

CONTACT US AND TOGETHER WE'LL  
FIND A CUSTOMIZED SOLUTION FOR  
THE CHALLENGES YOU FACE

FRAUNHOFER INSTITUTE FOR  
MECHANICS OF MATERIALS IWM

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#### **First contact**

Cooperation with the Fraunhofer IWM begins with an advisory meeting – entirely non-binding. This is when objectives are set and the timescale and financial framework are clarified. Projects are worked on with the highest levels of professionalism – irrespective of their budget.

#### **Confidentiality**

Client information is kept strictly confidential. Non-disclosure agreements can be included, at the client's request, in cooperation contracts.

#### **The latest equipment**

The Fraunhofer IWM works with modern equipment – the latest developments available on the market. This leads to unexpected insights into material and component behavior as well as to innovative solutions.

#### **Quality management**

The many hundreds of successful research and development projects carried out every year and a certified quality management system are proof of the institute's reliability in carrying out projects that meet the needs and conditions of industry. The high levels of customer satisfaction measured in customer surveys confirm the Fraunhofer IWM's reputation.

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#### **Your contact persons for thermophysical quantities and thermomechanical testing**

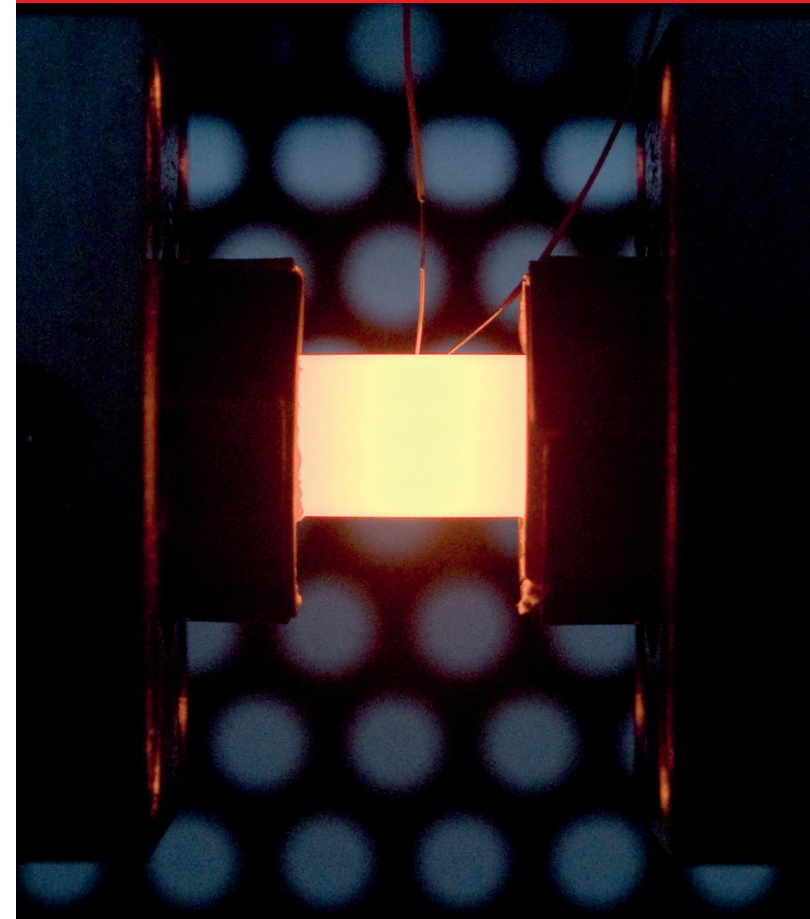
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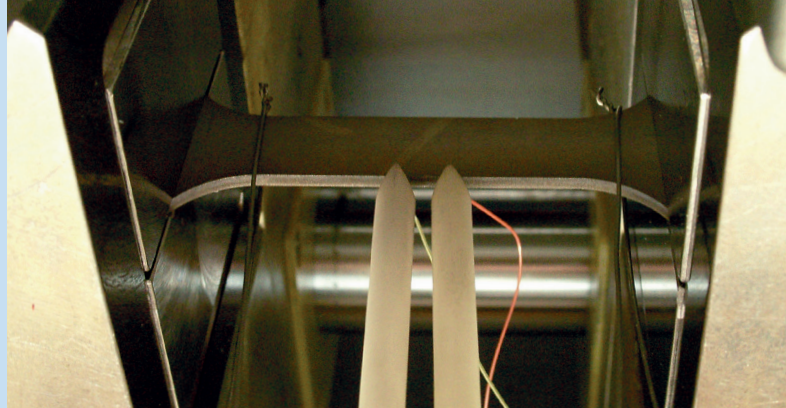
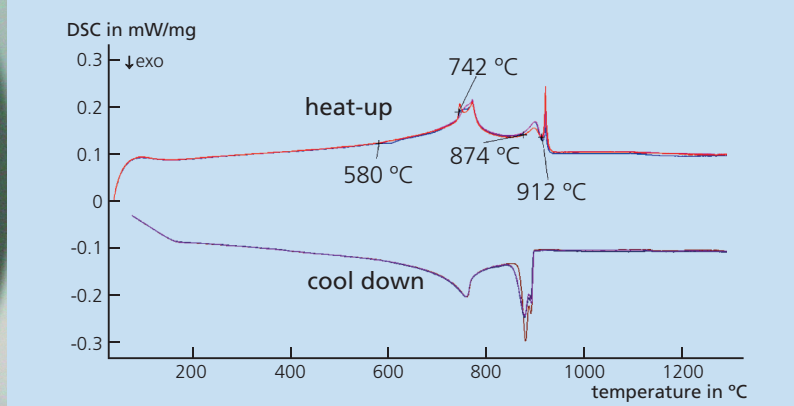
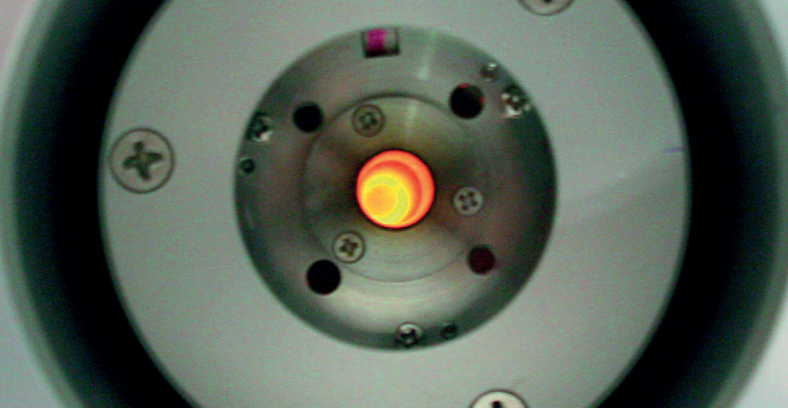
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## **THERMOPHYSICAL MEASUREMENTS AND THERMOMECHANICAL TESTING**





### Thermophysics at Fraunhofer IWM

In our thermophysical laboratory, we determine thermal expansion, specific heat capacity, density and thermal diffusivity. From these quantities we calculate the thermal conductivity of materials. There is a great variety of materials which can be analyzed here, ranging from metals, plastics, ceramics and thermoelectric materials to reactive coatings. We test specimens in the form of pastes, powders, liquids and solids at temperatures from ambient to 2 000 °C.

### Thermomechanics at Fraunhofer IWM

With our thermomechanical testing machine »Gleeble 3150« we offer thermomechanical characterization of metallic materials. We perform tests with conductive materials at elevated temperatures up to melting while applying mechanical loads under force or deformation control. Thus, we can conduct warm tension or compression tests and we are able to simulate heat treatments and welding processes. Additionally we determine Time-Temperature-Transformation diagrams, strain rate and temperature dependent flow stress curves and temperature cycles with super-imposed tension-compression loads.

### Our services

#### Measuring of heat capacity using dynamic differential scanning calorimetry

- Measurements from room temperature (RT) to 1 600 °C at heating rates from 0.01 to 50 K/min
- Determination of transformation temperatures, melting and crystallisation points and other energetic processes
- Quantitative assessment of exothermal and endothermal reactions, transformations and phase changes
- Measuring in different gas atmospheres and in vacuum
- Typical specimen dimension for solid materials diameter 5 x 0.5 mm

#### Dilatometric measurement of thermal expansion

- Measurements from RT to 1 600 °C at heating rates from 0.001 to 50 K/min
- Determination of the coefficient of thermal expansion
- Analysis of volumetric phase changes, sintering steps or softening
- Measurements in various gas atmospheres and in vacuum
- Typical specimen dimensions: diameter 3 to 6 mm with length of 5 to 25 mm, similar dimensions for sheet materials

#### Measuring of thermal diffusivity and thermal conductivity using Laser Flash Analysis (LFA)

- Measurement of the thermal diffusivity in the range of 0.01 to 1 000 mm<sup>2</sup> and from RT to 2 000 °C at heating rates between 0.1 and 50 K/min
- Measurements in various gas atmospheres and in vacuum
- Diameters of 6, 10, and 12.6 mm for cylindrical specimens, max 10 x 10 mm<sup>2</sup> for rectangular specimens
- Specimen thickness depends on the expected thermal diffusivity and ranges from about 1 to 3 mm

#### Thermomechanical tests of metals using »Gleeble 3150«

- Heating rates up to 8 000 K/s, cooling rates up to about 2 500 K/s
- Mechanical loads up to +/- 44 kN, ram velocity up to 800 mm/s
- Measurement possible in various gas atmospheres and in vacuum

#### Complementary analyses

- Analyses of microstructure by Light or Scanning Electron microscopy (EDX and EBSD analyses where applicable)
- Optical Scanning of surface geometries of devices, components and structures (measurement of springback, wrinkles, earring, distortion, shrinkage etc.)