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Study on growth model of cellular automata method in solidification simulation

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ABSTRACT

The forming process of casting alloy is generally complex and prone to segregation, resulting in uneven performance of its internal microstructure. And the cellular automaton (CA) is an effective method to simulate and predict the solidification morphology and properties. But different growth models in numerical simulation could produce differences results. Since the classical growth model is proposed on the basis assumptions of single phase equilibrium or near-equilibrium solidification, there are still individual solute components in cellular interface that mutated in the phase transition. And it is beyond the equilibrium solidification conditions, resulting in difference calculation results. Therefore, according to the Kurz–Giovanola–Trivedi (KGT) model and conservation model, a simplified method for processing the cellular interface mutation was proposed and applied separately to the growth velocity method and solute diffusion method. And the difference between the results by before and after correction method was compared. At the same time, the effect of the two methods for dendrite growth and grain evolution was discussed and analyzed with the experimental results. The results showed that the solute diffusion method used to process the solute concentration mutation is better more than the growth velocity method, and the numerical results are in good agreement with the experimental results. It further validates the usefulness and correctness of the revised solute diffusion method.

KEYWORDS: solidification, cellular automata, growth model, simulation