An Extensive Study on Aluminum Silicon Carbide Composite Focusing on Specific Mechanical Characteristics

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Abstract. The continuous improvement for the technologies of mobilization requires corresponding improvements to materials for a number of applications. Burkert However composite materials have been found as crucial always to integrate the mobility due reduction in weight and environmental sustainability. Metal Matrix Composites have become one of the most widely used materials in automotive industry during last decades, partially replacing conventional metallic materials to allow a better strength-to-weight ratio. At a macroscopic level, these composites are formed by the combination between metals and ceramics to increase mechanical and tribological performance, while reducing weight without decreasing strength. The Aluminium metal, used extensively in automotive applications is being replaced by Aluminium matrix composite.

1 Introduction

There are several mechanical properties of Al-SiC composites which improve their efficiency as spur gear. These properties of the composite resulted due to the combination of lightweight feature in T6 heat treatment class and wear resistant property, hardness that exists in SiC reinforced with Al -Mg components made it demandable at higher applications industries. Aluminium based composites reinforced with SiC and B4C has also been critically reviewed in this paper by emphasizing the development of improved mechanical properties (increased strength, improved corrosion resistance, reduced thermal expansion) to make these composites attractive for automotive and aerospace applications.

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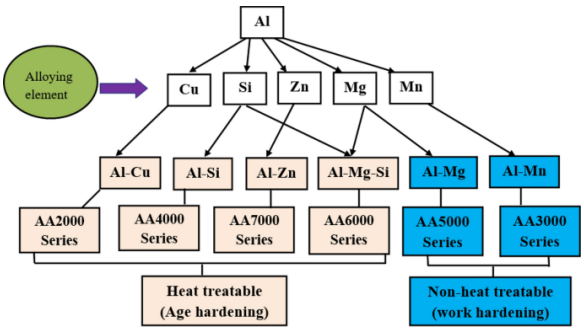

Fig. 1. Classification of MMC

2 Review of The Experimental Work

The influence of silicon carbide (SiC) filler fraction in aluminum-silicon carbide (Al-SiC) metal matrix composites are significant on the hardness of the materials. The most important results about this correlating are:
It was found that hardness of Al-SiC composites also increased with increase in content of SiC. The enhancement can be attributed to the reinforcement effect of SiC particles dispersed in aluminum matrix, which will account for the enhanced overall structure of composite. Ideal SiC Content: The variations in hardness with percentage of SiC addition (10, 15 and 20%) were investigated and it was observed that there is a direct relationship between the amount of SiC content and hardness. The presence of 20% SiC caused an increased hardness, thus the higher the reinforcement is, the better mechanical properties are improved.Uniform Distribution: Uniform dispersion of SiC content through the aluminum matrix is highly essential for the maximization of the hardness. The study highlighted that advanced process technology like microwave assisted powder metallurgy and extrusion, play a vital role in imparting such microstructure control required for optimization of hardness response offered by SiC reinforcement. The experiment result obtained mentioned that the higher hardness comparison to pure aluminum happened in Al-SiC composites, which indicates the ability of SiCas reinforcing agent. This higher hardness level is very critical for application so as to highly recommend wear resistance and durability.Figures and tables, as originals of good quality and well contrasted, are to be in their final form, ready for reproduction, pasted in the appropriate place in the text. Try to ensure that the size of the text in your figures is approximately the same size as the main text (10 point). Try to ensure that lines are no thinner than 0.25 point.

3 Properties Analysis

Characterization of these composites gave valuable information in relation to their mechanical and wear behavior. Below are the main findings: Tribological Studies: Tribological properties of Al-Si C microelectrodes The work focused on the tribological properties of the nano-composites (here Al Si C), focusing on their low density and good tribological performance, which makes them suitable for different applications. Influence of SiC Reinforcement: The impact of varying levels (10%, 15% and 20%) of silicon carbide (SiC) reinforcement was analyzed. According to the result, increasing the SiC content led to an increase of both mechanical strength and wear resistance in the composites. Wear Rate Reduction: The 20% Sic addition reduces the wear rate by 28% as compared to that of pure aluminum, so higher SiC content leads to significantly higher improvement in resistance.

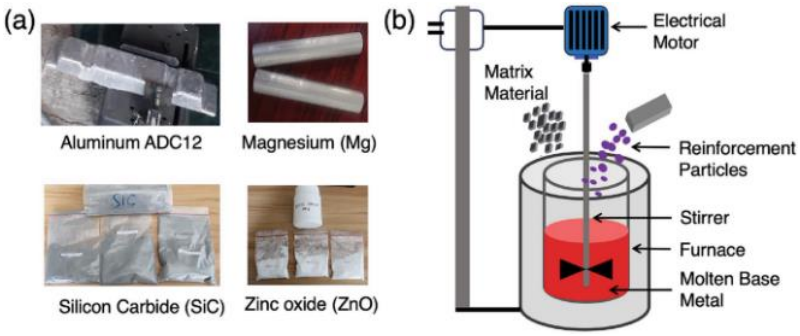

Fig. 2. Set up of Experimental Work

Advantages of Extrusion: The extrusion process played an important role in enhancing the properties of these composites. It served to direct the SiC particles during extrusion, inhibiting porosity and enhancing hardness. Overall Performance: The utilization of MAPM to prepare and extrusion for finishing has led Al SiC MMCs in good property. Such composites are believed to be suitable for lightweight and strong industrial usage. Given its higher mechanical performances and resistance to abrasion. In summary, the study demonstrated that innovative processing techniques greatly enhanced the mechanical properties and wear resistance of Al-SiC MMCs, positioning them as promising materials for a variety of applications. Fabrication and Characterization Methods: The fabrication and characterization of Al-SiC composites under various methods were studied using multiple advanced techniques: Microwave-assisted powder metallurgy the method employed to fabricate the composites was through a microwave assisted powder metallurgy, here in by enabling efficient sintering of the metal matrix and reinforcement. In addition, microwaves' uniform heating enhanced the material quality. Extrusion: After the microwave sintering, extrusion was employed in order to align Sic particulates as well as to reduce porosity of composite, which resulted mechanical and wear characteristics of composites were improved. Different Amount of Reinforcement: For all the tests, an attempt was made to determine if SiC content (10%, 15%, and 20%) had a significant role in mechanical properties and resistance against wear which leaded to the optimum SiC content providing the best results. Tribological Testing: The tribological testing was conducted to determine the wear resistance. This is important to understand how the materials perform when subjected to friction and wear, crucial for industrial applications.

4 Result and Discussion

The research work on aluminum-silicon carbide (Al-Si C) metal matrix composites (MMCs) discusses their significance and potential advantages for various applications. The key points from the introduction are:
Growing Interest for MMCs: The introductory section emphasizes the increasing interest in metal matrix composites that are lightweight and with excellent mechanical properties as a necessity of materials performing well in extreme conditions with reduced weight load.
Applications of Al-SiC Composites: Astro Met Al-SiC composites have been used for a wide variety of can be tailored and optimized to meet the specific needs of your application. The unique combination of properties in Astro Met s not found in any other material available. Tribological Behaviour: The applications in aerospace and automotive industries demands for better wear resistance. And so, it is useful to investigate the tribological properties of such composites. Innovative Processing Solutions: It is the presentation of

microwave-assisted powder metallurgy as a novel approach to elaboration combining advantages over other methods. Research Objectives: To investigate the objective of mechanical and wear behaviour response of silicon carbide filled composite developed to serve the purpose for industrial application by varying the level of SiC content in the composites.

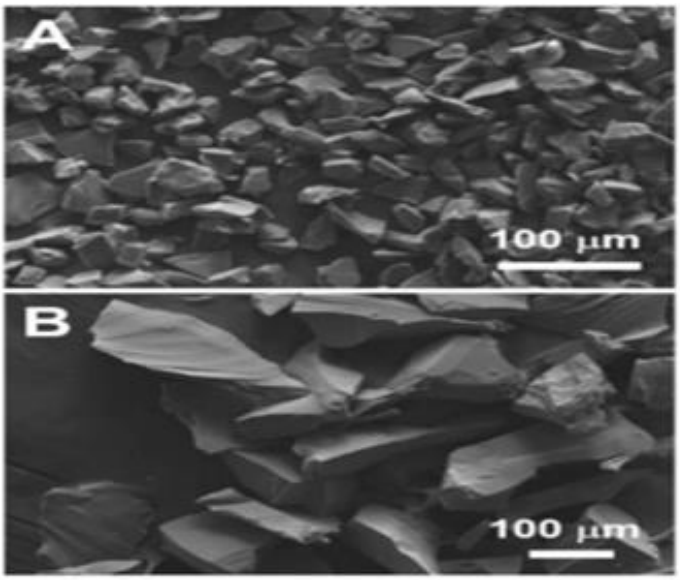

Fig. 3 Microstructure of Specimens

5 Conclusion

In conclusion, in an era of advanced manufacturing technologies such as microwave assisted powder metallurgy and extrusion used along with systematic study of SiC reinforcement level to develop high performance Al-SiC MMCs, the present investigation has led to generation of maximum wear resistant and better mechanical properties.
The introduction discusses the importance of Al-SiC MMCs, summary of its applications and brief description of the new methods applied in this study, shaping the basis for presented paper. The study revealed that novel processing methods improved the mechanical properties and wear resistance of Al-SiC MMCs, making these composites promising for a range of applications. The hardness of Al-SiC composites increases with increasing mass fraction of SiC and the optimum amount is observed at a higher mass fraction. The homogeneous distribution of SiC, which can be realized by the advanced processing techniques, is one of the factor to improve mechanical properties of the material. The paper presents the various types and methods of making aluminum composites reinforced by particles such as SiC and B4C which are known for their superior mechanical properties compared to bare Al including high strength, good environmental and thermal stability thus useful in automotive industries as well as aerospace applications.

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