Surface Tension Measurement of High Temperature Melt in Consideration of Oxygen Partial Pressure Under Microgravity Condition

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The oscillating droplet technique using electromagnetic levitation (EML) is one of the most promising methods to measure accurate surface tension of high temperature molten metals. When this technique is applied on earth, the theoretically-derived Cummings and Blackburn equation is required for calibration because the droplet is deformed from spherical shape due to the gravitational acceleration and magnetic force from a levitation coil. However, the effectiveness of this equation was not completely confirmed by experimental research. A European research group has been measuring surface tension of molten metals using EML called TEMPUS under microgravity conditions. The TEMPUS can not control the oxygen partial pressure ($P\text{o}_2$) of ambient atmosphere, though the surface tension of high temperature melts has strong oxygen partial pressure dependence. In this study, the EML for microgravity experiment called PFLEX (Parabolic Flight Levitation Experiment Facility) was improved. The purpose of this study was to establish the measurement method of surface tension under microgravity condition. Furthermore, we attempted to measure surface tension in consideration of the $P\text{o}_2$ of ambient atmosphere under microgravity using parabolic flight of an airplane. As a result the sample was levitated during the parabolic flight regardless of the gravitational change from 1.5G to microgravity. The $P\text{o}_2$ of the outlet gas was confirmed by ZrO_2 oxygen sensor. Surface oscillation of the droplet became simple under microgravity condition due to the release of the external force from gravitational acceleration and electromagnetic force. Surface tension of molten copper measured under microgravity was almost the same as that measured on Earth using the Cummings and Blackburn equation.