The Deformation Induced Martensitic Transformation and Mechanical Behavior of Quenching and Partitioning steels under Complex Loading Process

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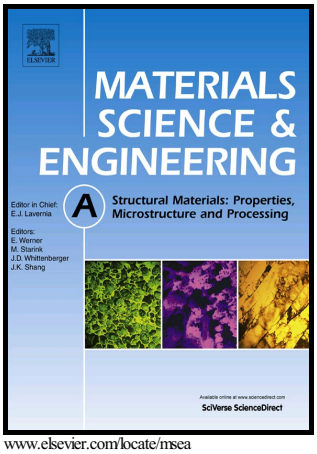

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Abstract:

The quenching and partitioning (QP) steels have received much attention due to its high strength and good ductility, which results from deformation induced martensitic transformation (DIMT). However, due to the stress state, temperature and strain rate dependent DIMT behavior, the DIMT related flow behavior of QP steels might be more complex than other advanced high strength steels (AHSS) without martensitic transformation. During forming process of such materials (non-linear loading process), effects of DIMT behavior and DIMT related flow behavior on springback prediction are still unknown. In this paper, we focused on the martensitic transformation behavior of QP steels under complex loading (linear loading and cyclic loading). The X-ray diffraction and digital image correlation techniques were performed to monitor the retained austenite evolution and strain history of the specimen, respectively. Then, flow behaviors of QP sheets steels subjected to complex loading are analyzed and compared with DP980 sheets steels (without DIMT). Finally, modified Yoshida and Uemori model calibrated by two different cyclic loading tests, i.e., tension-compression test and cyclic shear test, are adopted in this study to investigate the stress state dependent DIMT effect on springback prediction. The results show, for QP steels, the DIMT is stress state dependent. Accordingly, compared with DP steels, its flow behavior exhibits remarkable stress state sensitivity. Due to these special DIMT behavior and flow behavior of QP steels, its springback prediction should be treated differently compared with DP steels.

Key word: *Quenching and partitioning steel, deformation induced martensitic transformation, stress state, non-linear strain path, tension-compression tests, cyclic shear test*

1. Introduction

Facing with the increasing demands for the reduction of passenger car weight and the