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Development and characterization of aluminium silicon carbide composite materials with improved properties

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ABSTRACT

In the recent years Metal Matrix Composites (MMCs) have proved great application potential in the field of aerospace and automotive industries due to their superior strength to weight quantitative relation and resistance to high temperature. Due to high manufacturing cost of the particulate metal matrix composites component and several technical challenges associated with casting technology, its widespread application for engineering purpose is restricted. The main aim of the present study is to cast and evaluate properties of the composite by increasing the stirring time and limiting the weight percentage of reinforcement. In this study, Aluminium (Al) is used as the pure matrix material and Silicon carbide (SiC) is used as the reinforcement material for the stabilization of the matrix. Stir casting is used to make aluminium matrix composites (AMC) by varying SiC content (0 to 5% wt. %) with the help of four blade motor stirrers rotating at a speed of 550 rpm for 20 min. A detailed study of mechanical and micro structural properties of Al-SiC composites is performed using Scanning Electron Microscopy for the characterization of the composite properties. The results indicated that the mechanical properties of the composite have been improved considerably with the addition of SiC in Al matrix. It was also observed that SiC was uniformly distributed over Al matrix due to continuous stirring in the mould and presence of few clustering was revealed in Micro structural observation.

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1. Introduction

The breakthrough in the development of reinforcement, matrices, including composite manufacturing attributed to a greater understanding of the lightweight materials that composite materials can produce, resulting in lower total cost of final product with improvised performance. There has been an increase in demand for novel light-weight materials with high stiffness in fields such as aerospace and manufacturing [1]. Composite materials are evolving primarily in response to unprecedented technical demands resulting from rapidly advancing activities in the aerospace, aviation, and automotive industries. These materials outperform many traditional engineering materials like metals in terms of strength and modulus due to their low specific gravity. [2]. It is now able to make new composites with improved mechanical and physical properties as a consequence of comprehensive research into the existence of substances and a deeper understanding of their structure–property relationship. Continuous progress has led to the use of composites in a wider range of applications, including high-performance composites such as PMCs, CMCs, and MMCs [3]. With traditional monolithic materials, the ability to achieve a good combination of strength, stiffness, durability, and density is limited. Composites [4] are the most promising materials of recent interest for overcoming these shortcomings and meeting modern technology's ever-increasing demand. Metal matrix composites (MMCs) have significantly improved properties over unreinforced alloys, such as high specific strength, specific modulus, damping power, and high wear resistance. AMCs have a wide range of applications in our daily lives [5]. The advantages of using particles strengthened AMCs materials over unreinforced materials include increased strength and specific modulus, improved stiffness, light weight, low thermal expansion coefficient, high thermal conductivity, optimized electrical properties, increased wear resistance, and improved damping capabilities [6]. Within the matrix, particles, short fibres, continuous fibers, and mono filaments can all be used as reinforcing constituents. Aerospace, temperature con-

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