

Density Measurements of Liquid Fe-Ni Alloys Using an Electromagnetic Levitation Technique in a Static Magnetic Field

Manabu Watanabe^S, Hideo Higashi, Masayoshi Adachi and Hiroyuki Fukuyama^C

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

fukuyama@tagen.tohoku.ac.jp

Fe and Ni are important constituents for various industrial alloys such as stainless steels, hastelloy, inconel, permalloy, and invar alloys. Each alloy has an excellent property such as high corrosion resistance, high heat resistance, high magnetic permeability or low thermal expansion coefficient. From the practical importance, thermophysical properties of the Fe-Ni melts should be well established. As a first step, we have studied the density of the melts because the density is the most basic property required for measurements of surface tension, heat capacity, and thermal conductivity. Thus, the purpose of this study is to measure the accurate density of the Fe-Ni binary melts using an electromagnetic levitation technique in a static magnetic field. A static magnetic field was employed to effectively suppress the surface oscillation and translational motion of the levitated sample droplet, which enables a high-precision density measurement. This experimental facility is called PROSPECT, which has been designed to measure heat capacity, emissivity, thermal conductivity, density and surface tension of metallic melts with high accuracy in our laboratory. Using PROSPECT, the volume of the levitating sample droplet was measured from the sample images taken by a high-speed camera with a laser back illumination system. The sample temperature was monitored using a pyrometer, and it was calibrated using the liquidus temperatures of the alloy. The densities were measured from 0 to 100 mol% Fe in the Fe-Ni melts. For all compositions of the melts, the densities are expressed with a linear function of temperature. We also determined the molar volume of the melts as a function of composition. It shows a positive deviation from an ideal solution, which indicates that the excess molar volume is positive over the entire range of composition. Details of experimental procedure, results and discussion will be presented in the symposium.