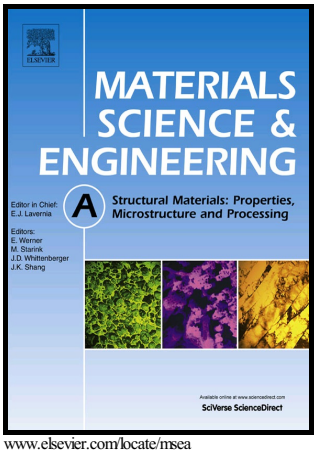
Fabrication and characterization of magnesium matrix composite processed by combination of friction stir processing and high-energy ball milling

Haiguang Liao, Juan Chen, Liming Peng, Jingyu Han, Hong Yi, Feiyan Zheng, Yujuan Wu, Wenjiang Ding



www.elsevier.com/locate/msea

PII: S0921-5093(16)31479-4
DOI: http://dx.doi.org/10.1016/j.msea.2016.11.104
Reference: MSA34430

To appear in: *Materials Science & Engineering A*

Received date: 14 September 2016
Revised date: 29 November 2016
Accepted date: 30 November 2016

Cite this article as: Haiguang Liao, Juan Chen, Liming Peng, Jingyu Han, Hong Yi, Feiyan Zheng, Yujuan Wu and Wenjiang Ding, Fabrication and characterization of magnesium matrix composite processed by combination of friction stir processing and high-energy ball milling, *Materials Science & Engineering A,* http://dx.doi.org/10.1016/j.msea.2016.11.104

Fabrication and characterization of magnesium matrix composite processed by combination of friction stir processing and high-energy ball milling

Haiguang Liao, Juan Chen*, Liming Peng, Jingyu Han, Hong Yi, Feiyan Zheng, Yujuan Wu, Wenjiang Ding

National Engineering Research Center of Light Alloy Net Forming and State Key Laboratory of Metal Matrix Composite, Shanghai Jiao Tong University, 200030 Shanghai, PR China

*Corresponding author: Juan Chen. Email: Juanchen@sjtu.edu.cn

Abstract:

Magnesium matrix composites have been prepared on pure magnesium and AZ31 alloy matrix by a combination of friction stir processing (FSP) and high-energy ball milling (HEBM) techniques. Microstructures and mechanical properties of as-fabricated samples are systematically investigated. The research shows that reinforcement HEBM particles disperse in the stir zone (SZ) as agglomerated streamline clusters and separated particles. In addition, the nano particles less than 100 nm can be directly observed in the SZ. The HEBM particles effectively refined the grains in SZ and probably resulted in high-density dislocations by pinning effect. The results observed by electron back-scattering diffraction (EBSD) also reveal that HEBM particles addition brings positive effect on the grain orientation randomization in the SZ. As for mechanical properties, macrohardness of powder aggregation in pure magnesium matrix is more than twice the value of neighboring normal SZ. In AZ31 alloy matrix composites, HEBM powders addition increased both yield strength and ultimate tensile strength of SZ samples by more than 30% while maintaining high ductility.

Keywords: Friction stir processing, High-energy ball milling, Magnesium matrix composite, Microstructure, Mechanical property

1. Introduction

Magnesium alloys have been increasingly applied to automobile and aerospace industry in recent years with their low density and high specific strength [1]. In order to further increase the mechanical properties of magnesium alloys, magnesium metal matrix composites (MMCs) which have high specific strength, stiffness, wear resistance and increased elastic modulus compared with conventional magnesium