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THERMOPHYSICAL PROPERTY MEASUREMENT USING LEVITATION TECHNIQUE UNDER MICROGRAVITY AND ON GROUND

Abstract

We review the thermophysical property measurement of high-temperature liquids using the levitation technique from the view point of comparisons of the result on the microgravity conditions with its on the ground conditions. Levitation technique has been developed with the space utilization research progresses. Under microgravity, materials levitate in space easily, therefore peoples have tried to use levitation technique for thermophysical properties measurements of high-temperature liquids, such liquid metals and alloys, and molten oxides. These thermophysical properties are required from the industrial necessaries for computer simulations of process control renovations.

The electromagnetic levitation system in Columbus/ISS named MSL-EML has been already operated for thermophysical property measurements using the oscillating drop method from late 2015. The electrostatic levitation system in KIBO/ISS named ELF started to perform thermophysical property measurements from 2017. However in ISS experiment time is limited, so we cannot obtain full data set of thermophysical properties with temperature and compositional dependences. We can obtain the benchmark data from the ISS experiments, therefore we need to obtain much data from the ground experiments in order to extrapolate the data obtained in ISS. On ground, the electromagnetic levitation technique has been used in long time to measure them. However since the electromagnetic force always generate the surface oscillation, we cannot obtain viscosity from the surface oscillation damping. Also, the electrostatic levitation technique with necessary the ultra high vacuum environments to avoid spark cannot control the evaporation from the high temperature liquid samples, which means that it is difficult to keep composition of alloy's liquid during the measurements. For these situations, we have been trying to apply the aerodynamic levitation (ADL) with the surface oscillation technique[1)] .

Using ADL technique, we obtained density, surface tension and viscosity of liquid metals and alloys and molten oxides on ground[2)]. For molten oxide, we combined the rotating bob method for viscosity measurements with ADL techniques. From these measurements, we obtained the temperature dependence of viscosity of molten oxides in wide temperature range[3)] . We discuss the surface oscillation phenomena of ADL droplet comparing with that obtained in ISS. From these discussions, we propose the correction method for the surface oscillation data taken on ground.

1) D. Langstaff *et al.*, Rev. Scientific Instruments, 84 (2013) 124901.
2) S. Hakamada *et al.*, Int. J. Microgravity Sci. Apple. 34 (2017) 340403.
3) D. Siafakas *et al.*, accepted in Int. J. Microgravity Sci. Apple.