Macrosegregation Caused by Convection Associated with Directional Solidification through Cross-Section Change

M. Ghods, M. Lauer, S.N. Tewari, D.R. Poirier and R.N. Grugel

Abstract:
Al-7 wt% Si and Pb-6 wt% Sb alloy samples were directionally solidified (DS), with liquid above and solid below and gravity pointing down, in cylindrical graphite crucibles through an abrupt cross-section change. Fraction eutectic distribution in the microstructure, primary dendrite spacing and primary dendrite trunk diameters have been measured in the DS samples in the vicinity of section change in order to examine the effect of convection associated with the combined influence of thermosolutal factors and solidification shrinkage. It is observed that convection not only produces extensive radial and axial macrosegregation near cross-section change, it also affects the dendritic array morphology. Primary dendrite spacing and primary dendrite trunk diameter, both, are influenced by this convection. In addition to the experimental results, preliminary results from a numerical model which includes solidification shrinkage and thermosolutal convection in the mushy zone in its analysis will also be presented.