Surface Position-Resolved Thermophysical Properties for Metallic Alloys

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One of the factors that affect the thermophysical property determination is compositional and morphological property nonuniformity in a material specimen. This has been made plainly evident in the simultaneous measurements of both the composition and thermal diffusivity by using the method of time-resolved spectroscopy of laserproduced plasma (LPP) plume emissions from the specimen surface for a number of alloy specimens [1]. Repetitive LPP measurements applied to a specimen exhibit systematic drift in the measured values of spectral emissivity and thermal diffusivity with increasing depth. We have pinpointed that the variability is traceable to the depth dependence of the near-surface elemental composition in each of the specimens [2] of interest is whether the reasons for the development of such depth-dependent composition are intrinsic to the metallic alloy systems. Our studies with the model system of Wood's alloy have shown that it is possible to drive the elemental composition of a surface layer away from the composition of the bulk by thermal cycling of a specimen between melting and resolidification [3]. It is quite possible to speculate that the depth dependence is manifest due to a distribution of islands of segregated elements at the surface, whose feature size and shape are irregular and depth dependent due to thermo-fluid dynamic instability during solidification. In this paper, we examine the lateral variation of elemental composition on the surfaces of two specimens, Wood's alloy and Nichrome ribbon. Statistical distributions of the composition and surface feature size will be presented.

[1] Y.W. Kim, *Int. J. Thermophysics*, **25**, 575 (2004).
[2] Y.W. Kim, *in Thermal Conductivity 26*, R.B. Dinwiddie, ed. (DEStec Publications, Lancaster, PA, 2005). p. 146-158.
[3] Y.W. Kim, *Int. J. Thermophys*, **26**, 1051 (2005).