Development of a New Certified Reference Material for Thermal Diffusivity Measurements

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The flash method is one of the most popular methods to measure thermal diffusivity [1]. The National Metrology Institute of Japan (NMIJ) in AIST has been studying the laser flash method in order to establish the SI traceable thermal diffusivity standard [2,3]. We have developed key technologies to reduce uncertainty in laser flash measurements [2]. We have established the SI traceable thermal diffusivity measurement procedure and started to a calibration service with the quality management system along to ISO 17025. Using these techniques, a reference material consist of four isotropic graphite specimens for thermal diffusivity measurements (NMIJ CRM 5804-a) that was produced according to ISO Guide 34 was developed and supplied. The thermal diffusivity of the reference material shows from 1.3 x 10^-5 m^2s^-1 to 1.0 x 10^-4 m^2s^-1 in the temperature range from 300 K to 1500 K. There are many thermal diffusivity data from the order of 10^-7 m^2s^-1 to the order of 10^-3 m^2s^-1 are reported in the scientific journals and data books [4]. In order to cover the wide range of thermal diffusivity measured by the flash method, various reference materials are required. There is a need of a new reference material which shows lower thermal diffusivity rather than the CRM 5804-a. We have investigated some materials and selected a black ceramics as the candidate for a new certified reference material. The disk-sets of different thickness specimens of the ceramics based on Al2O3 and TiC were prepared. Some specimens were sampled and measured in order to determine thermal diffusivity. And homogeneity and stability was also investigated. The thermal diffusivity of the new reference material was determined as a function of temperature from 300 K to 1000 K. The homogeneity of it was evaluated as the standard deviation of thermal diffusivity at room temperature of some sampled specimens. The range of thermal diffusivity value is from 2 x 10^-6 m^2s^-1 to 1 x 10^-5 m^2s^-1 dependent on temperature and the expanded uncertainty are 5 % ~ 8 % with a coverage factor k = 2. The reference material should be used in vacuum or in inactive gas flow. The reference material is a set of three disk-shaped specimens with 10 mm in diameter and 1 mm, 2 mm and 3 mm in thickness. It will be start to supply in 2015. It is important to discuss on how to use these reference materials. We will discuss about the topics, for example validation of minimum heat diffusion time of the apparatus and estimation of uncertainty.

References

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