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Indirect Paths to Final Equilibrium: Kinetics in Multicomponent Systems

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Currently available software makes it possible to calculate diffusion-controlled phase transformation kinetics in multicomponent systems. However, the paths toward equilibrium are often not direct. Several examples dealing with the austenite/ferrite transformation in steels will be given which reveal the formation and subsequent dissolution of the same phase en route to final equilibrium. While this behavior is certainly indirect, and perhaps not intuitively apparent, the various stages in the transformations can be readily explained by considering the interactions in multicomponent systems. Much of the behavior can be traced to the significantly different diffusion rates in austenite and ferrite, and the same general behavior can be expected in any two-phase system with phases that have grossly different diffusion rates.

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