Measurements of Specific Heat Capacity and Hemispherical Total Emissivity using a Feedback-Controlled Pulse-Heating Technique: An Examination of Measurement Uncertainty Due to Conductive Heat Loss

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A measurement technique for specific heat capacity and hemispherical total emissivity of electrically-conducting materials at high temperatures using a feedback-controlled pulse-heating technique has been developed in our laboratory. In this technique, a strip sample is heated rapidly by an electric current pulse up to a preset high temperature, and then it is kept at that temperature for a short time (about 500 ms) with a computer assisted feedback-control system.

In the present technique, the specific heat capacity and hemispherical total emissivity of the sample were calculated using a heat balance equation based on the Stefan-Boltzmann law assuming that the temperature distribution in the middle of the sample is uniform. However, this important assumption is not always valid due to the conductive heat loss from a pair of voltage probes and sample holders.

In the present study, the effect of the conductive heat loss was examined by measuring temperature distributions on a heated sample using a high-speed video camera. Also, we developed a new measurement technique using removable voltage probes. In this technique, the voltage probes (a major source of the heat loss) are used only for a measurement of electrical resistivity, and then, the probes are removed in the measurements of specific heat capacity and hemispherical total emissivity.

At the Symposium, the results of a measurement of temperature distributions of a heated sample and preliminary test experiments using the removable voltage probes will be presented.