Scheil or Lever Rule? - Modelling the Kinetics of Solidification

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Abstract

Global equilibrium (complete mixing in the liquid and solid phase) or Scheil conditions (negligible diffusion in the solid, complete mixing in the liquid phase) are known to represent two limiting cases in predicting concentration distribution and phase fraction in binary alloys. Both of these limiting cases can be described by analytical equations with simplified phase diagrams, or with FactSage or other program packages with detailed phase diagrams. In binary alloys, microsegregation can thus be estimated by considering the two limiting cases.

In multicomponent alloys, the situation is more complex. In addition to the concentration profiles, the solidification path (trace of liquid concentration at the interface as a function of temperature) is predicted by the equilibrium and Scheil conditions. For the solidification path, Scheil and equilibrium conditions are NOT the limiting cases, it is thus not sufficient to use simplified models. In certain cases also the concentration profile may not lie inbetween the two extreme predictions. It is then indispensable to model the kinetics of solidification in detail. For this, thermodynamic calculations need to be coupled with kinetic models, either by using an interface to the thermodynamic software like ChemApp, or a fully coupled model like SolKin.