Study of high-cycle rotating bending fatigue performance and fracture behavior in a pearlite-ferrite dual-phase steel

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July 13, 2020

Abstract

To clarify the effects of ferrite morphologies and contents on high-cycle rotating bending fatigue property of pearlite-ferrite dual-phase (DP) steel used for fabrication of commercial vehicle crankshafts, two types of DP steels with different ferrite grain sizes (S10: 13.1μm and S30: 21.4μm) and ferrite contents (S10: ˜9.5vol.% and S30: ˜30.4vol.%) were prepared. Stress-number of high cycles to failure (S-N) fatigue of the two DP steels were evaluated. Experimental results showed a fatigue strength of 510 MPa and 400 MPa for S10 and S30 steels, respectively, at 107 cycles. Fatigue cracks in S10 steel extended preferentially along the grain boundary, but it was easy for crack propagation to extend within a pearlite colony to form a zigzag crack morphology. Crack roughness was enhanced and high stress was introduced to the crack surface due to this kind of crack propagation behavior, which has positive effects on slowing down crack propagation. However, the crack propagation in S30 steel mainly occurred inside the soft equiaxed coarse ferrite grain. Analysis revealed that little stress was introduced to the crack surface. These results show that it is possible to improve high cycle rotating bending fatigue strength of pearlite-ferrite DP steel by appropriately manipulating the volume fraction and microstructure morphology of ferrite phase.

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