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Characterization of high-gradient welded microstructure and its failure mode in fatigue test

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Abstract: Multi-layer and double-pass welding technology induces high-gradient microstructure in the NiCrMoV narrow-gap welded joint, its effect mechanism on crack initiation and failure mode was investigated systematically during high cycle fatigue (HCF) test at different stress ratios (R). Firstly, uniaxial stress-controlled HCF tests were performed with R being -1 and 0.1, and retest methods were proposed by increasing stress level or changing R for unbroken specimens survived over 10^8 cycles to help better understanding failure essence. Three failure modes were founded, which are surface non-defect fatigue crack origin (SNFCO), surface defect fatigue crack origin (SDFCO) and interior defect fatigue crack origin (IDFCO). Surface initiation (SNFCO and SDFCO) was related to the high-gradient microstructure in the joint, while IDFCO mainly depended on the size and shape of defects. Retest results showed that it is easier to form IDFCO at -1 stress ratio than 0.1 due to the high stress amplitude promoting stage I crack as well as debonding of inclusion with matrix.

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