How the convective heat transport at the solid/liquid phase interface influences the stable mode of dendritic growth

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Abstract:

Convection plays an essential role in the growth of dendrites. Convection may influence the transport of heat and substances as well as mechanical deformation of dendritic crystals. In this paper, the effect of convective heat transport that substantially changes the dendrite tip diameter and its tip velocity is demonstrated. In addition, the Gibbs-Thomson condition connecting the phase transition temperature has been taken into account with allowance for the kinetic contribution arising from the effect of attachment kinetics at the phase transition boundary [1].

In this paper the growth of an anisotropic dendrite under conditions of convective heat transfer at the solid-liquid interface was analyzed theoretically. An analytical solution is obtained for the temperature distribution in the liquid phase for the parabolic and paraboloidal forms of the needle-like dendrite. The stability analysis is carried out and the integral of microscopic solvability is defined [2]. The selective ratio for the stable growth rate of the dendritic tip and its diameter is derived.

Keywords: Dendritic growth, Phase transitions, Solvability condition, Convective heat and mass transfer

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