Virtual: Appropriate metallic coating for thermal diffusivity measurement of transparent materials with laser flash method

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Thermal diffusivity is an important property to evaluate the heat transfer rate of a material, which is essential to the development of such as electronic device, nuclear reactor, and spacecraft. Thermal diffusivity is commonly measured by the laser flash method, which is regarded as a standard method for solids. However, the laser flash method requires the absorber of the laser pulse and the emitter of the infrared ray. In order to increase the absorption and emissivity for the laser flash measurement, coatings are generally applied. However, due to the transmission, the transparent materials are still difficult to be measured with the laser flash method directly. Thus, the present work aims to investigate the reliable measurement conditions for the thermal diffusivity measurements of transparent materials. Quartz glass disks were evaluated with the laser flash method to ensure the appropriate coating conditions for transparent materials. To verify the appropriate metallic conditions, different thick platinum and gold coatings were sputtered on the both surfaces of the glass disks by controlling the sputtering time, upon which high-emissivity carbon spray coatings are applied. Sample thickness dependence and temperature dependence of thermal diffusivity for quartz glass were also evaluated with the metallic coatings. In addition, in order to ensure the accuracy of the thermal diffusivity measurement with metallic coating, thermal diffusivity of Al2O3-TiC ceramics disks, which is a certified reference material supplied by NMIJ (National Metrology Institute of Japan), were also evaluated with and without the metallic coatings. In conclusion, in consideration of stability, operability and economic efficiency, applying a 32.70 nm thick gold sputter coating on the both surfaces of the transparent materials before the carbon spray is a useful method to measure the thermal diffusivity in the laser flash method.