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Full length article

Synthesize of AZ31/TiC magnesium matrix composites using friction stir processing

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Abstract

Friction stir processing (FSP) is a novel solid state technique to synthesize metal matrix composites. In the present work, an attempt has been made to synthesize AZ31/TiC magnesium matrix composites using FSP and to analyze the microstructure using scanning electron microscopy. A groove was prepared on 6 mm thick AZ31 magnesium alloy plates and compacted with TiC particles. The width of the groove was varied to result in four different volume fraction of TiC particles (0, 6, 12 and 18 vol.%). A single pass FSP was carried out using a tool rotational speed of 1200 rpm, traverse speed of 40 mm/min and an axial force of 10 kN. Scanning electron microscopy was employed to study the microstructure of the synthesized composites. The results indicated that TiC particles were distributed uniformly in the magnesium matrix without the formation of clusters. There was no interfacial reaction between the magnesium matrix and the TiC particle. TiC particles were properly bonded to the magnesium matrix.

Keywords: Magnesium alloy; Friction stir processing; TiC; Microstruture

1. Introduction

Magnesium alloys are progressively replacing aluminum and steel in the aerospace and automobile industries and plastic in the electronic and computer industries due to low weight and good thermal and electrical conductivity. However, magnesium alloys are used for high performance applications due to their low mechanical properties and wear resistance. But magnesium reinforced with ceramic particles, known as magnesium matrix composites (MMCs) provide enhanced mechanical and tribological properties [1]. It is difficult to produce MMCs using conventional methods such as powder metallurgy, stir casting etc.

Friction stir processing (FSP) is a novel solid state technique to fabricate metal matrix composites [2]. Mishra et al. [3] developed FSP, based on the principles of friction stir welding (FSW) to produce metal matrix composites. One method to produce composite using FSP is to prepare a groove of required depth and width, compact with ceramic particles, plunge the tool and traverse along the groove. The frictional heat softens the matrix alloy and the ceramic particles are dispersed within the plasticized matrix alloy due to the rigorous stirring action of the tool.

Some studies on the production of MMCs using FSP techniques were reported in literatures. Azizieh et al. [4]

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