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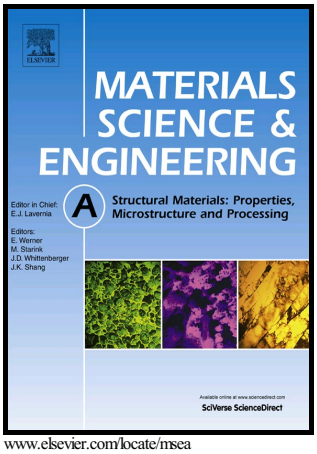

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Micromechanics of multiaxial plasticity of DP600: experiments and microstructural deformation modeling

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Abstract

Multiaxial plasticity behavior of Dual Phase (DP) 600 steel was evaluated through macroscopic testing and predicted through both continuum and micromechanics simulations. The stress state dependent mechanical properties of the material were examined through multiaxial loading under five stress states. The proposed continuum plasticity model was found to accurately predict the multiaxial mechanical response of the material through macroscopic simulations. The microstructure of DP600 contains a relatively soft ferrite matrix and relatively hard martensite particles, suggesting a more complex deformation behavior at the microscale compared to single phase materials. To understand the deformation mechanisms, a representative volume element (RVE) model based on the observed microstructures was built, which was able to predict the macroscopic multiaxial plasticity behavior of the material from the microstructural level. The local deformation inhomogeneity and stress states were also examined through this RVE model. The simulation results showed that in the DP steel studied, closely situated martensite particles