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Effect of magnetic field on crystallographic orientation for stainless steel 316L laser-MIG hybrid welds and its strengthening mechanism on fatigue resistance

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Abstract

In order to extend fatigue life of structures, traditional methods involving controlled creation of boundaries and local microstructure discontinuities are used to obstruct dislocation motion and change the crack propagation path during fatigue service. However, such strategies inevitably sacrifice ductility due to the reduced ability to accommodate dislocations. Herein, an external magnetic field is used to assist laser-MIG hybrid welding for 316L austenitic stainless steel. Fatigue crack propagation rate is decreased by 33% at f=0.1 Hz and 12% at f=1 Hz in air. The external magnetic field optimizes fatigue resistance of 316L welds from two aspects: diverse orientation distributions of ferrite and non-K-S orientation relationship (OR) between ferrite (δ) and austenite (γ). Diverse orientation distributions of δ induced by magnetic field activate different slip systems, promoting crack deflection in γ grain interior during cyclic deformation. Semi-coherent interface between δ-γ with non-Kurdjumov-Sachs (K-S) OR not only impedes transmission of the dislocation slip but also accommodates a considerable amount of plastic strain by continual loss of

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