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The double-edge effect of second-phase particles on the recrystallization behaviour and associated mechanical properties of metallic materials

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ABSTRACT

Most industrial alloys contain a matrix phase and dispersed second-phase particles. Several thermomechanical processing (TMP) steps are usually needed to produce a final product, during which recrystallization and its related phenomena may take place. Second-phase particles may *retard* or *accelerate* recrystallization, depending on their size and spatial distribution, the TMP conditions, among others. Besides their effect on recrystallization kinetics, the introduction of second-phase particles creates additional interfaces within the matrix, it also modifies the grain structure and crystallographic texture after recrystallization, which then either *improves* or *deteriorates* the associated mechanical properties of the investigated materials. The interactions between second-phase particles and recrystallization are further complicated when these particles are not stable. In addition to particle coarsening, they can also precipitate out or dissolve into the matrix before, simultaneously with or after recrystallization. This review article attempts to summarize the recent progresses on the complex interaction between second-phase particles and recrystallization and the science behind them. This double-edge effect of second-phase particles on recrystallization behaviour and mechanical properties of metallic materials is still far from being clear. A better understanding of this issue is of high academic and industrial interests, since it provides potential freedom for TMP design and microstructure control.

Contents

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1. Introduction

A very large part of metallic materials, which often contain a matrix phase and dispersed second-phase particles, are used in the wrought form. Several thermomechanical processing (TMP) steps are usually needed to produce an intermediate or final product for these materials, during which recrystallization and its related phenomena such as work hardening, recovery and grain growth may take place, all of which are strongly affected by second-phase particles. These interconnected metallurgical reactions, occurring concurrently or sequentially, need to be carefully controlled to obtain desired microstructures, which dictate the mechanical properties of the final products.