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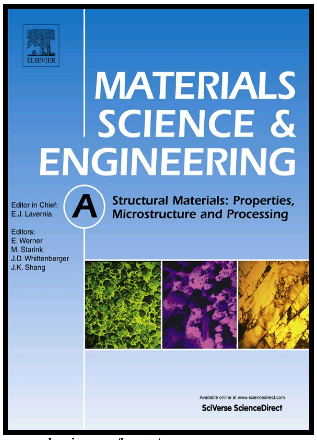

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Effect of Mn content on low-cycle fatigue behaviors of low-carbon bainitic steel

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Abstract

The microstructures and low-cycle fatigue behaviors of steels with different Mn contents subjected to continuous cooling heat treatment processes (from Ms +10 °C to Ms −20 °C) are examined. Phase transformation testing results show that the steel without Mn exhibits short transformation time and short incubation period. When Mn content increases from 1.8% to 3.2%, bainite transformation time is prolonged, especially incubation period. The microstructure of the steel without Mn is mainly grain boundary allotriomorphic ferrite, while the other three steels with Mn consist of bainitic ferrite plate and retained austenite. Mn is an essential element used to obtain lower bainite. The low-cycle fatigue of the steels undergoes three stages, namely, cyclic hardening, saturation or cyclic softening, and fracturing. Higher elongation of the steel without Mn is beneficial to improve fatigue life under plastic strain amplitudes. The Coffin–Manson formula and damage hysteresis model are then used to evaluate the fatigue performances of the steels. It shows that the steel with 2.3% Mn exhibits higher fatigue damage capacity (W_0) with a considerable damage transition exponent (β) than the other three steels. This result attributes to the largest distribution of high-angle misorientation of in the bainitic steel with 2.3% Mn.

Keywords: Mn content; Bainitic steel; Microstructure; Fatigue behavior