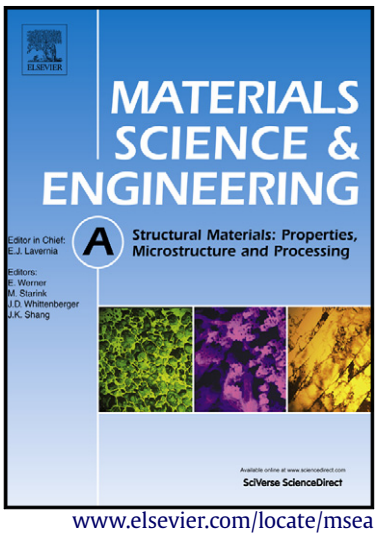

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Deformation twinning and martensitic transformation and dynamic mechanical properties in a Fe-0.07C-23Mn-3.1Si-2.8Al TRIP/TWIP steel

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Abstract

In the study describe here, we have explored the evolution of microstructure and mechanical properties in Fe-0.07C-23Mn-3.1Si-2.8Al steel with a stacking fault energy(SFE) in the intermediate range from 15 to 20 mJ m^{-2} during dynamic deformation and in the strain rate range of 10^1~$10^3$$s^{-1}$. The results showed that, the transformation induced plasticity (TRIP) effect and twinning induced plasticity (TWIP) effect coexisted during dynamic deformation. The mode of austenite to martensite transformation is γ→ε, ε→α′. With increase in the strain rate, the volume fraction intermediate ε-martensite was increased and α′-martensite remains nearly constant, and the frequency of intersecting deformation twins was also increased. This behavior steel was responsible for good combination of ultimate tensile strength of 913 MPa and total elongation of 75.4% at a strain rate of $10^3$$s^{-1}$. The strength and elongation increased significantly with increase at strain rate in the range of 10^1~$10^3$$s^{-1}$. The dominant plasticity enhancing mechanisms with increase in strain rate were strain-induced intermediate ε-martensite and intersecting deformation twins.

Keywords: microstructure, dynamic mechanical properties, martensite transformation, deformation twin, high strain rate

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