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Microstructures and mechanical properties of friction stir welded lap joints of commercially pure titanium and 304 stainless steel

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ABSTRACT

Friction stir welding was performed to accomplish dissimilar lap joining of commercially pure titanium (CP-Ti) to 304 stainless steel (SUS304). The joining speed was varied from 25 to 100 mm min⁻¹. At a joining speed of 50 mm min⁻¹, the morphology of the interface was a flat and simple interfacial reaction layer whose thickness was less than 1 μm. The reaction layer consisted of four layers: β-Ti (+ ω-Ti), Ti₂Ni, FeTi + Fe₂Ti, and σ-FeCr, listed in order from the CP-Ti side to the SUS304 side. At a joining speed of 25 mm min⁻¹, the interface consisted of a macroscopically mixed and laminated structure approximately 300 μm thick consisting of multiple reaction layers. During the tensile shear test, joint fractures occurred in the CP-Ti base material at every joining speed. However, during the peel test, joint fractures occurred at the joint interface.

Keyword: Friction stir welding, dissimilar joint, mechanical properties, microstructure, TEM

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