Numerical Modeling of Interaction of Particles with Solidifying Crystals

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The thermal fields for the movement of a solidification interface towards a spherical particle was dynamically modeled for studying the deformation of the interface in relation with different thermal properties of the particle with the matrix solid-liquid. Finite element methods were employed in an axi-symmetric model of the system. Both particle and matrix were considered of similar densities and heat capacity. The convective force in the liquid phase was not considered. The results show that a concave interface is found when the particle has a larger thermal conductivity than the matrix, and a convex interface is found in the opposite case.

In addition, the drag force on a particle being pushed by a crystal was calculated with a fluid flow model. The force was calculated for different pushing configurations and the results compared with the values given by the modified Stokes equation [1]; which show that the model value are slightly larger than those the calculated with the equation. This difference predict an equilibrium separation for pushing lower than the computed by modified Stokes expression when a Lifshitz-Van der Waals model for the repulsion force [2] is used.

[1] Uhlmann M.A., Chalmers B., Jackson K.A. *J. Appl. Phys*., 1964, **35**, 2986.
[2] Dzyaloshinskii E., Lifshitz E.M., Pitaeskii L.P., *Soviet Physics,* 1961, **73**, 153-176.

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