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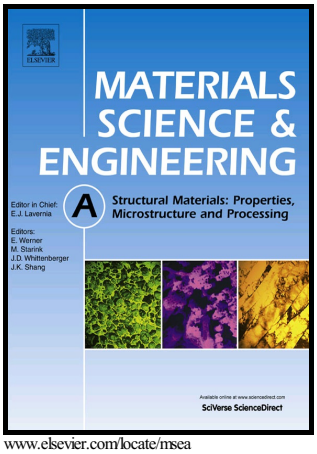

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Towards a micromechanical based description for strength increase in dual phase steels during bake-hardening process

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Abstract

The present work aims to study the bake-hardening behaviour in dual-phase (DP) steels. The mechanical properties and BH-values in dependency of the BH-parameters were determined and related to specific microstructural features in order to characterize the age- and strain-hardening behaviour. Micromechanical modelling by means of representative volume element (RVE) approach was used to describe the effect of BH on the mechanical behaviour of DP steel numerically taking into account microstructural features. 2D RVEs were created based on real microstructures. The flow behaviour of single phases was modelled using a Taylor-type dislocation-based work-hardening approach. The volume change during austenite-to-martensite transformation was also modelled and the resulting prestrained areas in ferrite were considered to be the storage place of GNDs. Afterwards, prestraining of 2 and 5% were imposed on the RVEs through numerical uniaxial tensile test. Then, the BH annealing was implemented on the prestrained RVEs in order to investigate the strain partitioning during annealing. Subsequently, numerical tensile tests were implemented on the bake hardened RVEs in order to study the stress-strain distribution on the microstructures. Finally, the flow curves of simulations on BH-treated and conventional DP steels were compared with experimental results showing a good correlation between experiments and simulations.

Keywords

Dual-phase steel; transformation-induced geometrically necessary dislocations; bake-hardening effect; representative volume element; dislocation density based model

1. Introduction

Advanced high strength steels (AHSS) have been developed not only for weight saving but also to improve crash safety of vehicles and combine good cold formability with a high strength level [1,2]. Dual Phase (DP) steels offer promising results in this field, while their extraordinary mechanical properties can be tailored and adjusted by alloying and processing.