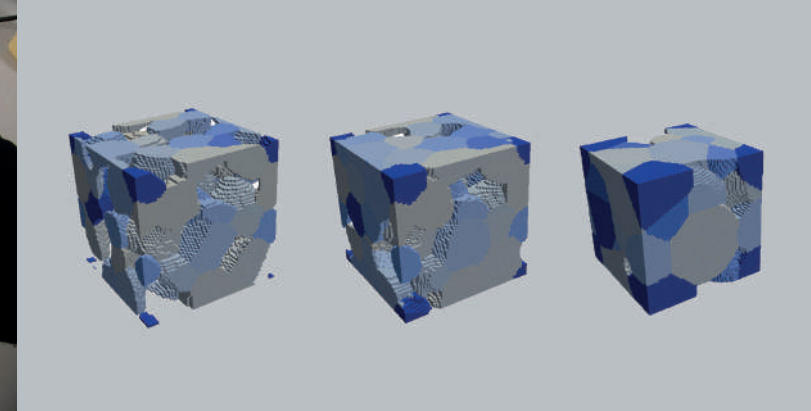
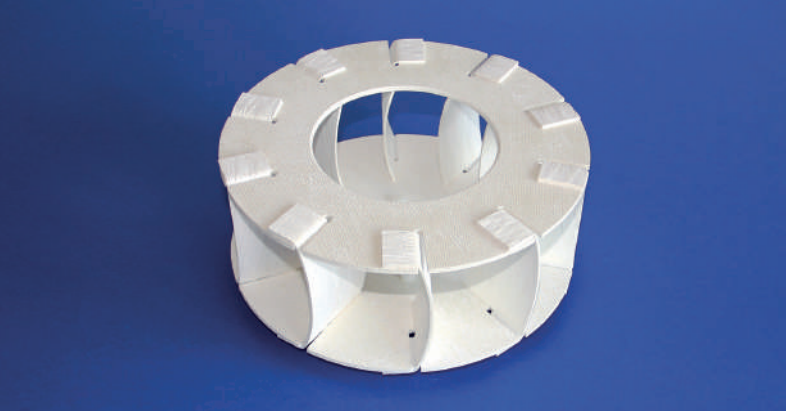
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## High Temperature Materials and Components





## High temperature components

Components used at high temperatures have to fulfil special requirements. They are frequently subjected to corrosive atmospheres or rapid changes in temperature as well as mechanical loads. Furthermore, they contribute to the heat management in the thermal process systems, where they are used, requiring specific setting of the heat transfer characteristics and heat capacity.

At Fraunhofer-Center for High Temperature Materials and Design HTL, high temperature stable ceramics are developed and optimized in various modifications: monolithic, porous, as coatings, fibers or fiber-reinforced ceramics (CMCs). HTL covers the entire development chain: beginning with the design of the components and the definition of the material requirements extending over laboratory and technical scale experiments up to the manufacture and testing of prototypes and small series. This way, new components and materials for sustainable thermal processes are created.

## Methods

HTL uses finite element (FE) procedures for a coupled thermal and mechanical component design. The selection of materials is supported by material databases, material indexes and thermodynamic software. Using special software for microstructure property simulation, optimum structures for multiphase ceramics are developed.

HTL has all the relevant methods for the manufacture and characterization of ceramic slurries at its disposal. Numerous procedures are available for shaping and wet-chemical coating. Differing 3D print processes can also be used for manufacturing prototypes. The heat treatment processes can be undertaken in various furnaces with temperatures up to 2400 °C and in all industrial-relevant atmospheres in usable volumes up to half a cubic meter.

For component testing, various non-destructive, mechanical and thermal test procedures are available

## Services

Our customers receive specific solutions for their intended purpose. Developments are undertaken as a direct order or within joint projects. HTL is certified according to ISO 9001:2015, and the applied methods are mostly standardized. Interfaces between many experimental and computer-based methods are adapted ensuring that developments can be carried out efficiently in accordance with ICME (Integrated Computational Materials Engineering).

In detail, the following services are available:

- Development of new high temperature materials
- Optimization of existing high temperature materials
- Determination of application requirements and selection of materials
- Ceramic-oriented design of high temperature components
- Manufacture of prototypes and small series
- Testing of high temperature materials and components
- Life cycle analyses
- Studies on high temperature materials