

Development of Electrical-Optical Hybrid Pulse-Heating System for High-Speed Multi-Property Measurements

Hikomichi Watanabe^{C, S} and Tetsuya Baba

National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Ibaraki, Japan

Satoaki Ikeuchi

Ulvac-Riko, Inc., Yokohama, Kanagawa, Japan

An electrical-optical hybrid pulse-heating system has been developed to measure thermal diffusivity, specific heat capacity, electrical resistivity, and hemispherical total emissivity of electrically conductive materials at elevated temperatures in less than one second. The system consists of a feedback-controlled electrical pulse heating system and an inexpensive and compact xenon flash lamp as the optical pulse source instead of pulse laser unit. In the experiment, feedback-controlling the direct current heating of the sample allows the sample to immediately attain a steady state where the sample is held at a target temperature above 800 K for less than 200 ms. The thermal diffusivity of the sample held in the brief steady state is determined from the thermal response of the sample to a short duration thermal pulse from the xenon flash lamp. The specific heat capacity and hemispherical total emissivity are determined based upon the principle of the direct heating calorimetry. The temperature of the sample during the subsecond experiment is measured by using a combination of high-speed radiation thermometer and thermocouple. The performance of the multi-property measurement system has been evaluated through the measurements of several metals and carbon materials such as molybdenum and isotropic graphite.