REVIEW OF RARE EARTH ASSISTED STRUCTURE–PROPERTY RELATIONSHIPS IN Al–Mg_2Si COMPOSITES

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ABSTRACT

Microstructure modification is an extensive research area for all the researchers owing to its mechanical property improvement. This has been made possible through the integration of numerous casting process developments and modifier refiners. The present work talks about the addition of modifier refiners focusing on the rare earth elements like Pr, Eu, Gd, Y, Ho, Ce, Ndin Mg_2Si reinforced Aluminium Metal Matrix Composites. Careful observations have revealed that increasing the weight percentage of rare earth elements promote the improvement of microstructure and mechanical properties, which can be attributed to its uniformity and globularity in the size of Mg_2Si particles as well as enhanced coherency between matrix and reinforcement due to the obstruction of dislocation flow. However, surplus weight percentage of refiners can have a detrimental effect arising from the over modification of particles.

Keywords: *Al-Mg_2Si, Modifier, Rare Earth Elements, Mechanical properties*

1. INTRODUCTION

The literature survey was conducted as part of the review process to examine extensive research efforts on composite materials, reinforcements, and modifier/refiners used to improve mechanical properties. Metal Matrix Composites (MMCs) have emerged as suitable materials due to their wide applications in automotive, structural, and aerospace sectors. It has been reported that replacing conventional metals with composites can reduce operational and maintenance costs by up to 20% [1]. Composite materials are formed by combining two or more constituents with different properties, resulting in enhanced physical and mechanical characteristics by integrating the advantages of individual components [2]. Literature indicates that most engineering applications demand lightweight materials with high strength and excellent wear and corrosion resistance for structural applications. Aluminium-based MMCs (Al-MMCs) have become highly attractive for earth-moving and aerospace industries due to their superior strength-to-weight ratio, high stiffness, and improved wear and corrosion resistance. Al-MMCs generally consist of an aluminium matrix reinforced with non-metallic particles such as SiC, B_4C, and Al_2O_3. The incorporation of reinforcements significantly enhances mechanical properties, including tensile strength, yield strength, wear resistance, specific heat capacity, and density [3]. Recently, researchers have focused on in-situ Mg_2Si-reinforced Al-based composites, which offer advantages such as low specific gravity, improved wear resistance, and better high-temperature performance. Mg_2Si intermetallic particles enhance properties such as melting temperature, hardness, and elasticity, while also reducing density and the coefficient of thermal expansion [4]. Considering these advantages, Al–Mg_2Si in-situ MMCs are potential alternatives to conventional Al–Si alloys and cast iron for automotive and aerospace applications. However, conventional casting techniques often lead to the formation of coarse primary and eutectic Mg_2Si