Investigation of the microstructural evolution and mechanical properties of diffusion welded equiatomic CoCrFeMnNi-based multi-component alloys to 316L stainless steel

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Abstract

Diffusion welding is a precision joining process that is used for dissimilar materials due to low welding distortion. CoCrFeMnNi-based multi-component alloys (MCAs) are expensive and these high-density materials can only be used in key sections of structures. As an alternative to MCA similar joint, dissimilar diffusion welding of SS316L to the equiatomic subsystems of CoCrFeMnNi (CoNi, CoCrNi, CoCrFeNi and CoCrFeMnNi) is conducted to assess the joint integrity. The microstructures and diffusion mechanism are examined by a Scanning Electron Microscope equipped with an Energy Dispersive Spectrometer (SEM-EDS) and X-ray Diffraction analysis (XRD) while the mechanical properties were assessed by nanohardness profiling and shear test. The MCAs were successfully joined to SS316L with low interfacial defects if any, and there was also no compositional segregation at the interfaces. The grain size of the SS316L in the welded assemblies became larger, especially near the bond interface than the grain size of the as-received SS316L. A diffusion zone was formed around the bond interface due to the interdiffusion of constitutive elements. The diffusion coefficients of these elements across the interface of the various matrices were determined based on Fick's second law of diffusion. The shear test results revealed that SS316L-CoCrNi and SS316L-CoCrFeNi joints offered the best shear strength which is comparable to that of similar joints with SS316L while the other joints had lower shear strengths.

Keywords: Diffusion welding, Energy Dispersive Spectrometer (EDS), Multi, component alloys, Scanning electron microscopy, Shear strength, Stainless steel

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