Zurich University
of Applied Sciences

School of Engineering
IMES Institute of Mechanical Systems

Laser Flash Analyzer (LFA)

Transient thermal processes cause time-changing temperature gradients in components. Due to thermal expansion, these lead to undesired changes in shape or thermal stresses. For the prediction and evaluation of these thermo-mechanical effects by means of numerical simulation, thermo-physical values such as the specific thermal conductivity and the specific heat capacity of the materials involved are required. For this purpose, the ZHAW Institute for Mechanical Systems (IMES) offers corresponding measurements with its high-temperature laser flash analyser (Fig. 1).

Fig.1: High temperature Laser Flash Analyzer LFA 467HT HyperFlash® from NETZSCH.

Applications:
Experimental determination of
- Thermal diffusivity
- Thermal conductivity (with additional determination of specific heat capacity by DSC)
- Specific heat capacity (with comparison of thermal diffusivity with reference sample)

Technical data:

• Light source:	Xenon flash lamp (pulse energy up to 10 J/pulse)
• Pulse width:	10 to 1500 µs
• Sensor:	InSb IR detector with *ZoomOptics* system to eliminate signal distortion due to sample surroundings
• Temperature range:	Room temperature up to 1250 °C, max. heating rate 50 K/min
• Gas atmosphere:	inert (argon and nitrogen), vacuum (< 150 mbar), oxidising
• Calculation models:	modified Cape-Lehmann, Parker and Cowan as well as 2-/3- layer models
• Correction models:	Puls length correction (thin, highly conductive materials), radiation correction (transparent / translucent samples), penetration correction (porous and rough materials)

Sample requirements:

- Materials: metals, glasses, ceramics, polymers, composites as well as thin and highly conductive metal and polymer foils (up to 30 µm) with thermal conductivities between 0.1 - 4000 W/(m-K), liquid and powder samples are also possible
- Thickness: ideally 1.5 – 2.5 mm, films up to 50 µm, thin films in compound
- Diameter: 12.6 mm (max. 12.7 mm)
- Tolerances: plane-parallel end faces

Norms: ASTM E1461, ASTM E2585, DIN EN 821-2, DIN 30905, ISO 22007-4, ISO 18755, ISO 13826

How it works:
A short energy pulse heats the front side of a plane-parallel sample. The infrared detector detects the resulting temperature rise on the back of the sample (Fig. 2), from which the thermal diffusivity can be calculated. If the density and specific heat capacity are also determined using of differential scanning calorimetry (DSC) measurement, the thermal conductivity can also be determined (Fig. 3).

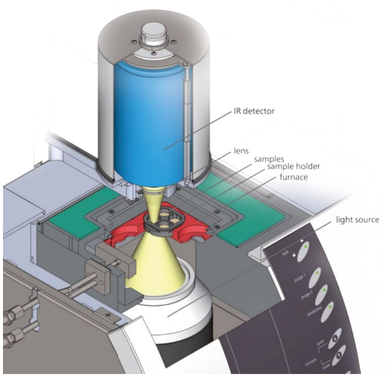

Fig.2: LFA HyperFlash setup from NETZSCH.

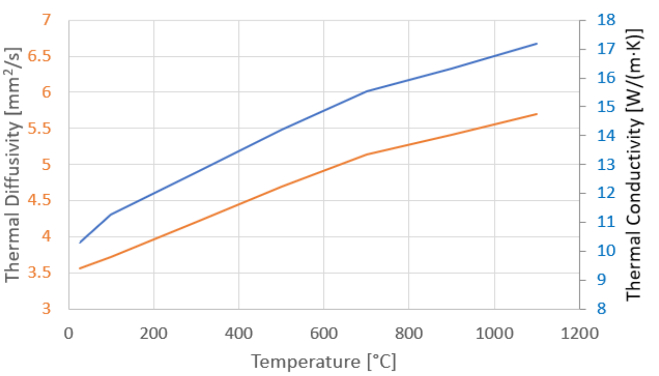

Fig.3: Thermal conductivity and thermal diffusivity of stainless steel 1.4404 (PBF-LB/M printed).

In addition to the high-temperature LFA, the Institute for Mechanical Systems offers further equipment for the complete thermo-physical characterisation of materials. This includes a density balance, a high-temperature dilatometer (NETZSCH DIL 402 Expedis Supreme) for determining thermal expansion and a differential scanning calorimeter (in collaboration with the ZHAW Institute for Materials and Process Engineering) for determining heat capacity.

For further questions regarding possibilities, costs, etc., please contact the address below.

Contact

ZHAW School of Engineering
Institut for Machanical Systems
Prof. Dr. Thomas Mayer
Technikumstrasse 9
CH-8400 Winterthur
T +41 58 934 47 31
M thomas.mayer@zhaw.ch