## Key areas of work

- Thermomechanical testing of ceramic matrix composites at temperatures up to 2200 K
- Characterization of the mechanical behaviour of monolithic ceramic, functional ceramic and porous ceramic
- Development of new testing procedures in mechanical testing
- Fiber reinforced light metals for aero engines
- Cooperation in the development of technical rules and standards (DIN NMP 291, CEN/TC 184)
- Customized mechanical testing

| BAM, division 5.2 (old V.2) is approved by DGA Deutsche Gesellschaft für Akkreditierung mbH according to DIN EN ISO/IEC 17025:2005 as an accredited testing laboratory. | Deutscher Akkreditierungs Rat DAR<br>DGA-PL-2614.16 |
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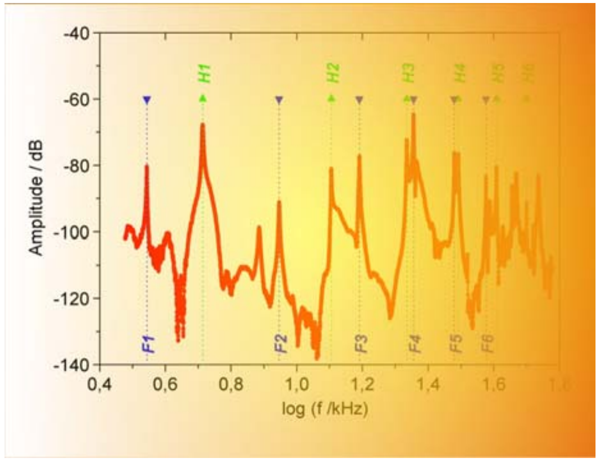
# Temperture dependent Young´s Modulus




## Working Group „Composite Materials“

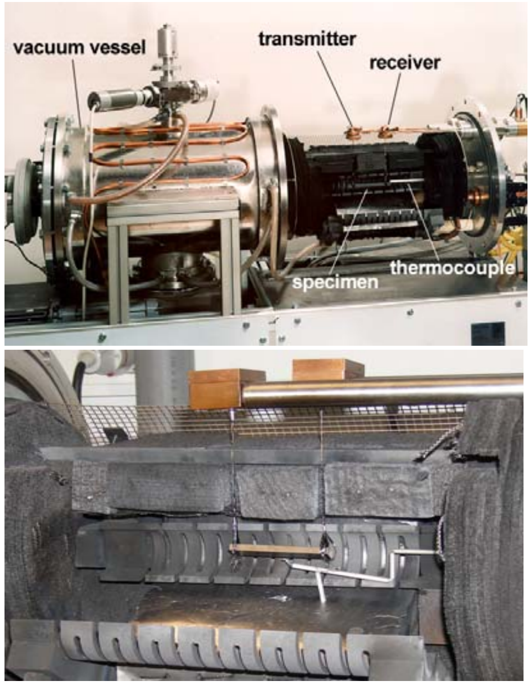
## Basic principles

Young`s Modulus is one of the most important characteristic values for design of constructions and components. Different procedures can be used for its determination, e.g. tensile test, bending test, resonance and ultrasound method.

In the case of resonance method, the Young´s Modulus is determined using the frequency of resonance peaks, dimensions of the specimen and density.

*E ~ $f_i$ * dimensions * density*

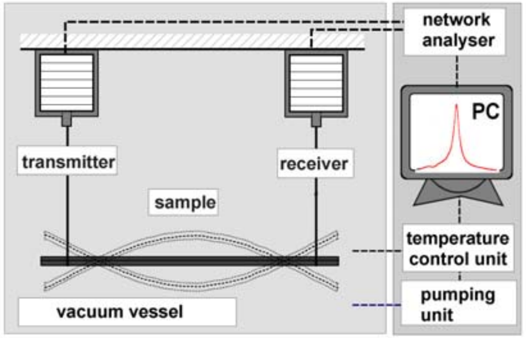
The testing device is equipped with a carbon felt insulated furnace with graphite heating elements in a vacuum chamber.




Elastotron 2000 (Fa.Reetz GmbH Berlin) , Testing device (overview and detail)

## Procedure

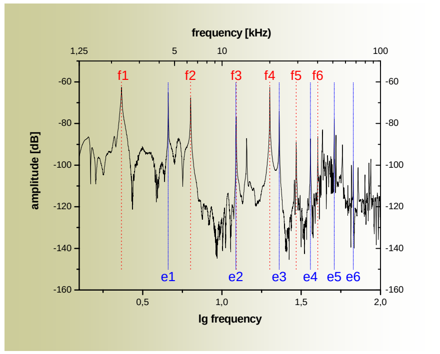
A sample is suspended between a piezoelectric transmitter and receiver using carbon fibre threads. A sinusoidal signal from the transmitter vibrates the specimen. A detector (receiver) picks up the resulting oscillations.



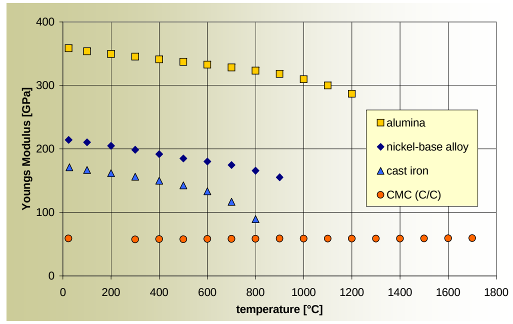

Schematic representation of the experimental se-

The resonance spectrum is obtained by continuously varying the excitation frequency between 0.1kHz and 100 kHz. To analyse the spectrum the relevant frequencies $f_i$ of the peaks are determined (resonance bending and resonance torsion) .

Determination of the Young´s Modulus with the




Resonance spectrum with resonance peaks (flatwise and edgewise)




Young´s Modulus depending on temperature for different materials

resonant procedure is a time-saving and competitiv methode to detect the temperature-dependence using only one specimens. The measurement uncertainty is lower than 1 %.

### Standards

- **DIN V ENV 843-3**

  *Determination of Young´s Modulus of advanced technical ceramics*

- **ASTM E 1875**

  *Determination of elastic properties with resonance method*

- **ASTM C 1198**

  *Elastic properties of advanced technical ceramics*

- **ASTM C623**

  *Elastic properties of glass and glass-ceramics*