Development of electric furnace designed for density measurement of metals

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The empirical linear relationship between density and sound velocity, the Birch's law, is well studied for solid Fe-alloys but it has not been well examined for liquid Fe-alloys yet. Even at ambient pressures, the relation between density and sound velocity can be studied by varying temperatures, especially for liquids. Although density and sound velocity of some liquid Fe-alloys have been reported at ambient pressures, the data-set is not enough and simultaneous measurements of density and sound velocity have not been performed. Thus, we developed an electric furnace designed for measurement of density and sound velocity to study the relationship between density and sound velocity of solid and liquid Fe-alloys. The density and sound velocity are measured using volume measurement and pulse-echo overlap method, respectively.

In this study, we report set-up of the furnace and results of density measurement of solid Fe and Ni up to 1923 K. The measured densities of solid fcc-Fe and fcc-Ni are consistent with previous results with the accuracy of ~1.5 % and ~0.5 %, respectively. The thermal expansion coefficient of fcc-Fe was estimated to be $(6.87 \pm 0.47) \times 10^{-5}$ [K^{-1}], which was close to the previously reported value of 6.4×10^{-5} [K^{-1}] (Komabayashi et al. 2010).

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