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The effects of Er addition on the microstructure and properties of an in situ nano ZrB_2-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_2 composites were investigated. The A356-3wt.%ZrB_2 composite was prepared by an in situ reaction between K_2ZrF_6 and KBF_4 salts, which were added in the proper stoichiometric ratio to form ZrB_2 in the A356.2 alloy melt at 1123K(850□). 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_2 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 α-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_2 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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