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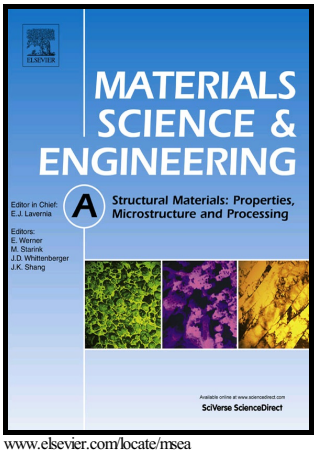

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Effect of welding heat input on grain boundary evolution and toughness properties in CGHAZ of X90 pipeline steel

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Abstract

In the present study, the simulated coarse-grained heat-affected zones (CGHAZs) of X90 pipeline steel were produced using a Gleeble 3500 simulator under different heat inputs (HIs) varying from 10 to 50 kJ/cm to study the effect of HI on grain boundary evolution and toughness properties in CGHAZ of X90 pipeline steel. The experimental results show that the microstructure and grain boundary is significantly influenced by different HIs. All the studied specimens have baintic dominant microstructure that composed of lath bainite (LB), granular bainite (GB) and M/A (martensite/austenite) constituents. The fraction of LB decreased with increasing of HIs, and the fraction of GB increased. The excellent combination of GB and LB obtained at an HI of 25 kJ/cm, resulting the highest impact absorbed energy, is 267 J. The impact toughness decreased sharply when HI increase from 25 kJ/cm to 30 kJ/cm, the impact toughness decreased to 18 J when the HI is larger than 30 kJ/cm. The number of HAGBs increased first and then decreased with increasing of HIs. However, for low energy coincidence lattice grain boundaries (low-ΣCSLs), the Σ3, Σ11, Σ25b boundaries decreased with increasing of HIs. Low fraction of M/A constituents are not the direct reason for the reduction of impact toughness in the