Electrical-Optical Hybrid Pulse-Heating Method for High-Temperature Thermal Diffusivity Measurement

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Electrical-optical hybrid pulse-heating method has been developed for measuring thermal diffusivity of conductive materials up to very high temperatures for the first time. This technique is a combination of the electrical pulse heating method and the laser flash method. A thin strip specimen is directly heated by the passage of current through the specimen and the temperature of the specimen is maintained constant at a preset high temperature for several hundred milliseconds by fast feedback control of the heating current. The front face of the specimen under the brief steady state realized by the feedback control is heated by a light pulse of several hundred microseconds duration and the transient temperature response is observed at the rear face of the specimen. Thermal diffusivity is calculated by observed heat diffusion time across the thickness of the strip specimen based on the data analysis of the flash method for thermal diffusivity measurements. Heat capacity, electrical resistivity, normal spectral emissivity, and hemispherical total emissivity also can be measured for the same specimen by this measurement system based on the regular procedure of the electrical pulse heating method. Thermal conductivity can be calculated as the product of thermal diffusivity and heat capacity per volume. Preliminary results measured by this method on some metals are presented and are compared with the literature data. Since this method can minimize exposure time of specimen to high temperature, contamination of the specimen is reduced.