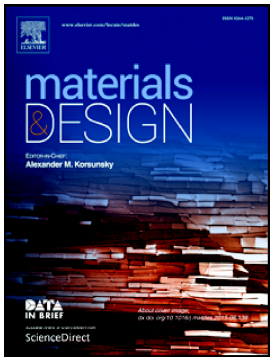

A high-performance TRIP steel enhanced by ultrafine grains and hardening precipitates

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A high-performance TRIP steel enhanced by ultrafine grains and hardening precipitates

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Abstract: Using thermo-mechanical processing, a heterogeneous microstructure with ultrafine grains and efficient hardening nanoprecipitates was introduced into a transformation induced plasticity (TRIP) steel with composition of Fe-12Mn-2Ni-Mo-Ti-(Al), such that the fabricated steel has an excellent combination of yield strength, ductility and thermal stability. It is shown that the Laves phase precipitates which hindered the ultrafine grains from coarsening were formed at high temperature, whereas the most efficient hardening nanoprecipitates inside these ultrafine grains were introduced at a lower temperature. The former precipitates are hexagonal $(Fe,Mn)_2(Mo,Ti)$ Laves phase containing Si and the later nanoprecipitates belong to the B2 phase.

Keywords: TRIP steel; Ultrafine grains; Laves phase; Precipitation; Thermo-mechanical processing

1. Introduction

Transformation-induced plasticity (TRIP) steels with the exceptional combination of ultimate strength and ductility have become attractive in the development of new advanced structural steels. However, TRIP steels with fully austenitic structures have a shortcoming, i.e., low yield strength [1-4]. There are several methods for improving the yield strength of TRIP steels, such as grain refinement [5-7], introducing defects [8], introducing gradient hierarchical nanotwins [9] and precipitation strengthening [10-12]. In particular, grain refinement is a popular way to improve the yield strength of materials because it usually