New In-house Designed High-Temperature Guarded Hot Plate Apparatus at CMI

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Guarded Hot Plate (GHP) is recognized as a precise method for thermal conductivity/resistance measurement mainly focused on thermal insulating materials. For measurements at moderate temperatures, GHP is well established e.g. in building industry enabling the determination of thermal conductivity with an uncertainty lower than 2%. GHP is a steady-state method based on Fourier's law of heat conduction. The specimen is sandwiched between two plates with different temperature which leads to setting a temperature gradient through the specimen. From the knowledge of the geometrical properties (contact surface area and specimen thickness) and hot plate heating power at steady state conductivity can be evaluated. High-temperature region brings many limitations and challenges to GHP method: Narrower range of materials can be used, disrupting of desired temperature profile in the specimen due to heat losses has to be minimized and high accuracy of temperature measurement has to be maintained. As a consequence, the uncertainty of the thermal conductivity measurements using GHP is rather high. Recently, Czech Metrology Institute (CMI) developed High-Temperature Guarded Hot Plate (HTGHP) apparatus allowing maximum operating temperature 850 °C and target uncertainty of measurement lower than 5%. With this apparatus CMI is involved in European Metrology Research Programme (EMRP) project SIB52 Thermo in which one of the tasks is to improve European equivalence in thermal conductivity measurement up to 800 °C. The apparatus design, results of preliminary measurements together with the current uncertainty budget will be presented.