Measurement of Thermophysical Properties of High Temperature Liquid Metals and Alloys by Aerodynamic Levitation Combined with a Surface Oscillation Excitation System

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We have developed the measurement technique for density, surface tension, and viscosity, for high temperature liquids by using aerodynamic levitation (ADL) combined with acoustically oscillation excitation methods [1]. Using the system, we succeeded in obtaining these properties for molten oxide system [2]. In the present study, we applied the measurement technique for liquid metals and alloys using new facilities composed with the process chamber designed for levitation of liquid metals and alloy samples. The process chamber can be evacuated to 10⁻³ Pa and be controlled with the ambient oxygen partial pressure using an oxygen pump made with stabilized zirconia. Using the above setup system, we succeeded in obtaining density, surface tension, and viscosity of Fe melts under oxygen partial pressure below 10⁻¹² Pa. Our measured density, surface tension, and viscosity data were in quite good agreement with previous literature data. From the results, we confirmed that our measurement system can be applied for high temperature liquids metal systems. Especially, viscosity of liquid alloys is difficult to measure using the levitation technique under the ground conditions; therefore our measurement system using ADL combined with the acoustically oscillation excitation method has advantage for viscosity measurement of high temperature liquid alloys. In the presentation, we discuss the details of the measurement results for Fe melts and also discuss the problems to be solved for more precise measurements of viscosity of high temperature liquid alloy systems.

References:

[1] S. Hakamada et al., Int. J. Microgravity Sci. Appl., 34 (2017) 340403.

[2] A. Nakamura et al., Int. J. Microgravity Sci. Appl., 34 (2017) 340404.