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Nominal vs. actual supersaturation of solutions

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Abstract

Following the formalism of the Classical Nucleation Theory beyond the dilute solution approximation, this paper considers a difference between the actual solute supersaturation (given by the present-to-saturated solute activity ratio) and the nominal supersaturation (given by the present-to-saturated solute concentration ratio) due to formation of subcritical transient solute clusters, called heterophase fluctuations. Based on their distribution function, we introduce an algebraic equation of supersaturation that couples the nominal supersaturation of a binary metastable solution with its actual supersaturation and a function of the specific interface energy and temperature. The applicability of this approach is validated by comparison to simulation data [E. Clouet et al., Phys. Rev. B **69**, 064109 (2004)] on nucleation of Al_3Zr and Al_3Sc in model binary Al alloys.

Keywords: A1. Supersaturated solutions, A1. Nucleation, A2. Growth from solutions, A1. Solid solutions, B1. Alloys

1. Introduction

Because decomposition of supersaturated solutions occurs in many natural phenomena and important technological processes, this problem traditionally attracts much attention (for some recent results see, e.g., Refs. [1, 2, 3, 4, 5, 6,
5 7, 8, 9, 10] and references therein).

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