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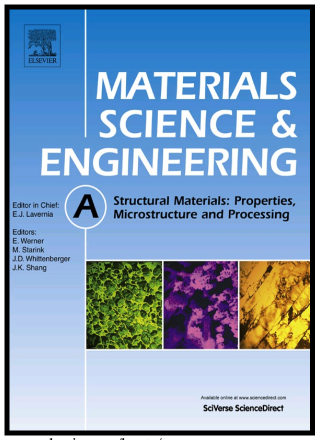

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Abstract:

High Mn austenitic Fe-Mn-C steel is a superior material which exhibits excellent strain hardening behavior, with high strength and good ductility as a result of deformation-induced twinning. In this paper, a dislocation-based strain hardening model is developed by considering the effect of the Mn content on the mechanical behavior of TWIP steel. The Mn content varies in the range of 22-26 wt.%. In the model, the stacking fault energy (SFE) is considered to be dependent on the composition of the TWIP steel and the plastic strain. The driving force for twinning, which is controlled by the SFE, dominates the mechanical twin nucleation probability. The dislocation density evolution, which controls the strain hardening behavior, is influenced by the twinning volume fraction. The mechanical behaviors of TWIP steels with different Mn contents are tested in axisymmetric tension, and the microstructure evolution is observed in-situ by means of light-optical microscopy. The twinning volume fraction is determined on the basis of the observed twin area fraction. The predictions of the proposed model are verified by comparison with experimental data and the influence of the Mn content of the TWIP steel on the mechanical behavior is also analyzed.

Keywords: TWIP steel, Strain hardening model, Mechanical twinning, Stacking fault energy

1. Introduction

Because of austenite Twinning Induced Plasticity (TWIP) in deformation process, TWIP steels have the advantages of strong work hardening, high strength and good ductility simultaneously. Therefore,