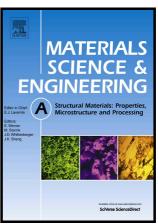
## Author's Accepted Manuscript

Effect of La inoculation on composition, content, granularity and mechanical properties of *in-situ* Al-30wt%Mg<sub>2</sub>Si Composite

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#### **ACCEPTED MANUSCRIPT**

### Effect of La inoculation on composition, content, granularity and mechanical

#### properties of in-situ Al-30wt%Mg<sub>2</sub>Si Composite

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Abstract: In this paper, the phase composition and content of Al-30wt%Mg<sub>2</sub>Si 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-30%Mg<sub>2</sub>Si composite have been studied. Scanning electron microscope (SEM) and X-ray diffraction (XRD) images show that the phase composition and content of Al-30wt%Mg<sub>2</sub>Si composite agree with pseudo-binary Al-Mg<sub>2</sub>Si phase diagram. The effect of La inoculation on microstructure indicates that La addition can change the morphology of primary Mg<sub>2</sub>Si particles and refine the particle size of primary Mg<sub>2</sub>Si. When the La addition reaches to 0.8wt%, the refinement effect of Al-30%Mg<sub>2</sub>Si 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 Mg<sub>2</sub>Si 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%Mg<sub>2</sub>Si 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–Mg<sub>2</sub>Si composites have high potential application as automobile brake disc material because intermetallic compound Mg<sub>2</sub>Si exhibits a high-melting, low density, high hardness, low thermal expansion coefficient (TEC) and high elastic modulus [5]. Like many other intermetallic compounds, Mg<sub>2</sub>Si is a severe brittle phase that makes its processing difficulty and limits its further application, especially under low temperatures condition [6]. Moreover, the primary Mg<sub>2</sub>Si particles exhibit coarse morphology and brittleness in the composites, which has a detrimental effect on the mechanical properties [7,8]. Thus, primary Mg<sub>2</sub>Si 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-Mg<sub>2</sub>Si system is a pseudo-eutectic section was published earlier <sup>[9,10]</sup>, and pseudo-binary phase diagram of Al-Mg<sub>2</sub>Si was confirmed by S. Li and J. Zhang <sup>[11,12]</sup>. Since then, different contents of Mg<sub>2</sub>Si phase in Al-Mg<sub>2</sub>Si composite were extensively studied in range of 0wt%Mg<sub>2</sub>Si - 25wt%Mg<sub>2</sub>Si by using the theoretical basis <sup>[13-18]</sup>. However, little study on excess concentration of Mg<sub>2</sub>Si-reinforced aluminum matrix composites has been reported, as the Al-30wt%Mg<sub>2</sub>Si composite that primary Mg<sub>2</sub>Si particles act as a leading role in microstructure and mechanical properties. Thus, the investigations of Al-Mg<sub>2</sub>Si composites system modification need to further consummate. In addition, different concentrations of Al-Mg<sub>2</sub>Si composites were prepared by adding suitable mass fraction of starting materials by *in-situ* process, but the mass fraction of Mg<sub>2</sub>Si

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