

Chemo-mechanical phase-field model for two-sublattice phases: η -phase precipitation in Al-Zn-Mg-Cu alloys

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The electrochemical properties of high strength 7xxx Al-Zn-Mg-Cu alloys strongly depend on the substitutional occupancy of Zn by Cu and Al in the strengthening η -phase, and its microstructural and compositional prediction is the key to design of new generation corrosion resistant alloys. In this work, we will present a chemical-potential-based phase-field model capable of describing multi-component and two-sublattice ordered phases, during commercial multi-stage artificial ageing treatments, by directly incorporating the compound energy CALPHAD formalism [1-3]. The model developed has been employed to explore the complex compositional pathway for the formation of the η -phase in Al-Zn-Mg-Cu alloys. In particular, the influence of alloy composition, solute diffusivity, and heat treatment parameters on the microstructural and compositional evolution of η -phase precipitates, was systematically investigated from a thermodynamic and kinetic perspective and compared to electron probe microanalysis validation data. Furthermore, we have also studied the influence of grain boundary (GB) solute segregation, GB diffusion, precipitate number density, and far-field matrix composition, on the growth of a population of GB η -precipitates in a model AA7050 alloy. Finally, the extension of the chemo-mechanical model to a finite-strain elasto-viscoplastic material containing multiple chemical components will be presented.

Keywords: Phase field; Chemo-mechanics; Grain boundary precipitation; 7xxx alloys

References:

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