

Author's Accepted Manuscript

Effect of La inoculation on composition, content, granularity and mechanical properties of *in-situ* Al-30wt%Mg₂Si Composite

Yuyan Ren, Tongyu Liu, Yingmin Li, Hao Hu



PII: S0921-5093(17)31013-4
DOI: <http://dx.doi.org/10.1016/j.msea.2017.08.010>
Reference: MSA35358

To appear in: *Materials Science & Engineering A*

Received date: 23 December 2016

Revised date: 28 May 2017

Accepted date: 2 August 2017

Cite this article as: Yuyan Ren, Tongyu Liu, Yingmin Li and Hao Hu, Effect of La inoculation on composition, content, granularity and mechanical properties of *in-situ* Al-30wt%Mg₂Si Composite, *Materials Science & Engineering A* <http://dx.doi.org/10.1016/j.msea.2017.08.010>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Effect of La inoculation on composition, content, granularity and mechanical properties of *in-situ* Al-30wt%Mg₂Si Composite

Yuyan Ren, Tongyu Liu, Yingmin Li, Hao Hu

School of Material Science and Engineering, Shenyang University of Technology, 110870 Shenyang, P.R China

Abstract: In this paper, the phase composition and content of Al-30wt%Mg₂Si composite prepared by *in-situ* process have been investigated; and the effect of different addition of La inoculation on microstructure, granularity and mechanical properties of Al-30wt%Mg₂Si composite have been studied. Scanning electron microscope (SEM) and X-ray diffraction (XRD) images show that the phase composition and content of Al-30wt%Mg₂Si composite agree with pseudo-binary Al-Mg₂Si phase diagram. The effect of La inoculation on microstructure indicates that La addition can change the morphology of primary Mg₂Si particles and refine the particle size of primary Mg₂Si. When the La addition reaches to 0.8wt%, the refinement effect of Al-30wt%Mg₂Si composite is the best. Similarly, the results reveal that La addition can effectively improve the ultimate tensile stress (UTS), breaking elongation (BE) and Vickers microhardness (VM) values. When La addition is over 0.8wt%, primary Mg₂Si particles become coarsening and mechanical properties decline. The crystal size was characterized by XRD and deduced by Cauchy and Gaussian approximation. The relationship between crystal size and UTS or VM can be described by Hall-Petch relation. The linear fitting degree of UTS is better.

Key words: *in-situ*; Al-30wt%Mg₂Si Composite; La inoculation; crystal size; Hall-Petch; Mechanical Properties

1. Introduction

Discontinuously particulate reinforced aluminum metal matrix composites (MMCs) have attracted a considerable attention in recent years because of their inherent low density, high wear resistance, low thermal-expansion and much lower costs of production ^[1-4], which make them the ideal candidates to partly replace steel and cast iron to meet the great market demand for light-weight and low-fuel-consuming products in automotive industry. Al-Mg₂Si composites have high potential application as automobile brake disc material because intermetallic compound Mg₂Si exhibits a high-melting, low density, high hardness, low thermal expansion coefficient (TEC) and high elastic modulus ^[5]. Like many other intermetallic compounds, Mg₂Si is a severe brittle phase that makes its processing difficulty and limits its further application, especially under low temperatures condition ^[6]. Moreover, the primary Mg₂Si particles exhibit coarse morphology and brittleness in the composites, which has a detrimental effect on the mechanical properties ^[7,8]. Thus, primary Mg₂Si particles in aluminum metal matrix composites must be modified to change its morphology and distribution so as to improve its mechanical properties.

Equilibrium diagram of Al-Mg₂Si system is a pseudo-eutectic section was published earlier ^[9,10], and pseudo-binary phase diagram of Al-Mg₂Si was confirmed by S. Li and J. Zhang ^[11,12]. Since then, different contents of Mg₂Si phase in Al-Mg₂Si composite were extensively studied in range of 0wt%Mg₂Si - 25wt%Mg₂Si by using the theoretical basis ^[13-18]. However, little study on excess concentration of Mg₂Si-reinforced aluminum matrix composites has been reported, as the Al-30wt%Mg₂Si composite that primary Mg₂Si particles act as a leading role in microstructure and mechanical properties. Thus, the investigations of Al-Mg₂Si composites system modification need to further consummate. In addition, different concentrations of Al-Mg₂Si composites were prepared by adding suitable mass fraction of starting materials by *in-situ* process, but the mass fraction of Mg₂Si

Download English Version:

<https://daneshyari.com/en/article/5455568>

Download Persian Version:

<https://daneshyari.com/article/5455568>

[Daneshyari.com](https://daneshyari.com)