Deformation and annealing behaviour of dual phase TWIP steel from the perspective of residual stress, faults, microstructures and mechanical properties

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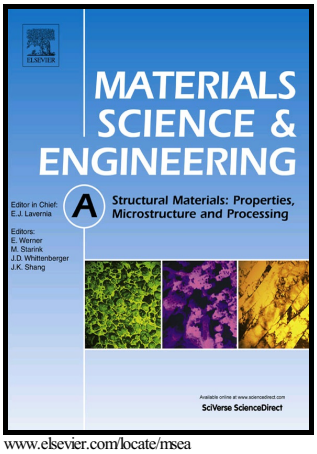

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Abstract

The present study aims to examine the deformation and annealing behaviour of Fe–0.07C–20Mn–2.6Si–1.6Al TWIP steel in the viewpoint of microstructural characterisation, fault analysis, triaxial residual stress measurement and mechanism of twin formation. 50% cold deformation results in improvement of hardness and tensile strength (428 HV and 1419 MPa, respectively), whereas annealing at 900°C of the same leads to improvement in ductility (61%) with the decrease in strength (873 MPa). The residual stress is maximum and compressive in nature in deformed sample which has been diminishing after annealing. Hot rolled and hot rolled-solution treated samples develop dual phase microstructure along with annealing twins, whereas fine nano twins and high dislocation density with dual phase microstructure are apparent after 50% cold deformation. The presence of Shockley partial dislocation, overlapping of stacking faults, Lomer-Cottrell lock, intrinsic and extrinsic stacking faults affect the mechanical properties as obstacles of dislocation movements or assisting twin formation. Goss component, Brass component of texture are dominating after rolling, whereas annealing results in weakening of rolling texture components. The nucleation mechanism of twin has been consistent with the pole mechanism along with the deviation process. Hence the present work amplifies the present understanding of deformation and annealing behaviour on low carbon dual phase TWIP steel from different characterisation perspectives.