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Study of mechanical properties on Nano metal matrix Composites: Duralcan process

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Abstract

Aluminium metal matrix nanocomposites with aluminium nanoparticles were created using the durolcan process. It is a stir casting process in which metals and ceramics are layered one on top of the other and composites are formed through heating and stirring. The nano Al_2O_3 was used in the composite in weight percentages of 1,1.5 and 2.5. The hardness and tensile strength of composite properties with and without heat treatment were investigated. According to the results of the tests, increasing the percentage of nanoparticles increases the hardness of the composite materials.

Introduction

Metal matrix composites have a high interest in light metal fabrication works. This fabrication work has been done in automotive, aircraft, electrical and electronics, etc. On these methods, Aluminium is one of the leading metals used in this process. This composite has more methods like stir casting, powder metallurgy, compo casting, squeeze casting, etc. From all these methods, stir casting is the easiest method to produce these types of composite materials. The purpose of these composites is to reinforce the hard ceramic particles that are included into the metal matrix. Because the wear resistance of the ceramic particles is very high, reinforcing these hard ceramics within the metal matrix improves the composites features of tribology [1], [2], [3], [4]. Here two important parameters playing a vibrant role in the properties of the composites are the volume and ceramics particles size. Varying the volume andparticle size leads to property differences in the composites. By optimizing the size and the volume will give good properties in the metal matrix composites. These composites will replace the traditional metal and make the material cheaper and affordable to the industries with these good properties. It is preferable to employ aluminium matrix composites (AMCs) with nano-reinforcements rather than monolithic aluminium alloys since they have better thermal properties. In addition to enhancing the qualities of base aluminium alloys ceramic reinforcing materials such as silicon carbide, Tanium dibromide, boron carbide, and aluminium oxide are often utilised. In recent years, many researchers have turned to fly ash for the production of MMCs since it is a low-cost and low-density reinforcing particle [5], [6], [7], [8], [9].

The nano-ceramic particles are favoured over the micro-ceramic particles because the material's ductility degrades when the concentration of ceramic particles is high. Additionally, a reduced volume proportion of nano-reinforcement particles significantly improves the weight to strength ratio. The dispersion strengthened composite's soft, ductile

matrix contains finely dispersed second phase reinforcing compounds. Dislocations are slowed down, and the strong particles strengthen the matrix. The primary principle of reinforcement, in this case, is to improve the matrix by the creation of dislocation loops around the dispersed particles. Numerous factors influence the degree of strengthening, including dispersion, size, shape and interparticle spacing [10], [11]. This work aims to investigate the mechanical properties of Nano Metal Matrix Composites manufactured by the Duralcan Process. Also, examine the effect on micro Al_2O_3 with different weight percentages of 1,1.5 and 2.5.

Section snippets

Materials and method

Matrix alloy - AA336 and reinforcement material - Nano Alumina are weighed using the Precisa 205 A digital scale. The measurement was accurate to within 0.001 percent. To ensure the purity of the nanoparticles and the accuracy of the tests, all measurements were carried out in a closed environment. The measured particles are then packed in the butter tissues and kept in airtight containers. AA336 is cut into small pieces, is weighed and put into the preheated crucible as a layer. Then the…

Results and discussion

The hardness tests were conducted on samples prepared according to the specifications, both non-heated and heated samples.The alloys are heated and cooled by quenching in oil during the hardening process. The results demonstrated that the hardness values increased with an increase in the percentage of reinforcement in both the non-heat treated and heat-treated samples, regardless of the treatment method. The hardness graphs that were constructed are depicted in Fig. 5 (a) and (b), respectively.

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Conclusion

Metal Matrix Composites are made up of nanosized aluminium oxide particles that have been produced effectively utilising the Duralcan Process. The findings of the testing revealed that increasing the percentage of nanoparticles in composite materials increases their hardness, and that heat-treated samples have the highest hardness compared to non-heat-treated samples. Tensile strength tests found that as the percentage of nanoparticles increased by more than 2.5 percent, the percentage of…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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