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PROCEEDINGS

Wire Arc Directed Energy Deposited High Performance Aluminium Alloy

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ABSTRACT

Wire and Arc Additive Manufacturing (WAAM) technology has the advantages of high-efficiency and low-cost to fabricate large-scaled components with medium-complexity. 2319 aluminum alloy is a widely used in aerospace and military industries. Problems of porosity, residual stress, distortion, and poor mechanical properties were focused on in this paper. The mechanism of defect formation during fabrication and strengthening mechanism of peening process were investigated. In order to learn the droplet transfer and molten pool flow behavior, CFD models of molten pools for the pulse mode of CMT (CMT + P) and pulse reverse polarity CMT mode (CMT + PA) were established. Two arc modes of CMT were compared through the CFD models and experimental results. It is found that both the heat input and the molten pool volume in pulse CMT+P mode were larger than those in CMT+PA mode. The molten depth in CMT+PA mode was extremely small, but the time required for the molten pool to recover from the droplet impact was shorter than that in CMT+P mode. The influence of processing parameters on the dimension, microstructure and mechanical properties of 2319 aluminum alloy was studied for single pass, multi-pass in one layer, blocks with multi-layer and multi-pass, and featured structures. The range of optimized processing parameters in CMT+P mode with different wire feeding speed and welding speeds was obtained through experiments. The prediction model of the influence of wire feeding speed, welding speed and substrate temperature on the geometries of the deposited layer was established. Peening process was applied to improve the mechanical properties of the as-deposited aluminum alloy. The influence of the peening process parameters on the single bead deformation was systematically analyzed, and the mechanism of the peening strengthening on 2319 aluminum alloy was studied. The theoretical study and experimental research in this study provided a guidance for the engineering application of CMT additive manufacturing of large-sized components.

KEYWORDS

Additive manufacturing; cold metal transfer; 2319 aluminum alloy; hammering; stress and distortion

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