INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
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Technical Specifications for Thermal Conductivity/Thermal Diffusivity measurement Instrument

The bidder should enclose documents/literature with the technical bid to support the claim of compliance with the specifications.

The general requirement is of an instrument to measure the **thermal conductivity**, **thermal diffusivity** and **specific heat** of a wide range of materials using the flash diffusivity technique. The measurement should be possible as a function of temperature. Detailed features and capabilities are listed below.

Capabilities

- Thermal conductivity measurement in the range: 0.1 - 2000 W/(m.K) or more.
- Thermal diffusivity measurement in the range: 0.01-2000 mm^2/s or more
- Specific heat measurement of solid samples
- Thermal diffusivity measurement of bulk, powders, thin films (cross plane) and liquids
- Temperature range : room temperature to 1250 ^0C or similar

Key Specifications

- Flash lamp should be Xenon or Laser: Pulse energy up to 10 Joules/pulse or higher, Possibility of variable pulse width in the range 10 to 1500 μs or similar,
- Infrared detectors for temperature measurement in the range :RT- 1250°C or similar.
- The setup should be operable in various atmospheres like Inert, oxidizing, static and dynamic vacuum. Provision for sample chamber evacuation and back filling should be provided.
- Data acquisition interval upto 2 MHz or higher (adjustable measurement time depending on thermal conductivity, thickness of specimen). Provision for data acquisition, storage and viewing of real time data should be provided with the setup.
- Wide range of sample holderssuitable for solids, thin films, powders and liquid samples. Indicate possibility for auto sampling.
- Possibility of fast sample heating: maximum around 50 K/min

- Accuracy of the measurement should be:· Thermal diffusivity: ± 3% , Specific heat: ± 5% or higher
- Precision or Repeatability of the measurement should be : Thermal diffusivity: ± 2% , Specific heat capacity: ± 3% or higher.

Additional Sheet :

Detailed Specifications about the Harware and Sample Holders are provided below

- **Furnace and Sample Chamber**
  1) The temperature range of room temperature to 1250 ^{0}C or similar should be reachable using a single furnace.
  2) The provision for static and dynamic vaccuum should be such that the vacuum pump is integrated to the device and not a separate component.
  3) Heating rates upto 50 K/min should be possible.
  4) The temperature accuracy of the furnace should be ±0.1 K.
  5) The operation under various atmospheres which require gas purging should be facilitated by mass flow controllers (MFC) with flow rate of 0 to 250 ml/min or higher.
  6) The sample chamber should be integrated to the instrument with provision for easy cleaning.

- **Flash Lamp and Detector**
  1) Provision of independent tuning of pulse width and pulse energy should be there
  2) Single detector to measure for the entire temperature range fromroom temperature to 1250 ^{0}C or similar.
- **Sample Holder and Auto Sampler**
  1) The automatic sample changer should provide for measurements upto 4 samples or more in the enite temperature range.
  2) The sample position in the furnace must be such that it allows for uniform heat distribution.
  3) Individual thermocouples for temperature measurement of each sample holder which is placed as close as possible to the test specimen.

4) For measurement of thin films and foils possibility to measure upto 0.01 mm depending on the thermal diffusivity.
5) Dimensions and quantity of solids, thin films, powders and liquid samples to provided:
   Solid/Thin Films: Round samples with diameters of 12.7 mm and 10 mm, square sample of 10 mmx10 mm area. Liquid: re-usable sample holders made of suitable material, Powders: Standard sample holder with cap. The quantity for each should be that as required with the automatic sample changer. Dummy disks for covering unused sample holder positions to be provided.
6) Standard reference materials with calibration data for measurement of thermal diffusivity and specific heat should be provided.

- **Data Aquisition and Software**

1) Data acquisition interval upto 2 MHz or higher (which corresponds to minimum time interval between data collection of 0.5 micro-seconds or lower). Sufficient measurement points to work with thin samples should be there (number should be specified by vendor).
2) Provision for data acquisition, storage and viewing of real time data allowing easy handing of projects. Software should provide for standard options like baseline corrections, evaluation with different models (to be specified by vendor).