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MECHANICAL PROPERTIES OF ALUMINIUM ALLOY Al356.2 MATRIX REINFORCED WITH ZIRCONIUM PARTICLES.

Adil Ahmed.S[1], Dr.N.S.Prasanna Rao[2], Dr.P.L.Srinivas Murthy[3], Suraj.S[4]

[1] *Assistant Professor, Mechanical Department, M S Engineering College, Bangalore, Karnataka, India*
[2] *Professor, Mechanical Department, MSRIT, Bangalore, Karnataka, India*
[3] *Professor, Mechanical Department, MSRIT, Bangalore, Karnataka, India*
[4] *PG Scholar, Mechanical Department, M S Engineering College, Bangalore, Karnataka, India*

Abstract - ***Aluminium Matrix Composites are important engineering materials because of their excellence, low weight & huge demand in automobile industries. These growing requirements of materials with high specific mechanical properties with weight savings as fuel significant research activities in recent times targeted primarily for further development of Aluminium based composites. The present work deals with the study in incorporation of Zirconium Nano Particles in Molten Al356.2. This can be achieved by melting the matrix by stir casting route at 750°C. Scanning Electron Microscope is used to study the micro structure and mechanical tests, such as tensile and hardness were used. Tests were conducted and results showed that microstructure and mechanical properties for 15wt % of reinforcement particle fabricated at 750°C has homogenous reinforcement particles and thus it enhanced the mechanical properties.***

Key Words: *Aluminium Matrix Composite, Stir Casting, Tensile, Hardness, Micro Structure, Reinforcement, Zirconium…*

1. INTRODUCTION

Aluminium alloy based metal matrix composites (AMMCs) have been now established themselves in various engineering fields due to their low weight to density ratio. Al alloys are quite attractive due to their high thermal and electrical conductivity, Corrosion resistance, Ductility, Reflectivity etc.

In many cases, the performance of metal-matrix composites is superior in terms of improved physical, mechanical, and thermal properties (specific strength and modulus, elevated temperature stability, thermal conductivity and controlled coefficient of thermal expansion). The intrinsic advantage of MMCs over the unreinforced alloy is the improvement of mechanical properties due to addition of the reinforcement material. Mechanical properties of MMCs are directly related to their micro structural features such as the reinforcement, matrix/reinforcement interfaces, dislocation, etc. General MMCs exhibits considerable increase in strength and stiffness. However, they also have poor ductility, low values of fracture toughness and poor cycle fatigue properties [1-4]. The main contribution to increase the mechanical properties of particle reinforced metal matrix composites (PRMMCs) is particle addition; it affects most of the properties of PRMMCs. Parameters related to the particle are volume fraction, size, shape and distribution of particles.

The most important parameter is volume fraction Lee.W.B [5] reported that the important factor controlling elastic modulus is volume fraction of particles. Moreover, as the volume fraction of particles is increased, tensile and yield strengths generally increases and fracture toughness decreases. [6-8].

The amount of thermal residual stress along depends on the volume fraction. Increasing volume fraction monotonically increases the thermal residual stress and also increases dislocation densities [9,11].

In this study the effect of particle volume fraction on the mechanical properties of PRMMCs was examined.

2. EXPERIMENTAL PROCEDURE

Raw materials used in this work were Base metal Al 356.2 and reinforcement were Zirconium Nano Particles (ZrO_2). For casting resistance furnace equipped with stirrer system was used and muffle furnace was used for pre heating of die. Initially the resistance furnace was set to 750℃ and crucible was preheated. Die made out of cylindrical holes of 16mm diameter was subjected to preheating at 250℃ temperature using muffle furnace to

eliminate moisture content after applying of chalk powder on it for easy removal of the specimens.

Alloys are placed in the crucible and once it gets melted degassing tablets are added in order to remove entrapped gas in the form of slag. Stirring is carried out which is run at 150rpm.

Once stirring is started after few seconds reinforcement particles in 10wt%, 15wt% and 20wt% are added in different trials and stirring process in carried out up to 15min.After completion of stirring process the molten metal is poured in to the die. And is left for solidification after which the specimens are removed from it and subjected to machining process for testing according to standards. The chemical Composition of Al356.2 is shown in Table 1

Table 1: Chemical Composition of Al356.2 Alloy Matrix.

Si	Fe	Cu	Mn	Mg	Zn	Ni	Ti
6.5-7.5	0.15	0.03	0.10	0.4	0.07	0.05	0.1

3. RESULTS AND DISCUSSION

3.1 Tensile Properties.

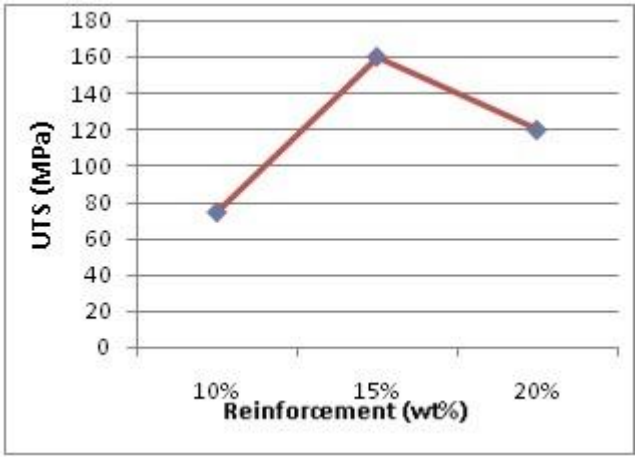

Fig 1: Ultimate Tensile Strength vs Reinforcement (wt %)

There is an increase in tensile strength with increase in reinforcement percentage and 15% reinforcement has got maximum tensile strength

3.2 Hardness

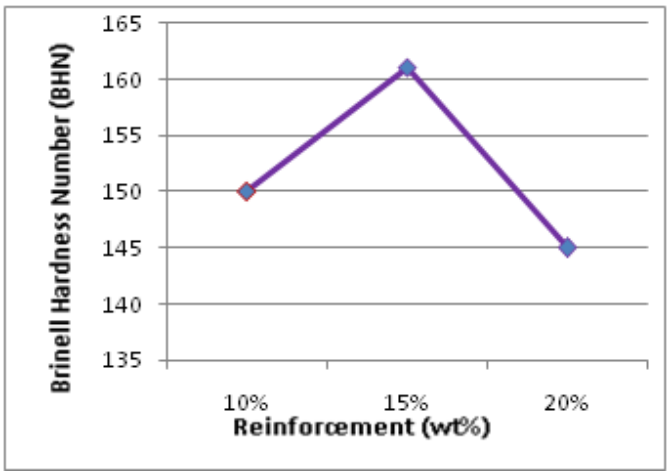

Fig 2: Hardness vs Reinforcement (wt%)

3.3 Micro Structure

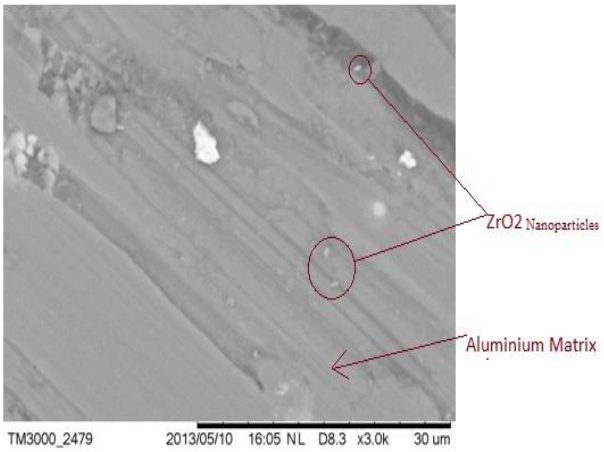

Fig: 3 Al356.2 aluminium alloy reinforced with 10 wt. % at x3.0k at 30µm

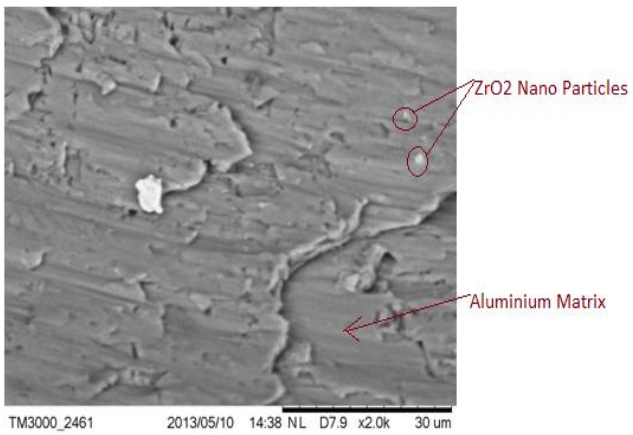

Fig: 4 Al356.2 aluminium alloy reinforced with 15 wt. % at x2.0k at 30µm

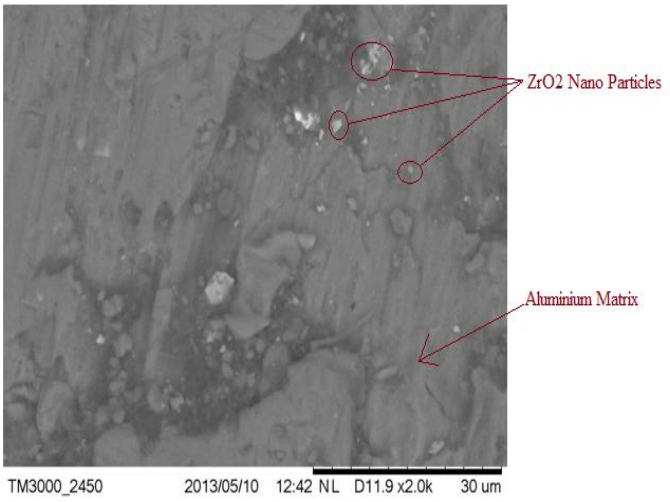

Fig: 5 Al356.2 aluminium alloy reinforced with 20 wt. % at x 2.0k at 30µm

4. CONCLUSIONS

Vortex method is used for successful incorporation of Zirconium particles into the aluminium alloy. Using this method 10, 15 and 20 wt% composites were fabricated. It is found that hardness and tensile strength of the composites increases with increase in reinforcement (%) upto 15% and decreases.

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BIOGRAPHIES

Adil Ahmed S is Assistant Professor of Mechanical Department at M S Engineering College, Bangalore. He has completed M-Tech at Ghousia College of Engineering and presented journal papers in international research journals. He has teaching experience of 16 years and 1 year industrial experience. His area of interest are Composite and Smart materials

Dr. N S Prasanna Rao is Professor in Mechanical Department at MSRIT. He has 21 years of teaching experience. There are many international research journals with his name. His area of interest is CFD.

Dr. P L Srinivas Murthy is Professor in Mechanical Department at MSRIT. He has 29 years of teaching experience in same college. Materials are special interested field and there are many international journal papers on these.

Suraj S received his B.E degree in Mechanical Engineering from Visvesvaraya Technological University in 2013 and presently pursuing M Tech in Machine Design, Department of Mechanical Engineering from M S Engineering College, Bangalore. His area of interest are Product Design, CAD & FEM.

