

An introduction to phase-field modeling of microstructure evolution

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The phase-field method has become an important and extremely versatile technique for simulating microstructure evolution at the mesoscale. Thanks to the diffuse-interface approach, it allows us to study the evolution of arbitrary complex grain morphologies without any presumption on their shape or mutual distribution. It is also straightforward to account for different thermodynamic driving forces for microstructure evolution, such as bulk and interfacial energy, elastic energy and electric or magnetic energy, and the effect of different transport processes, such as mass diffusion, heat conduction and convection. The purpose of the paper is to give an introduction to the phase-field modeling technique. The concept of diffuse interfaces, the phase-field variables, the thermodynamic driving force for microstructure evolution and the kinetic phase-field equations are introduced. Furthermore, common techniques for material parameter determination and numerical solution of the equations are discussed.