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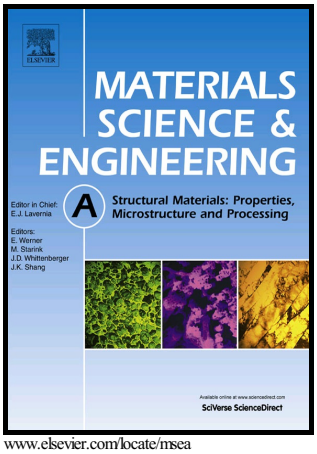

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Effect of bainitic transformation combined with hot forming on the microstructure and mechanical properties of bainite-martensite multiphase steel

Jingli Zhao [a], Xianming Zhao [a*], Chunyu Dong [a], Xiaoyu zhao [a], Shouxu Kang [a]

[a] The State Key Laboratory of Rolling and Automation, Northeastern University, Shenyang110819, China

[*] Correspondence: Tel.:+86 83688544 .zhaoxm@ral.neu.edu.cn

Abstract

We have investigated the effect of introducing hot deformation and bainite isothermal treatment to the quenching-partitioning process for steel on the mechanical properties. The results indicate that the number of bainite-nucleation sites increase and the total elongation improves by deforming the steel and subsequently refining the martensite sheaves. Following this process, an excellent strength-elongation product of 27.5 GPa% is obtained.

Keywords

Hot forming; Intracrystalline bainitic ferrite; Microstructure; Phase transformation; Mechanical properties.

1. Introduction

Strength and ductility are key mechanical properties for the development of a new generation of automotive steels that are energy-efficient and lightweight[1]. Unfortunately, high strength often results in the degradation of formability. However, a new metal forming process developed during the last decade (hot-formed steel) may solve this problem[2, 3]. The hot-stamping process includes simultaneous heat treatment and metal forming in a single step; however, the elongation of current hot-formed steel is usually limited to 6% after the hot stamping process, leading to a low product of strength and elongation (PSE) value of about 9 GPa%[4]. Liu[5] proposed a combined process of hot stamping and quenching-partitioning (QP), which can improve the PSE value to greater than 20 GPa%; however, in this rapidly developing industry, PSE levels reaching 30 GPa% are becoming a necessity. Young and Bhadeshia[6] insisted that joining soft phases and a hard matrix could enhance the