Paper ID: 16536
oral
student

MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Fluid and Materials Sciences (2)

Author: Mrs. Elham Jafar-Salehi
Ryerson University, Canada

GRAVITY EFFECTS IN MASS AND SOLUTE TRANSPORT IN A BINARY METALLIC SYSTEM IN THE PRESENCE OF THERMODIFFUSION

Abstract

In this research work, a correlation between the sign change in the thermal diffusion factor and a change in the molecular structure, mixture viscosity and activation energy in non-ideal binary molten metal mixtures was established. To quantify this correlation, we modify our recently developed thermodiffusion model (Eslamian, Sabzi, Saghir, Physical Chemistry Chemical Physics, 12, 13835-13848, 2010) based on the non-equilibrium thermodynamics approach. We introduced an expression for the estimation of thermodiffusion factor in binary liquid mixtures where the convection was studied by solving the transport equations numerically. The predictive capability of the proposed expression, as well as other pertinent models was examined against the experimental data. It was found that a more accurate estimation of the chemical potential used here leads to a more accurate prediction of the thermodiffusion coefficient. Throughout this work, we considered the effect of gravity on convection. However, we would prefer to examine the predictive capability of our model in microgravity conditions. Therefore, our goal is to compare our gravity based model and study the predictive and suitability of our proposed model with space based experimental data. Transport equations for various Ra numbers and radiation effect in a square cavity of molten Sn-Bi, were considered. This model is covering both stable and unstable flow fields with and without the thermodiffusion effect and predict the temperature and concentration profiles as well as flow streamlines in the binary mixture. Numerical results show that at a high Ra numbers, the presence of thermodiffusion makes the flow excessively unstable. Surface radiation alters significantly the existence range of the solution and the average heat transfer through the horizontal walls of cavity.