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# The effects of Er addition on the microstructure and properties of an in situ nano ZrB<sub>2</sub>-reinforced A356.2 composite

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## Abstract

In this study, the effects of Er addition on the microstructure and properties of in situ nano A356-3wt.%ZrB<sub>2</sub> composites were investigated. The A356-3wt.%ZrB<sub>2</sub> composite was prepared by an in situ reaction between K<sub>2</sub>ZrF<sub>6</sub> and KBF<sub>4</sub> salts, which were added in the proper stoichiometric ratio to form ZrB<sub>2</sub> in the A356.2 alloy melt at 1123K(850°C). The addition of Er could modify the coarse lamellar eutectic Si particles into fine fibrous particles and refine the second dendrite arm spacing (SDAS) of the grains simultaneously. Furthermore, the Er also influenced the distribution and size of the ZrB<sub>2</sub> particles by homogenizing the distribution of the nanoparticles and reducing their size. Tensile testing showed that the tensile strength and elongation increased to 325 MPa and 13.65%, respectively, due to the homogeneous distribution of the nanoparticles, the refinement of the SDAS of the  $\alpha$ -Al grains and the modification of the eutectic Si particles upon increasing the Er content to 0.05 wt.% combined with T6 heat treatment.

**Keywords:** Nano A356.2-ZrB<sub>2</sub> composites, Microstructure, Si modification, Grain refinement, Homogeneous distribution, Tensile properties

## 1. Introduction

Al-Si alloys have received much attention for aerospace, automobile and structural applications due to their high specific strength and specific stiffness, high hardness and wear resistance, and good elevated temperature resistance [1-3]. To improve the mechanical properties of Al-Si alloys, efforts have been made to develop aluminium

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