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Particle capture by a freezing front in a binary alloy JUSTIN KAO, ALEXANDER GOLOVIN, STEPHEN DAVIS, Northwestern University — We examine the interaction between a particle and a nearby solidification front in a binary alloy, subject to constitutional undercooling, Gibbs-Thomson effect, hydrodynamic lubrication, and van der Waals disjoining pressure. We solve for the shape of the front and obtain the particle velocity as a function of distance from the front, and quasi-steady traveling solutions as a function of velocity. We find scaling relations for the critical speed of solidification, which separates particle rejection and particle capture. It is shown that the presence of solute (e.g. impurities) in the system can lower the critical speed for capture by an order of magnitude, with the particle-front gap becoming dominated by constitutional undercooling rather than van der Waals premelting.

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