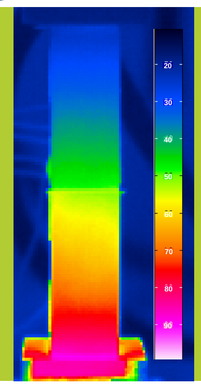
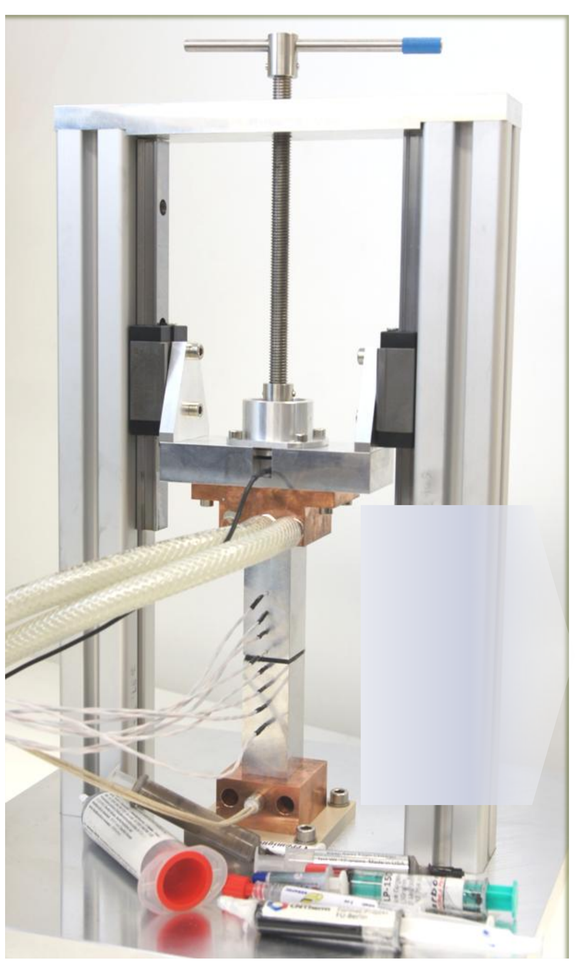
Freie Universität Berlin

Guarded Heat Flow Meter

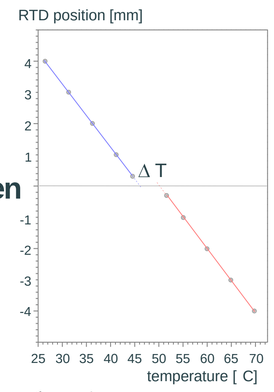
Observation By Means of IR-Monitoring - Thermography



Setup for the measurement of the thermal conductivity of thermal interface material (greases)



specimen



$$\frac{1}{R_{th}} \cdot \frac{d}{A} = \lambda \qquad \frac{Q_{Al}}{\Delta T} = \frac{1}{R_{th}}$$

$$m \cdot \lambda_{Al} \cdot A = Q_{Al}$$

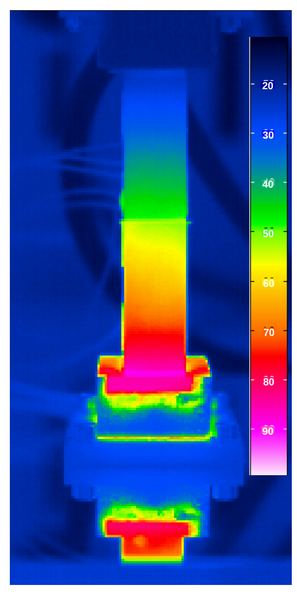
$$R = R_{int}{}^{1} + R_{sample} + R_{int}{}^{2}$$

A static test (method) for which the specimen is placed in between two well-characterized meter bars, which are used to extrapolate the surface temperatures and to measure the heat flux through the sample and to thereby determine the thermal conductivity λ [W/mK] of a sample.

The most important requirements for the precise determination of λ are:
- Uniform heat spreading in both bars,
- Negligible heat exchange with the environment during the measurement time.

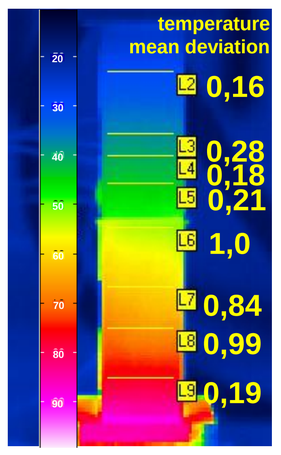
The compliance with these conditions are monitored by use of thermography.

Optical artifacts



The optical reflection of the measuring device - Heat Flow Meter - in the polished floor plate clearly demonstrates an "artifact".

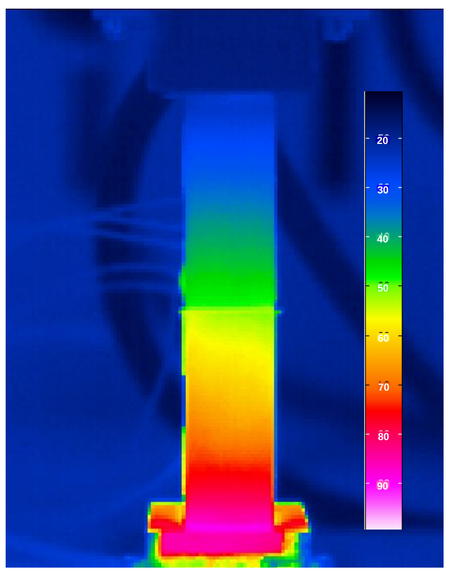
To eliminate the optical artifacts, the Al-bars were coated with a µm thin layer of Graphite.

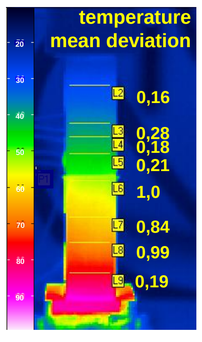


The deviation of the mean temperatures along horizontal lines on the bars depict a strong increases at the positions L6-L8. This image indicates an inhomogeneous heat spread within the hot bar. A defect, which might affect the accuracy of the thermal conductivity measurement.

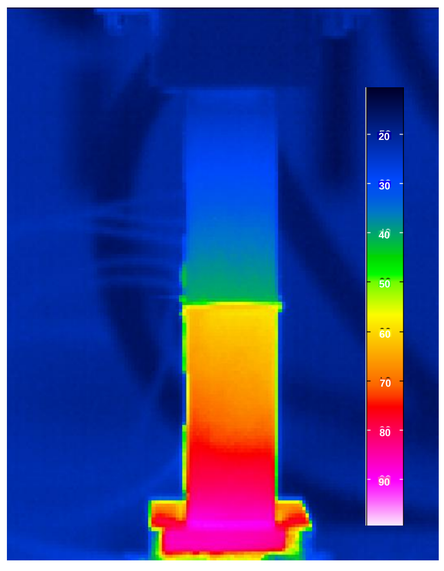
The thermograms of the connected bars from the Heat Flow Meter

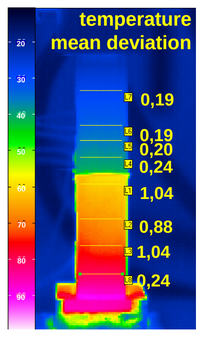
bare bars
no interface material



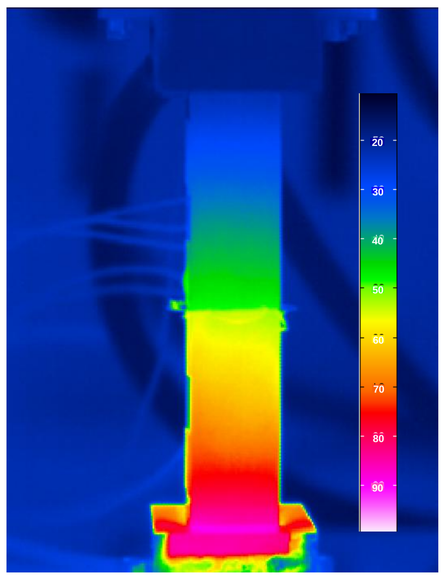


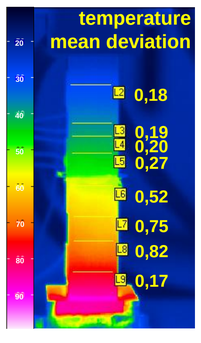
ZnO interface pad



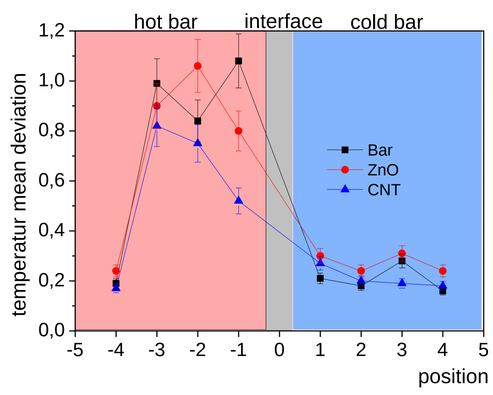


Carbon nanotube
based thermal grease





An efficient heat transfer between the bars can be realized by
- applying high pressure (tight contact)
- low interfacing distance
- large contact surface
- high thermal conductivity of the interface material



The Diagram displays the vantage of the carbon nanotube containing thermal grease by the thermal bridging of the two bars.

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