Correlations Between Excess Volume and Thermodynamic Functions for Liquid State Binary Gold Alloys

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The correlations between excess volume and thermodynamic functions of liquid state binary alloys have been reported since 1937 [1]. In 1988, Iida and Guthrie summarized the relationship between excess volume and enthalpy of mixing [2]. In the report, they concluded that enthalpy of mixing was expected to have negative value for the binary alloys having negative excess volume. However, in our recent research [3], it was clarified that Fe-Ni, Fe-Co, and Bi-Tl systems had positive excess volume with negative enthalpy of mixing. Thus, these systems do not follow the correlation proposed by Iida and Guthrie. These alloy systems have a common characteristic feature in their phase diagrams, i.e., they have order-disorder transitions in their solid solutions. From this point of view, in this study, we focused on the Au-Pd and Au-Cu systems, which have order-disorder transitions. For comparison, Au-Ni was also studied, which has a miscibility gap in the solid solution. The densities of those alloys in a liquid state were measured by an electromagnetic levitation (EML) method with a static magnetic field. Based on the results, we discussed correlation between excess volume and enthalpy of mixing (and excess Gibbs energy) of alloys. Details of experimental procedure, results, and discussions will be presented in the conference.

References:

[1] G. Scatchard et al., Trans. Faraday. Soc., 33(1937) 160-166.
[2] T. Iida et al., The physical properties of liquid metals, Clarendon Press, Oxford (1988) 68-69.
[3] M. Watanabe et al., J. Mater. Sci., 51(2016) 3303-3310.