Quick thermal conductivity meter

Products/ Catalogue / Quick thermal conductivity meter

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For thermal conductivity measurement of insulating samples (λ≤ 5W/mK) in form of plates based on measuring the net heat flux through the sample per unit temperature gradient

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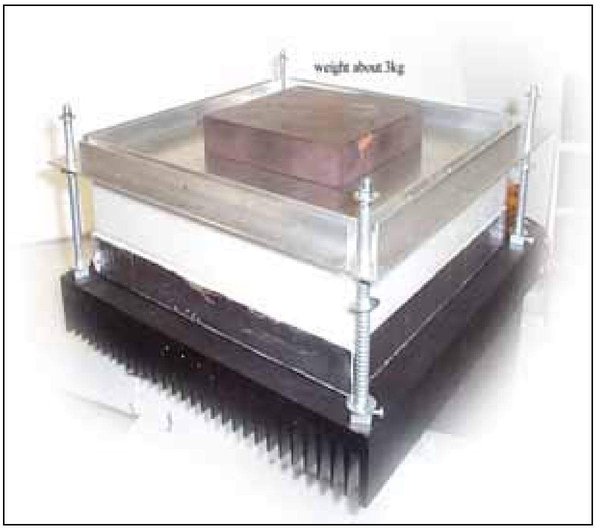
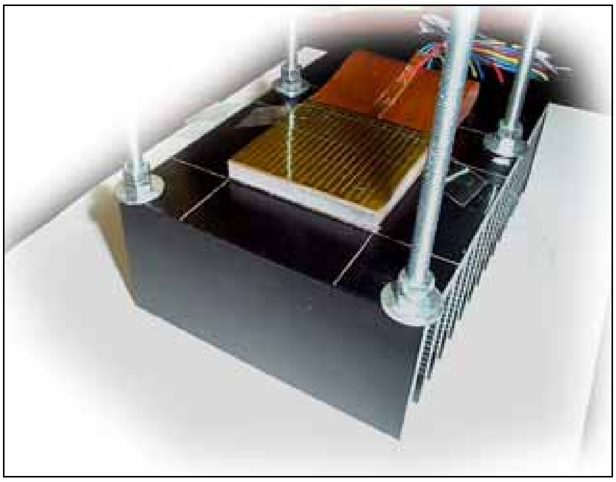
Operating principle

Thermal conductivity of any homogeneous materials is the steady heat flux per unit area, per unit temperature gradient so that thermal conductivity is easily determined from the ratio between the net heat flux through the sample measured in W/m^2 over the temperature gradient across the sample measured in °/m.

The net heat flux through the sample to be tested is supplied by the flat square flat electric heater thermally insulated by the thick polystyrene plate shown in the figure. The insulating sample (with shiny edges) to be tested is placed between the heater and the air cooled bottom sink. Accurate results are obtained if the sample thickness is lower than 1/10 of the lateral dimensions and if ΔT is about 10 °C.





The sample is inserted in the flexible thin foil ΔT sensor which consists of a series association of plated thermocouples indicating the temperature difference across the sample. The mV readout of the ΔT sensor (about 2.2 mV for =10°C) is translated in °C and divided by the plate thickness in meter to give the temperature gradient in °C /m.

The steady net heat flux through the sample is the average value of the heat fluxes entering the hot side and leaving the cold side that is $(\varphi_{entering} + \varphi_{leaving})/2$ in W/m^2. This net heat flux sample is measured by inserting the sample inserted in the ΔT sensor between two calibrated heat flux sensors. The net heat flux is thus equal to the average the heat flux readings translated into W/m^2

Determining the thermal conductivity of a plate (dimensions in the range 5mm-300mm consists:

- to insert the sample in the ΔT sensor and to put that measuring assembly on the air cooled heat sink incorporating a calibrated heat flux sensor
- to place the flat heater (insulated by a polystyrene plate on its top side) and adjust the dissipated electric power until ΔT is about 10 °C; the heat fluxes are measured at steady state
- to determine the net heat flux per unit temperature gradient
- to repeat the same determination on measurement onto a sample of different thicknesses in order to determine the thermal conductivity from the slope of the curve independently on the contact thermal resistances

The sensors are connected to any data acquisition system as shown in the figure and the heater to any standard electric power supply

Advantages:

- absolute thermal measurements reference insulating samples are not needed
- measurement independent on the sample temperature
- the time required to wait for the steady net heat flux is short
- the accurate measurements 5% up to 10W/m°