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Achieving ultra-high strength friction stir welded joints of high nitrogen stainless steel by forced water cooling

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Abstract

The microstructure and properties of water-cooled and air-cooled friction stir welded (FSW) ultra-high strength high nitrogen stainless steel joints were comparatively studied. With additional rapid cooling by flowing water, the peak temperature and duration at elevated temperature during FSW were significantly reduced. Compared to those in the air-cooled joint, nugget zone with finer grains (900 nm) and heat affected zone with higher dislocation density were successfully obtained in the water-cooled joint, leading to significantly improved mechanical properties. The wear of the welding tool was significantly reduced with water cooling, resulting in better corrosion resistance during the immersion corrosion test.

Keywords: Friction stir welding; stainless steels; mechanical properties; corrosion

1. Introduction

Low nickel and nickel-free high nitrogen stainless steels (HNSs) have recently been developed, aimed at reducing the amount of expensive alloy elements and improving the mechanical properties and localized corrosion resistance. Nitrogen, as a powerful austenite

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