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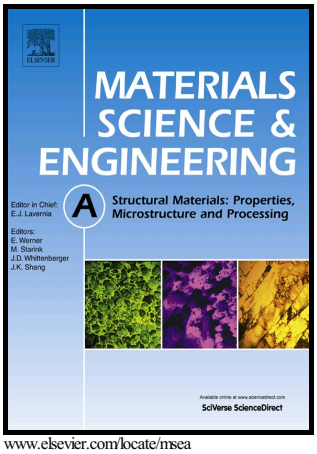

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Abstract

This paper reports the theoretical design of time-temperature matrix for intercritical annealing of hot-rolled medium-Mn (4.75 wt.%) steel, followed by experimental validation and correlation with mechanical properties. Considering the predicted temporal elemental distribution within the austenite region, the amount of retained austenite was calculated for different annealing time-temperature combinations. The partitioning behavior of alloying elements and subsequent austenite stabilization was studied for the annealing temperatures from 570 to 670 °C and for the holding durations in the range of 1 to 46 h. The resulting microstructures mainly comprised martensite and retained austenite. However, carbides were observed to form at low annealing temperatures. The experimentally estimated retained austenite content showed an increasing trend with increase in the annealing temperature and time. This is found to be in close correspondence with theoretical predictions. The maximum amount of retained austenite (22.4±0.9 %) was observed for the sample annealed at 650 °C for 46 h. The YS/UTS ratio and energy absorption capability (UTS×TE) showed a strong dependence on retained austenite content and improved linearly with it. The UTS×TE values (variation from ~10 to 25 GPa %) showed dependence on changes in annealing parameters, indicating its importance to achieve high energy absorption capability.