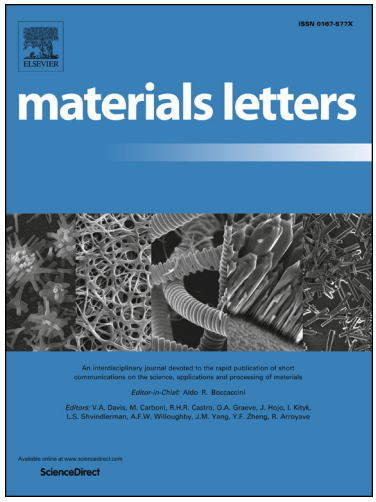

High-strength titanium alloy/steel butt joint produced via friction stir welding

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High-strength titanium alloy/steel butt joint produced via friction stir welding

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Abstract

For the first time, defect-free butt welds of titanium alloy/steel were successfully fabricated via friction stir welding. Joints were produced by employing rotation speed varied at 600 and 950 rpm with a constant travel speed of 47.5 mm/min. An increasing of rotation speed leads to thicken the intermetallic compound layer, coarsen the grain size and thus decrease the joint microhardness. Thanks to the solid-state joining process, only a thin FeTi layer was formed at the interface even rotation speed increased to 950 rpm. As a result, all obtained joints fractured at the base steel material. The work carried out clearly shows the good weldability of titanium alloy to steel via friction stir welding.

Keywords: Titanium alloy; Steel; Welding; Microstructure; Intermetallic compound

1. Introduction

Hybrid titanium/steel structures provide cost saving by allowing titanium to be used in selected critical areas, which let dissimilar titanium/steel joining be an attractive topic in industrial manufacturing [1, 2]. However, the mismatch in their thermophysical properties and the tendency to form brittle intermetallic compounds (IMCs), such as FeTi and Fe_2Ti, lead poor fusion weldability for Ti/steel joining [3]. As a solution, the use of solid-state joining techniques (i.e., friction welding [4, 5], friction stir welding [1, 2, 6-9], diffusion bonding [10-12]) helps in reducing IMCs because no melting