High-Temperature Thermophysical Property Measurement System Using an Electromagnetic Levitator in a DC Magnetic Field

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Thermophysical properties of high-temperature melts are indispensable for numerical simulations of materials processes such as semiconductor and optical crystal growth of the melt, and casting of super-high-temperature alloys for jet-engine turbine blades, in addition to welding in automobile manufacturing. Accurate data are necessary to improve the modeling, which cost-effectively engenders high-quality products. However, crucial obstacles render measurements of thermophysical properties difficult at elevated temperatures because of high chemical reactivity and fluidity of melts. From the background mentioned above, we are developing a high-precision measurement system for thermophysical properties such as heat capacity, thermal conductivity, emissivity, density and surface tension of high-temperature metallic melts [1-6]. This system consists mainly of an electromagnetic levitator incorporating a superconducting magnet, laser heating system, high-speed video camera and data-logging system. An electromagnetically levitated droplet behaves as a hard sphere in a dc magnetic field given by a superconducting magnet. The oscillation and convection of the droplet are suppressed because of the Lorentz force, which enables measurement of its true thermal conductivity using modulation laser calorimetry and high-accuracy measurements of density and surface tension. This development is contributed by researchers as follows:

(1) Thermophysical property measurements
- 1-1) Heat capacity, thermal conductivity and emissivity: H. Fukuyama, H. Khosroabadi, H. Kobatake, T. Tsukada(Tohoku University)
- 1-2) Surface tension: S. Ozawa, K. Morohoshi (Tokyo Metropolitan University), T. Hibiya (KeioUniversity)
- 1-3) Density: T. Aoyagi, A. Mizuno, M. Watanabe (Gakushuin University)

(2) Numerical simulation for evaluating convection in a droplet: K. Sugioka (Osaka Prefecture University), T. Tsukada (Tohoku University)

(3) Development of operating and analytical software: S. Endo, S. Fujimaki, S. Kojima, Y. Takasaki (ULVAC-RIKO, Inc.)

The details of the development will be introduced in the Symposium.

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[5] Watanabe *et al.*, *Faraday Discussions*, **136** (2007) 279.
[6] Morohoshi *et al.*, *J. Japan Inst. Metals*, **72** (2008) 708.