Large-Scale Simulations of Normal and Abnormal Grain Growth in the Presence of Particles[1]

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ABSTRACT

The paper describes large scale, massively parallel, three-dimensional Monte Carlo simulations of grain growth in the presence of particles using lattice sizes ranging from 8 to 64 million sites. The effect of simulation domain size, lattice temperature, precipitate size and precipitate distribution on the slope and intercept of the Zener-Smith equation are discussed. The occurrence of abnormal grain growth in particle-containing grain structure with isotropic boundary properties is investigated by relaxing the Zener pinning locally on the largest grain in the pinned structure by dissolving the grain boundary precipitates. The effect of anisotropy is investigated by providing a slight mobility advantage for the largest grain after dissolving the boundary precipitates. The simulations also consider the effects of maximum to mean grain size ratio, grain size to particle size ratio, and the rate of dissolution of the grain boundary precipitates, on the initiation of abnormal grain growth. The simulation results are compared with the analytical and experimental investigations of abnormal grain growth in particle containing systems.

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