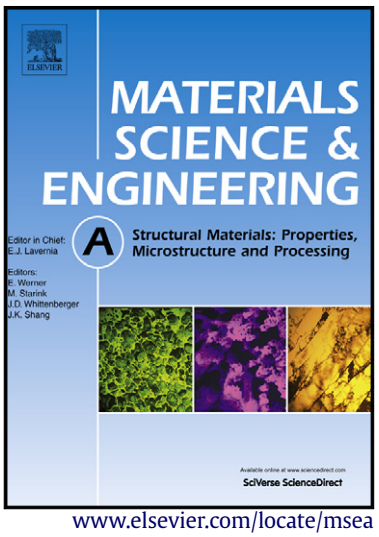

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Effect of Microstructure on the Very High Cycle Fatigue Behavior of a Bainite/ Martensite Multiphase Steel

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Abstract

We describe here the effect of microstructure on the very high cycle fatigue (VHCF) behavior of a high-strength bainite/martensite (B/M) multiphase steel (0.2C-1.4Si-2.2Mn-0.8Cr) studied through ultrasonic fatigue test, where the different microstructures were obtained via control of heat treatment. The study clearly points to that the microstructure had a significant effect on the VHCF behavior of B/M steel. The endurance limit of the steel after oil-cooling was enhanced by 75 MPa because of change in the microstructure. Three types of failure modes were observed depending on the inclusion and microstructure, i.e., surface defect-induced failure, inclusion-induced failure, and non-inclusion induced failure, where the non-inclusion induced failure was influenced by microstructure. Large plastic deformation occurred within the bainite lath, leading to debonding from the adjacent martensite, and the crack initiated at grain boundaries between large bainite laths and martensite. There was a competition between inclusion-induced failure and non-inclusion induced failure modes, and the crack initiated at relatively weak sites that existed between the matrix and inclusions. The present study underscores a potential approach for improving VHCF properties of next generation of advanced high strength steels, where microstructure can be tuned to improve the VHCF performance.

Keywords: Very high cycle fatigue; bainite/martensite multiphase steel, non-inclusion crack initiation

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