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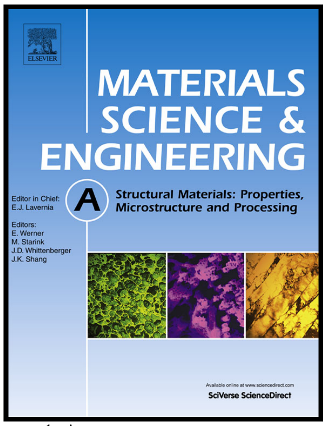

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M.H. Razmpoosh, A. Zarei-Hanzaki, A. Imandoust

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Effect of the Zener-Hollomon parameter on the microstructure evolution of dual phase TWIP steel subjected to friction stir processing

M.H. Razmpoosh, A. Zarei-Hanzaki*, A. Imandoust

The Complex Laboratory of Hot Deformation and Thermomechanical Processing of High Performance Engineering Materials, School of Metallurgy and Materials Engineering, College of Engineering, University of Tehran, Tehran, Iran

Abstract

The present work is devoted to investigate the correlation between the Zener-Hollomon parameter and the grain structure of the thermo-mechanically processed dual phase twinning induced plasticity (TWIP) steel utilizing the friction stir processing (FSP) technique. To this end 3mm thick workpieces were subjected to FSP under rotational speeds of 800-to-2500 rpm and constant traveling speed of 50 mm/min. Additionally, isothermal hot compression tests were conducted at temperatures in the range of 800-1100°C under the strain rates of 0.001-0.1 s^{-1}. Employing the flow stress data acquired from compression tests, the precise value of deformation activation energy (Q) was determined through Arrhenius-type constitutive model. The results indicate that increasing the rotational speed from 800 to 2500 rpm has led to Z-value variation between 1.04–0.03 ($\times 10^{20}$) s^{-1}. However, the scanning electron microscopy (SEM) characterization shows that the grain size reach a certain minimum value at 1600 rpm. Three different models have been established to interpret the correlation between Z-value and the size of FSP-induced grains in the case of the experimental TWIP steel.

Keywords: Twinning induced plasticity steel; Friction stir processing; Zener-Hollomon parameter; Deformation activation energy; Thermomechanical processing.

1. Introduction

* Corresponding author

Tel.: +98 21 61114167; Fax: +98 21 88006076.

E-mail address: zareih@ut.ac.ir (A. Zarei-Hanzaki)