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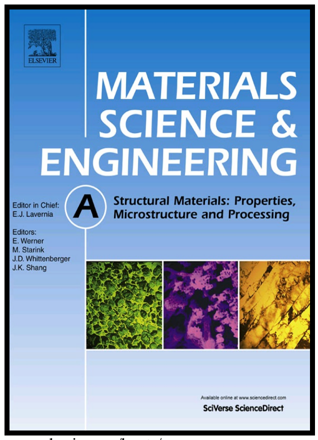


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# Location-related Thermal History, Microstructure, and Mechanical Properties of Arc Additively Manufactured 2Cr13 Steel Using Cold Metal Transfer Welding

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## Abstract

The wire arc additive manufacturing (WAAM) 2Cr13 thin-wall part was deposited using robotic cold metal transfer (CMT) technology, and the location-related thermal history, densification, phase identification, microstructure, and mechanical properties of the part were explored. The results show that pre-heating effect from previously built layers can be effectively used to reduce residual stresses; cooling rate firstly decreased rapidly and then kept stable in the 15th-25th layers. The peaks of the α-Fe phase of the AM part drifted slightly toward a relatively smaller Bragg's angle as a result of solute atoms incorporation when compared with that of the base metal. Small amounts of pores were present with the absence of cracks in different layers, being indicative of a high densification level. As-deposited microstructure consisted of martensite and ferrite, along with (Fe, Cr)$_{23}$C$_6$ phase precipitated at α-Fe grain boundaries. Martensite content increased gradually from the 5th layer to the 25th layers, indicating that metastable martensite partly decomposed into stable ferrite due to the carbon atoms diffusion. The hardness and UTS changed slightly in the 05th-15th layers and then increased quickly from the 20th layer to the 25th layers at the expense of ductility; the fracture process transformed from ductile (01st-10th layers) to mixed-mode (15th-20th layers), and finally to

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