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Electrochemical Performance of a Wire Arc Additive Manufactured PH 13–8Mo -AISI 420 Martensitic Stainless Steels Dissimilar Metal Combination

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ABSTRACT

In this study, the electrochemical response of the interfacial region between a wire arc additive manufactured PH 13-8Mo stainless-steel part on a AISI 420 martensitic stainless-steel (MSS) substrate was investigated. The complex thermal history associated with the deposition of PH 13-8Mo layers led to the formation of multiple interfacial regions with distinct microstructures, i.e., far heat-affected zone (FHAZ), close heat-affected zone (CHAZ), partially melted zone (PMZ), and fusion zone (FZ). The formation of an austenitic structure with coarse grains was observed in the PMZ. The electrochemical analysis results revealed severe deterioration of corrosion performance along the interfacial region, possibly attributed to the formation of high concentration of fine chromium-rich carbides. The corrosion onset at the interface region was initiated at the carbide/matrix interface in the CHAZ and PMZ, where chromium depleted regions adjacent to the carbides intensify the micro-galvanic coupling effect. The corrosion resistance of the as-printed PH 13-8Mo sample was notably higher than the 420 MSS substrate and the interface samples, attributed to the superior protective nature of the formed passive film on the 13-8Mo PH side. The formation of uniform martensitic lath structure possessing low energy levels at their boundaries and the absence of metastable chromium-rich micro-constituents due to the lower carbon content in the PH 13-8Mo alloy contributed to the superior electrochemical performance of the as-printed 13-8Mo PH MSS alloy.

Keywords: Wire Arc Additive Manufacturing, AISI 420 stainless steel, PH 13-8Mo, Corrosion, Interface.