

# **Lattice Boltzmann study of the effect of stirring on the migration rate of curved interfaces in binary slurries**

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Stir the slurry during alloy solidification can lead to largely modified microstructure and substantially improved cast properties, and the technique is named semisolid metal processing (SSM) [1]. The microstructural evolution in SSM generally follows the routine from dendrite to rosette, and finally the spherical shape as the increasing of stirring intensity. Interface kinetics is considered to play one of the most important roles.

Based on the interface stability theory and the stagnant boundary layer flow model, Vogel and Cantor have predicted that the dendrite growth is encouraged by melt flow [2]. The result is conflicted with the experimental observations. To overcome the theoretical difficult, a number of phenomenological models have been developed, e. g. dendrite fragmentation, root remelting, abrasion and ripening. Recently, phase-field method with extended stagnant boundary layer flow model have been utilized to study the particle growth under melt flow [3]. Convinced numerical results have been obtained and the early conflict between theoretical prediction and experimental observation has been solved.

However, extended stagnant boundary layer flow model is a phenomenological model which needs to be valid. The effect of melt flow on the migration rate of solid-liquid interface should be calculated accurately. Due to the complexity of interface geometry, dynamic property of moving interface and the length scale of dendrite arms, traditional computational fluid method is not practicable. Lattice Boltzmann method turns out to be an idea choice.

In the present work, D2Q9 lattice Boltzmann model has been utilized to calculate the melt flow and chemical diffusion in a shearing binary system where a double-peak-shaped solid-liquid interface is involved. Migration rate of interface is calculated by means of constitutional undercooling theory. The results agree with experimental observations in SSM well.

## References

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- [2] Vogel A and Cantor B, J. Cryst. Growth 37 (1977) 309.
- [3] Qin RS and Wallach ER, Mater. Sci. Eng. A 357 (2003) 45.