INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 5)
Available online at: www.ijariit.com

Studies of effect of hardness property of aluminium metal matrix composites by heat treatment

G. Ramesh
gramesh_me@yahoo.co.in
MEA Engineering College, Perinthalmanna, Malappuram, Kerala

Anerudh Vijayaraghavan
anerudh.bugatti@gmail.com
Meenakshi Sundararajan Engineering College, Chennai, Tamil Nadu

C. Kailash Krishnamoorthy
kailash1997@yahoo.co.in
Meenakshi Sundararajan Engineering College, Chennai, Tamil Nadu

S. Harish Balaji
hb7835@gmail.com
Meenakshi Sundararajan Engineering College, Chennai, Tamil Nadu

T. S. Karthik
tskarthiksekar@gmail.com
Meenakshi Sundararajan Engineering College, Chennai, Tamil Nadu

Kshitij Swamy
kshitijs12345678@gmail.com
Meenakshi Sundararajan Engineering College, Chennai, Tamil Nadu

ABSTRACT

The Al6061 alloy matrix materials exhibiting excellent mechanical properties with the addition of SiC and B_4C particulates as reinforcement. Liquid Metallurgy route is preferred for preparing composite specimen materials. Composites were subjected to heat treatment process followed by quenching in castor oil. Then all the specimens are subjected to artificial aging at a temperature of 120˚C for different time duration. Using a Rockwell hardness testing machine, hardness properties are examined for the composite materials before and after heat treatment. It is observed that Al6061 metal matrix composite experimented under identical heat treatment conditions shows a considerable increase in hardness.

Keywords— *Metal Matrix composites, Solutionizing, Artificial ageing, Hardness*

1. INTRODUCTION

The Metal Matrix Composites are in advance extensively used in some areas due to its enhanced mechanical properties when compared with metals/alloys, particularly in applications where weight and strength are of most important consequence. The advantages of particulate reinforced composites over others are their formability with expenditure benefit and its different strengthening mechanisms [1]. Metal matrix composites are suitable for appliances which oblige characteristics such as combined strength, damping properties thermal conductivity, and coefficient of thermal expansion along with lesser density. The unique properties of metal matrix composite enhance their usage in automotive and tri-bological applications [2-4] such as in pistons, brake drum, brake disc, and cylinder block. The current improvement in metallic matrices, for the fabrication of HAMMCs consist of generally used metals viz., Al, Mg, Ti, Cu, and their alloys reinforced with hard ceramic particles usually silicon carbide, alumina, [5,6] and soft particles usually graphite, talc etc.[7,8].

2. MATERIALS SELECTION

In this paper, SiC and B_4C particulates reinforced with Al6061 matrix composite are selected as it provides a higher combination of strength to weight ratio.

3. PREPARATION OF HYBRID ALUMINUM METAL MATRIX COMPOSITES (HAMMCS)

Stir casting technique is one of the popular Liquid Metallurgy Routes and a very promising route for manufacturing near net shape hybrid metal matrix composite components at a normal cost. This is one of the vortex methods to create a good distribution of the reinforcement material in the matrix. In the present work, stir casting technique is used to fabricate Al 6061 alloys with a varying weight percentage of SiC and B4C reinforcement. Temperature can be easily controlled and measured. The stirrer is used to stir the molten metal. The melt was maintained at a temperature above the melting point. Vortex was created by using a mechanical stirrer. SiC with particulates size 20µm and B_4C 20 µm with are preheated at 400˚C and added into the melt with constant mechanical stirring. Two specimens Al6061 reinforced with 3% SiC, 3% B4C composites were made with the same procedure. Then the furnace is opened and the molten metal is allowed to flow in the die which was kept in the bottom of the furnace. After

cooling the specimen was taken from the die. Specimens were tested using Rockwell hardness tester machine. A load of 500 Kgf for a period of 30 seconds was applied with a ball indenter of 10 mm diameter. The test was carried out at five different regions. Hardness was determined by measuring the indentations diameter produced. The average of all the five readings was taken as the hardness of the composite.

4. HEAT TREATMENT PROCESS

Al 6061 matrix alloy with SiC particulates reinforced composites were kept to solutionizing treatment at a temperature of 470˚C for a period of 2 hr using muffle furnace, followed by quenching in castor oil. Artificial aging treatment was carried out for a duration of 2 hr. to 10 hr in steps of 2 hr.

5. RESULTS AND DISCUSSION

5.1 Hardness Survey

Hardness test was carried out using Rockwell hardness tester with six indentations of each sample and then the average values were used to calculate hardness number. A considerable increase in hardness of the matrix was seen with the addition of SiC particles. The hardness of MMCs increases with the weight fraction of particulate in the alloy matrix. It is observed that with increased weight % of reinforcement in the matrix alloy, there is a significant improvement in the hardness of the composites. The hardness of MMCs increases with a weight percentage of particulate in the Al alloy matrix. The added amount of SiC particulates in the matrix will enhance hardness due to the dislocation pile-up of the matrix lattice. Fig shows that the sample with 3% SiC particulates has lesser hardness. The variation of hardness with increased weight % of reinforcement in the Al6061 matrix alloy and heat treated Al6061 particulate composites are as shown in the figures. Maximum hardness was measured for Al6061 3%SiC.

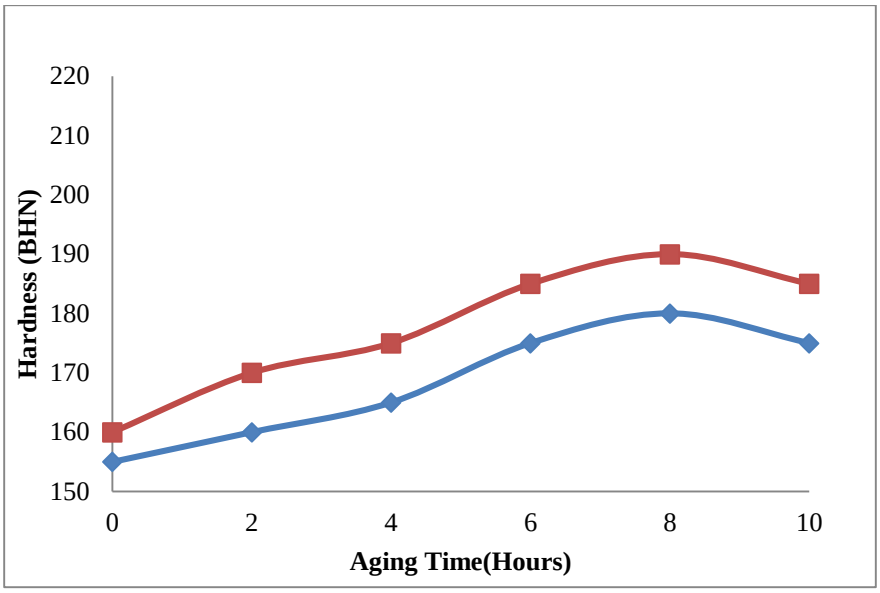

Fig. 1: Solutionizing Temperature: 470˚C, Quenching Media: castor oil, Ageing Temp: 120˚C

6. CONCLUSION

The hardness of composites increased significantly with increased content of SiC and B_4C. Heat treatment has a significant effect on the hardness of Al 6061 matrix composites. Oil quenching followed by artificial aging for 8 hr resulted in maximum hardness of composites.

7. REFERENCES

[1] Sanjay KT, Brij KD. "The Influence of Interfacial Characteristics Between SiCp and Mg/Al Metal Matrix on Wear, Coefficient of Friction and Microhardness," Wear, 2001, 247, 191-201.
[2] Sharma SC, Girish BM, Kamath R, Satish BM. "Fractography, Fluidity, and Tensile Properties of Aluminum/Hematite Particulate Composites," J. Mater. Eng. Perform., 1999, 8(3), 309-314.
[3] Seah KHW, Sharma SC, Rao PR, Girish BM. "Mechanical Properties of as-Cast and Heat-Treated Za-27/Silicon Carbide Particulate Composites," Mater. Des., 1995, 16(5), 277-281.
[4] Shanta S, Krishna M, Jayagopal U. "A Study on Damping Behavior of Aluminite Particulate Reinforced Za-27 Alloy Metal Matrix Composites," J. Alloys Compd., 2001, 314(1-2), 268-274
[5] Park BG, Crosky AG, Hellier AK. "Material Characterisation and Mechanical Properties of Al2O3-Al Metal Matrix Composites," J. Mater. Sci., 2001, 36, 2417-2426.
[6] Srivastava TS, "Microstructure, Tensile Properties and Fracture Behaviour of Al2O3 Particulate-Reinforced Aluminium Alloy Metal Matrix Composites," J. Mater. Sci., 1996, 31, 1375-1388.
[7] Seah KHW, Sharma SC, Girish BM. "Mechanical Properties of as-Cast and Heat-Treated Za-27/Graphite Particulate Composites," Compos. Part A. Appl. Sci. Manuf., 1997, 28(3), 251-256.
[8] [8] Jha AK, Dan TK, Prasad SV, Rohatgi PK. "Aluminium Alloy-Solid Lubricant Talc Particle Composites," J. Mater. Sci., 1986, 21(10), 3681-3685.

