

Influence of Oxygen Partial Pressure on the Surface Tension of Molten Silver

Keisuke Morohoshi^S and Shumpei Ozawa^C

Department of Aerospace Engineering, Tokyo Metropolitan University, Hino, Tokyo, Japan

Taketoshi Hibiya

Graduate School of System Design and Management, Keio University, Yokohama, Kanagawa, Japan

Hiroyuki Fukuyama

Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, Miyagi, Japan

The surface tension of a metallic melt has a dependence on the partial pressure of oxygen, because the oxygen adsorption on the melt surface affects surface tension to a great extent. However, few data have been reported on the influence of oxygen partial pressure. For measurement of surface tension, a conventional sessile drop method can assure measurement only within a narrow temperature range. The objective of this study was to measure an accurate surface tension of molten silver in consideration of oxygen partial pressure dependence. Surface tension of molten silver was measured by oscillating droplet method using an electromagnetic levitation (EML) furnace. This method assures the measurement in a wide temperature range including undercooled and superheated conditions. The oxygen partial pressure of an inlet gas was controlled by mixing 6N-Ar (He), 5 % H₂-Ar (He), and 3 % O₂-Ar gases. The surface tension was calculated from the surface oscillation frequency of $l=2$ mode of the droplet by the Cummings and Blackburn's equation. We successfully measured surface tension of molten silver within a very wide temperature over 500 K under controlled oxygen partial pressure. The surface tension temperature coefficient shows a negative value when the oxygen partial pressure is less than 10⁻¹² Pa. However, surface tension shows a “boomerang shape” behavior in an atmosphere with oxygen partial pressure as high as 10² Pa. At 1600 K it has a maximum value; it shows a positive temperature coefficient less than 1600 K, whereas it shows a negative value over 1600 K. The oxygen partial pressure dependence of surface tension for molten silver was confirmed in this study.