MODELING OF MICROSTRUCTURE EVOLUTION IN MULTICOMPONENT ALLOYS USING THE LEVEL SET METHOD WITH ADAPTIVE MESH REFINEMENT

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A level set method combining features of front tracking methods and fixed domain methods is presented to model microstructure evolution in the solidification of multi-component alloys [1]. Phase boundaries are tracked by solving the multi-phase level set equations. Diffused interfaces are constructed from these tracked phase boundaries using the level set functions [2]. Based on the assumed diffused interfaces, volume-averaging techniques are applied for energy, species and momentum transport. Fast marching and narrow band computing are also utilized for fast level set computation. Adaptive mesh refinement in the rapidly varying interface region based on the level set variable makes the method practical for multi-scale solidification modeling. Parallel computation using domain decomposition based on the adaptively refined mesh allows us to address problems at low and high under-cooling values that were previously computationally unreachable. Several two- and three-dimensional dendritic solidification examples will be considered to validate the method and demonstrate its potential for modeling solidification of realistic alloy systems.

References

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