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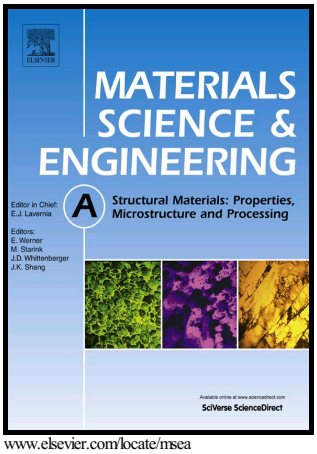

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The sources of the micro stress and strain inhomogeneity in dual phase steels

Sajad Zarei[1], **Reza Jafari Nedoushan** [1], **Masoud Atapour**[2*]

[1]Department of Mechanical Engineering, Isfahan University of Technology, Isfahan84156-83111, Iran.

[2] Department of Materials Engineering, Isfahan University of Technology, Isfahan 84156-83111, Iran.

[*]Corresponding author. m.atapour@cc.iut.ac.ir

Abstract

The microstructure of dual phase steels comprises of ferrite phase, reinforced by martensite grains. Computational modeling has been developed to study the dual phase steels behaviors at microstructure level. Inhomogeneity of the material response in the micro level is the key difference between macro and micro levels. Correct prediction of stress and strain inhomogeneity can lead to a better estimation of material behaviors like damage. The various orientations and shapes of the grains are well-known sources of the inhomogeneity. Change of the mechanical properties of the ferrite phase with distance from the martensite boundary is another source that is recently detected. In this paper, a new method is proposed to consider this phenomenon in finite element modeling of dual phase steels microstructure. Two types of finite element models were created based on SEM images. In the first model, grains and boundaries are directly created from the SEM images, while the second model uses a Voronoi type algorithm to construct geometries. In the second model crystal plasticity constitutive law is also employed to model the ferrite and martensite grains behavior. It is observed that by considering the ferrite phase inhomogeneity, the model can predict macro stress precisely and a better prediction of shear band formation compared to the homogeneous models is obtained.

Keywords: Dual phase steels; Finite element microstructural modeling; Response inhomogeneity; Ferrite phase inhomogeneity; Voronoi model

1. Introduction