Title: Weld microstructure and mechanical properties in ultrasonic enhanced friction stir welding of Al alloy to Mg alloy

Authors: Xueqi Lv, ChuanSong Wu, Chunliang Yang, G.K. Padhy

PII: S0924-0136(17)30551-4
DOI: https://doi.org/10.1016/j.jmatprotec.2017.11.031
Reference: PROTEC 15505

To appear in: *Journal of Materials Processing Technology*

Received date: 17-6-2017
Revised date: 16-10-2017
Accepted date: 17-11-2017

Please cite this article as: Lv, Xueqi, Wu, ChuanSong, Yang, Chunliang, Padhy, G.K., Weld microstructure and mechanical properties in ultrasonic enhanced friction stir welding of Al alloy to Mg alloy.Journal of Materials Processing Technology https://doi.org/10.1016/j.jmatprotec.2017.11.031

Weld microstructure and mechanical properties in ultrasonic enhanced friction stir welding of Al alloy to Mg alloy

Xueqi Lv, ChuanSong Wu*, Chunliang Yang, G. K. Padhy

Key Laboratory for Liquid-Solid Structure Evolution and Materials Processing, Institute of Materials Joining, Shandong University, Jinan 250061, China.

Corresponding author: ChuanSong Wu, Tel.+Fax: +86 531 88392711,
E-mail: wucs@sdu.edu.cn

Abstract

A preliminary investigation was carried out into the application of angularly exerted ultrasonic vibrations in friction stir welding for the joining of AA 6061-T4 alloy to AZ31B at different tool rotation speeds. The variations in the welding process and weld properties due to the applied acoustic field were investigated. The process temperature was increased, the material flow path was widened and mechanical interlocking features at weld interfaces were improved in the presence of ultrasonics. Morphology and distribution of intermetallic compounds were influenced by the added vibrations at all rotation speeds. Formation of intermetallic layers at the weld interfaces was driven by heat input. Composition of the intermetallic compound was roughly unaffected but the layer thickness was reduced by the additional acoustic field. The ultrasonic enhanced improvement in weld mechanical properties was significant at very low rotation speeds but less substantial at higher rotation speeds.

Key words: Ultrasonic vibration; friction stir welding; aluminum alloy; magnesium alloy; dissimilar alloy joint; intermetallic compounds

1. Introduction

Fusion welding of Al alloy to Mg alloy is unattractive because of the frequently encountered weld defects such as cracking, spatter and solidification void, as reported by Liu et al. (2007). Moreover, the mechanical properties of the fusion welded Al-Mg joints are further degraded by the presence of large amounts of brittle intermetallic compounds (IMCs) which are formed due to the high heat input of the process. Wang et al. (2008) found that IMCs layers formed in the fusion zone of 1060Al/AZ31Mg joints made using metal-inert-gas welding can be as thick as 120μm. Liu et al. (2014) used a filler metal Zn-29.5Al-0.5Ti in gas tungsten arc welding of Mg/Al. They found that although the amount of Al-Mg IMCs were reduced, large amounts of Mg-Zn and Al-Mg-Zn IMCs were induced in the welds.