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Stress corrosion cracking of laser alloyed 304L stainless steel with Ru in hot chloride solution

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Abstract

The exceptional ductility and good uniform corrosion resistance of austenitic stainless steels especially the commonly used 304L stainless steel is lost with its severe embrittling in aqueous conditions in the presence of chlorides at elevated temperatures. With the addition of ruthenium (Ru) the corrosion resistance of 304L stainless steel is enhanced, as well as the resistance to stress corrosion cracking. However, the cost of Ru is high and this limits the possibilities. Therefore, to lower the cost of Ru, a layer of approximately 950±90 μm was laser cladded on the surface of 304L stainless steel. The purpose of this investigation is to evaluate the effectiveness of Ru additions to surface layer through laser cladding to mitigate cracking. Ru was applied to the surface of 304L stainless steel with a Nd:YAG laser as a metal powder with Ru concentrations of 1, 2, 5 and 10 wt%. With these methods, the cost of Ru is kept low while it can still cause inhibition of cracking. Three-point bend stressed samples were exposed to distilled water with 100 ppm sodium chloride at 200˚C with an initial dissolved oxygen concentration of 8 ppm at 25˚C. As expected the as-received 304L stainless steel was susceptible to stress corrosion cracking. With the addition of Ru to 304L stainless steel, the resistance to cracking improved markedly, the minimum and maximum crack propagation rate attained was 0.013 and 0.023