

Density Measurement of Steel Material Melts Using a Surface Oscillation Suppression Technique in Electromagnetic Levitation

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The thermophysical properties of the liquid states of steel materials are important to accurately simulate the steel manufacture process and the welding process. However, it is difficult to measure, because the steel materials have high melting temperatures and high reactions. Thus, containerless techniques must be required to measure thermophysical properties of the liquid state of steel materials. In this work, we used the Electromagnetic Levitation (EML) Method. In the measurement of density using this method, the volume of levitated droplets is obtained from the shape of the droplet. However, large error values appear in the temperature dependence of density due to the asymmetry of the surface oscillation of electromagnetically levitated droplets on the ground. Therefore, we must suppress surface oscillation of the droplet to measure the density accurately. For this purpose, we imposed static magnetic fields to the droplet using a superconducting magnet. We have already shown that the shape of the electromagnetically levitated droplet under a static magnetic field keeps a rotational symmetry around the vertical axis without surface deformations [1,2]. Using this method, we measured the density of steel material liquids with temperature range from about 1700 K to 2100 K. We evaluated uncertainties in these measured data based on GUM (Guide to the Expression of Uncertainty in Measurement). The uncertainties obtained were small. We conclude that this measurement technique has the ability to precisely measure the density of steel material melts.

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