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Phase-field simulation of gravitational settling of a growing dendritic crystal. MINH DO-QUANG, GUSTAV AMBERG, KTH — When solidifying a melt, for instance in casting of metals, the melt is typically cooled until its bulk temperature is below the equilibrium freezing temperature. Then any free nuclei in the melt will grow, often creating dendritic 'equiaxed' crystals. These growing solid particles typically have a slightly different density from the melt, and will thus begin to settle due to gravity. In the present talk an individual nucleus is simulated as it grows into a dendritic crystal. The melt flow and the convective heat transfer around the crystal are simulated as it settles due to gravity. There is an intricate coupling between the settling and the evolution of the crystal, as the relative flow will influence the growth, which in its turn will affect the subsequent settling motion. Simulations are done in two dimensions using a semi-sharp phase-field model. Inside the solidified part, the flow is constrained to a rigid body motion by using Lagrange multipliers. The model is formulated using two different meshes. One is a fixed background mesh, which covers the whole domain, the other is an adaptive mesh that is translated and rotated with the movement of the solid particle.

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