Phase-field simulation of microstructure evolution in Ni-Based superalloys

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Abstract

Ni-base superalloys show a superior strength at elevated temperatures because of their precipitation hardening of γ' [Ni3 (Al, Ti)] phase coherently in FCC matrix. It is known that the mechanical properties strongly depend on the distribution and size of the precipitates. One effect could be that the finer grains produce a more brittle material [Callister, 2007]. The phases identified in this material are γ (matrix) and γ' (precipitates). Both the γ and γ' phases have FCC crystallographic lattices, but there remains a small misfit between them. During phase transformation, elastic stresses arise due to this lattice misfit among the phases. Elastic anisotropy in turn has a strong influence on the microstructure and its evolution, due to which the precipitates grow as cuboids. Hence, knowledge of the growth process is an important aspect for the design and development of superalloys. The present research work is directed towards numerical simulation of Ni-based superalloy's precipitate growth with and without external load using multi-phase field multi-component model.