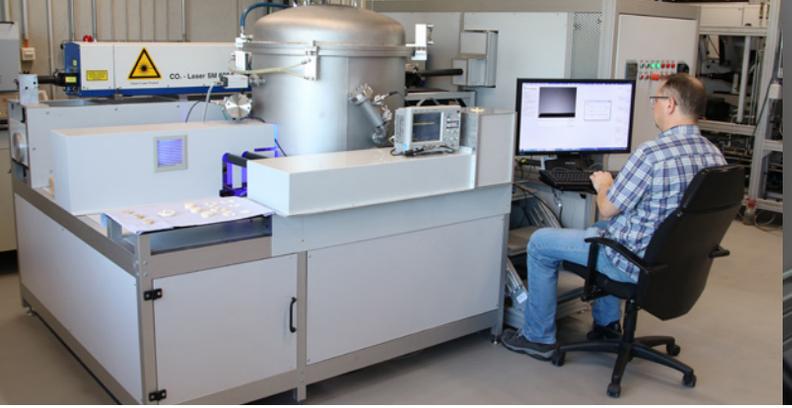

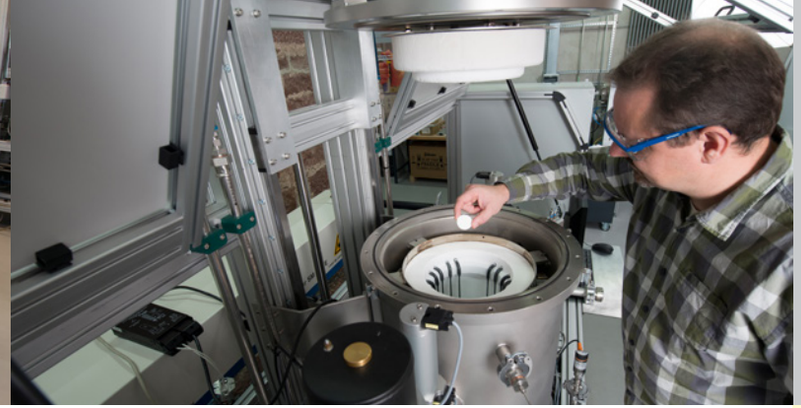

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Technical Data

Depending on the application, in-situ measurements for sintering up to temperatures of 2200°C can be undertaken in specific ThermoOptical Measurement systems (TOM). The FE-simulation is implemented using a formal kinetic procedure in thermal-mechanical coupled models with the software COMSOL.

In-situ Measured Variables

- Shrinkage due to sintering (optical measurement, reproducibility 0.02 %)
- Shape distortion (up to 20 measurement positions, 2D or 3D)
- Thermal conductivity (Laser-Flash measurement)
- Viscous moduli (uniaxial viscosity and Poisson's ratio)
- If required weight changes, wetting properties etc.

Sintering Atmospheres

- Air
- Gas burner atmosphere
- Inert gases
- Reducing gases (as well as 100 hydrogen)
- Over-pressure (up to 30 bar)
- Vacuum

Please feel free to contact us:

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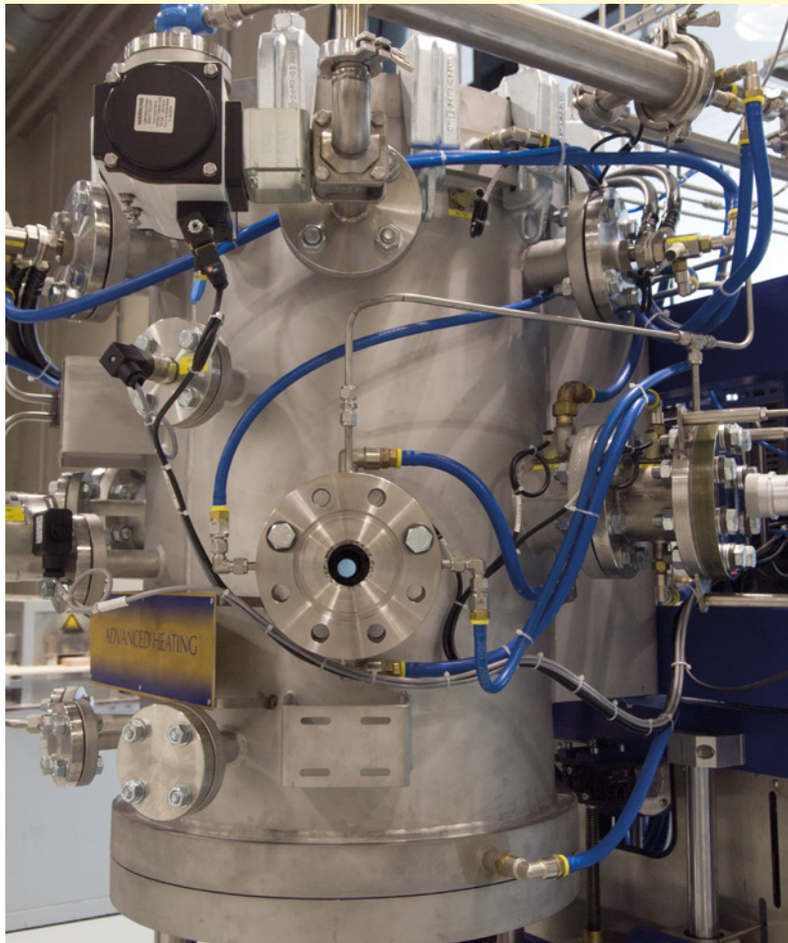
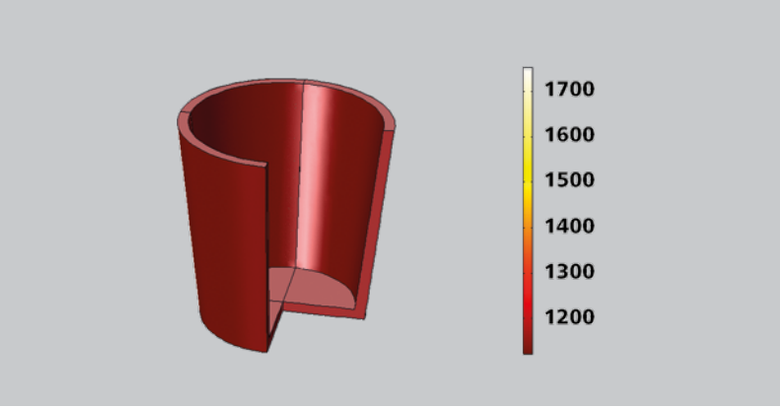
Sintering Processes





Targeted Optimization

For all powder metallurgically manufactured materials, the sinter process is a vital element for product quality and manufacturing costs. It must be carefully optimized to achieve the following results:

- Near-netshape component geometry
- Homogeneous microstructure
- Minimal scattering of properties
- Low waste rates
- High levels of reliability
- Low manufacturing costs
- Favorable CO_2 footprint

For optimization of the process parameters, special methods have been developed at Fraunhofer-Center HTL. These methods enable targeted identification of the optimum temperature cycle, the furnace atmosphere and the setting schemes. They can be used with the following materials:

- Oxide ceramics
- Non-oxide ceramics
- Silicate ceramics
- Refractory materials
- Sintered metals

Procedure

Optimization of the process parameters is undertaken in three stages:

1. Initially, the industrial sintering process is simulated in the so-called ThermoOptical Measurement systems (TOM). The HTL has various TOM systems available that can be used to work in inert, oxidizing or reducing gas atmospheres. The TOM systems facilitate recording of all sinter process relevant data with very high reproducibility.

2. The measured data recorded during sintering are parameterized and used as an input in special finite-element (FE)-models. The process parameters can be optimized using FE-simulation. Primarily, this involves the temperature cycle as well as the interaction of the material to be sintered with the refractory equipment. The optimized conditions are verified using the TOM systems.

3. The optimized process parameters are then transferred to the manufacturing furnace. The temperature gradients, setting schemes and gas flows are taken into consideration. If necessary, they can be recorded in the manufacturing furnace using a mobile measurement station.

Our Services

The HTL optimizes sintering processes with a focus on optimum product quality and minimum manufacturing costs. The optimized process parameters are determined by measurements in the laboratory measurement furnace (TOM system) and by FE-simulations based on the measured results. If required, measurements are undertaken on the manufacturing furnace to determine relevant additional furnace data for the optimization process. Process parameters for optimization are:

- Temperature cycles
- Composition and flow speeds of the furnace gases
- Refractory equipment and release agents
- Placement schemes

If necessary, the preceding heat treatment steps such as drying and debinding will also be optimized at the HTL. The suitability of green bodies for the sintering process can be evaluated with special measurement processes. If necessary, sintering materials, e.g. with suitable sintering additives, will be developed to deliver the optimum sintering result.