Simultaneous Measurement of Thermophysical Properties at Multiple Temperatures

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We have investigated the thermophysical properties for a number of non-crystalline metallic alloy specimens by using the method of real-time spectroscopy of laser-produced plasma (LPP) plumes from each specimen surface. When the specimen is thermally driven through a range of high temperatures and returned to room temperature, its transport properties invariably change, and this is explicitly due to a change in the near-surface profile of elemental composition. (See Y.W. Kim, *Int. J. Thermophysics* 28, 732 (2007), and references therein.) Several physical processes are involved in this type of thermal cycling: heating, thermal expansion, structural phase transformation, atom diffusion and cooling. At times, even melting and solidification come into play. In order to narrow the diversity of thermal forcing mechanisms, we carry out transport property measurements at each heated state. Furthermore, the measurement is carried out at several temperatures simultaneously by exploiting a topologically simple structure of the temperature gradient. When a long ribbon-shaped specimen is clamped at its two ends by heavy electrodes and heated electrically, the ribbon along its long axis exhibits a zone at each end that is steeply non-uniform in temperature. These zones are examined by the method of LPP plume spectroscopy. Position-resolved analysis of LPP plume emissions following a single laser-pulse excitation with a spatially extended footprint can provide a set of measurements of both the thermal diffusivity and elemental composition at multiple temperatures within a microsecond. The technique and the result of the thermophysical property measurement will be presented for a set of binary alloys.

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