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# Particle pushing: Reexamine the thermodynamic criterion

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## ABSTRACT

During solidification, solid particles are either pushed or engulfed by the freezing front. The redistribution of particles in the solidified ingot is determined by the interaction between particles and the freezing front. A thermodynamic criterion, based on surface free energy considerations, has been widely accepted for predicting if particles are pushed by a freezing front.

However, experiments supporting the thermodynamic criterion were performed in either water or pure transparent materials containing particles. Little convincing experimental results have been obtained in metallic alloys to support models based on surface-free energy considerations. This article describes experiments performed in aluminum master alloys that suggest that we may have to reconsider the thermodynamic criterion for particle pushing based on surface-free energy considerations.

**KEYWORDS:** solidification, particle pushing, aluminum alloys