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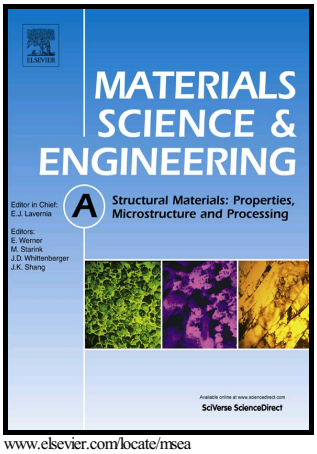

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The role of fibrous morphology on the Charpy impact properties of low carbon ferrite-bainite dual phase steel

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Abstract:

Primarily ferrite-pearlite microstructure having coarse ferrite grain size (24 μm) and high pearlite fraction (42%) offered YS ~ 575 MPa with poor impact properties such as, upper shelf energy (USE) of only 30 J and ductile brittle transition temperature (DBTT) as high as 27°C in an industrially hot-rolled plate of 0.25 wt.% C steel. In order to improve the strength along with the impact properties by developing ferrite-bainite microstructures, two different types of heat-treatments, namely step-cooling (SC) and intermediate cooling (IC) treatments, were carried out on the as-received material. Significant improvement in strength along with the impact toughness (with YS of 740 MPa, USE of 222 J and DBTT of -57°C) has been achieved by developing fibrous microstructure, with alternate thin-films (2-4 μm thick) of ferrite and bainite through intermediate cooling (IC) treatment. Fine film-like structure with large orientation difference across the ferrite-bainite interface boundaries not only increased the strength but also resulted in frequent deflection in cleavage crack propagation path which improved the low-temperature impact toughness and reduced the DBTT.

Key words: Dual phase steel; Ferrite-bainite microstructure; Strength; Impact toughness; Crystallographic orientation; Cleavage crack propagation.

1. Introduction

An excellent combination of strength, ductility and impact toughness is an essential requirement of the steel grades used for construction, linepipe, pressure vessel, automotive, naval and defense applications [1–12]. Ferrite-martensite or ferrite-bainite dual phase steels can be