Interfacial Phenomena and Thermophysical Properties of Molten Steel and Oxides- Fundamental Research of Steel Processing Using Electrostatic Levitation Furnace (ELF)

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Present steel processing, interfacial phenomena between molten steel and oxides in which are usually called slag or mold flux, play important roles in materials design. For examples, in continuous casting, Marangoni convection due to the gradient of the interfacial tension between molten iron and molten oxide enhances heat transfer, and also avoid drop-off of oxide particles from flux into molten iron. Therefore, interfacial tension must be known for process controlling. From this requirement, we proposed the interfacial tension measurement technique between molten steel and oxides using the modified oscillating drop method with levitation techniques. The interfacial tension data using traditional technique based on the sessile drop method have been obtained only in temperature at melting temperature of iron due to dissolution of containers and the substrate into molten steel and oxides in higher temperature regions. Our propose technique to obtain temperature dependence of interfacial tension between molten iron and oxides is used a core-shell form droplet including interface between two liquids [1] using the electrostatic levitation, which can achieve the containerless conditions. However, since the difference of viscosity of molten steel and oxides are larger, the large viscosity difference affects on the surface oscillation of droplet [2]. Therefore, we performed numerical simulation of droplet oscillation of core-shell drops of molten iron and oxides, and we discussed the best conditions of droplet conditions including the viscosity value range for interfacial tension measurements from the outer surface oscillation frequency. The measurements will start late 2015 in International Space Station (ISS) using the electrostatic levitation furnace (ELF) in KIBO.

References:

[1] M. Saffren et al., Proceedings of the 2nd international colloquium on drops and bubbles, (1981) 7.
[2] K. A. Landman, AIChE Journal, 31(1985) 567.