Density and Surface Tension of Liquid Ternary Cu-Co-Fe Alloys

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Despite the importance of ternary Cu-Co-Fe alloys, information about their thermophysical data in the liquid state is sparse. Therefore, we will present density and surface tension data which have been measured contactlessly using the technique of electromagnetic levitation. In order to determine the volume, V, of a levitated sample, a CCD camera records a series of side view shadow images. The volume, from which the density can be derived, was calculated afterwards from an average of the profile lines. The surface tension is obtained from an analysis of the surface oscillation spectra. These have been extracted by an image processing algorithm from a number of top view images.

At temperatures above and below the liquidus point, density and surface tension are found to be linear functions of temperature. The experimental density results were compared to the regular solution model, and it turned out that they could be predicted from the binary phases alone, i.e. no assumption about ternary interactions had to be made. The measured surface tension values are in good agreement with the numerical solutions of the Butler equation where the known Gibbs excess energies were taken into account. It was found that, for Cu-Co-Fe, it is possible to predict the surface tension from the binary systems as well.

In addition to this, it was observed that the surface tensions are insensitive to substitution of the two transition metals Co and Fe. With respect to the surface tension, the system can be described by the formula Cu-(Co,Fe), with copper being the main parameter for the surface tension. This latter observation has led to a simplified model of the surface tension, which will be described as well.