Balasubramaniam, R.; **Subramaniam, R. S.**

Thermocapillary bubble migration-thermal boundary layers for large marangoni numbers.
(English) Zbl 1135.76356
Int. J. Multiphase Flow 22, No. 3, 593-612 (1996).

Summary: The migration of an isolated gas bubble in an immiscible liquid possessing a temperature gradient is analyzed in the absence of gravity. The driving force for the bubble motion is the shear stress at the interface which is a consequence of the temperature dependence of the surface tension. The analysis is performed under conditions for which the Marangoni number is large, i.e. energy is transferred predominantly by convection. Velocity fields in the limit of both small and large Reynolds numbers are used. The thermal problem is treated by standard boundary layer theory. The outer temperature field is obtained in the vicinity of the bubble. A similarity solution is obtained for the inner temperature field. For both small and large Reynolds numbers, the asymptotic values of the scaled migration velocity of the bubble in the limit of large Marangoni numbers are calculated. The results show that the migration velocity has the same scaling for both low and large Reynolds numbers, but with a different coefficient. Higher order thermal boundary layers are analyzed for the large Reynolds number flow field and the higher order corrections to the migration velocity are obtained. Results are also presented for the momentum boundary layer and the thermal wake behind the bubble, for large Reynolds number conditions.

MSC:

76Txx Multiphase and multicomponent flows

Cited in **11** Documents

Keywords:

thermocapillary migration; bubbles and drops; Marangoni convection; boundary layers; asymptotic analysis

Full Text: DOI