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Heat Treatment for Property Enhancement of Wire Arc Additive Manufactured Stainless Steel

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Abstract

The influence of the different heat inputs and post-deposited heat treatment on the metallurgical and mechanical properties of the GMAW-based WAAM SS316L was investigated. Epitaxial columnar grain growth was observed along the build direction for all three heat inputs. The fine and coarse vermicular δ -ferrite structures were observed in the bottom and middle regions, respectively. The reticular δ -ferrite morphology was observed in the top region due to the absence of remelting or reheating. The presence of δ -ferrite and σ -phases increases with increasing heat input. The higher volume fraction of δ -ferrite and σ -phases results in an increase in anisotropy in metallurgical and mechanical properties. The post-deposition heat treatment at 1050° C for 15 min dissolves the σ -phases and decreases the δ -ferrite volume fraction from 9.35 % to 2.15 % for the lower heat input wall. The complete elimination of σ -phases leads to a decrease in Y.S., UTS, and microhardness values.

Keywords: Wire arc additive manufacturing, stainless steel, heat treatment, mechanical properties, δ -ferrite and σ -phases.