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Fabrication and Micro structural Analysis of Carbon Nano Tube Materials by Adding Nano Fly Ash to Alumina

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ABSTRACT
The application spectrum of low cost material reinforced metal matrix composites is growing rapidly in various engineering fields due to their superior mechanical and thermal properties. In the present study it is proposed to explore the possibilities of reinforcing aluminum alloys (AlSiC and Al6061) with locally available inexpensive rice husk and fly ash for developing a new composite material. A sample of TiB_2 also added to one sample to get better phenomena's in matrix composites. A rice husk and fly ash particles of 5, 10 and15% each by weight are proposed to develop metal matrix composites using liquid metal processing route. Stir cast and in-situ methods are used to prepare composites. Fabrication did by considering constant stirrer RPM. The fabricated samples analyzed to study internal bonding applications and properties by using SEM and OM. Thermal conductivity voltage constants also observed in microstructure analysis and flow of material also analyzed.
Keywords: Fabrication of MMC, SEM, OM, Microstructures, Bonding between atoms

I. INTRODUCTION

Mechanical properties of composites are affected by the size, shape and volume fraction of the reinforcement, matrix material and reaction at the interface. The interface between the matrix and reinforcement plays a critical role in determining the properties of MMCs. Stiffening and strengthening rely on load transfer across the interface. Toughness is influenced by the crack deflection at the interface and ductility is affected by the relaxation of peak stress near the interface. . Evidences of the existence of inter-phase polymers in composite fibers, characterizations of their structures, and fiber properties are discussed and summarized. Implications of interphase phenomena on a broader field of fiber and polymer processing to make much stronger materials are now in the early stages of exploration. Beside improvements in tensile properties, the presence of Fly ash in polymeric fibers strongly affects other properties, such as thermal stability, thermal transition temperature, fiber thermal shrinkage, chemical resistance, electrical conductivity and thermal conductivity. While investigating the opportunity of using fly ash as reinforcing element in the aluminum melt, R.Q.Guo and P.K.Rohatagi observed that the high electrical resistivity, low thermal conductivity and low density of fly-ash may be helpful for making a light weight insulating composites. Rohatgi reports that with the increase in volume percentages of fly ash, hardness value increases in Al–fly ash (precipitator type) composites. He also reports that the tensile elastic modulus of the ash alloy increases with increase in volume percent (3-10) of fly ash. Aghajanian, etc have studied the Al_2O_3 particle.

Reinforced Al MMCs, with varying particulate volume percentages (25, 36, 46, 52 and 56) and report improvement in elastic modulus, tensile strength, compressive strength and fracture properties with an increase in the reinforcement content.

II. METHODOLOGY OF FABRICATION

In the present research work the stir casting method is adopted for fabrication of AlSiC with inclusion of Fly ash, husk ash particles and TiB_2.

The simplest and most commercially viable technique is the vortex technique or stir casting technique. The stir casting setup consists of a furnace, an electric motor with a stirrer arrangement and temperature sensors. In this method, ceramic particulates are incorporated into liquid metal melt and the mixture is allowed to solidify. It is important to create a good wetting between the particulate reinforcement and the liquid metal. The vortex technique requires the introduction of pre-treated ceramic particles into the vortex of the molten matrix created by a rotating impeller. Generally, it is possible to incorporate up to 30% ceramic particles in the size range 5 to 10μm in a variety of molten aluminum alloys.

Advantage of NANO Fly Ash: Particularly NANO Fly ash is one of the finest composites because of its regular and minute shapes i.e the particles is fine grinding with equal μm shapes which can be deposited in the gaps easily to create fine formation of fabricated object. This nature of grains with light density can minimize blow hole formations while pouring the liquid state material to casted mold.

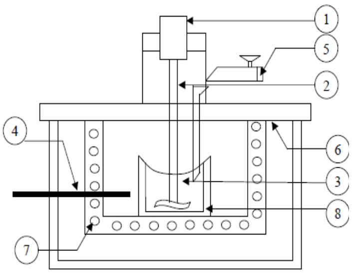

Fig. 1. Schematic view of setup for Fabrication of composite

1. Motor
2. Shaft
3. Molten aluminium
4. Thermocouple
5. Particle injection chamber
6. Insulation hard board
7. Furnace
8. Graphite crucible

Experimental Work

Preparation of Raw materials
↓
Stir casting equipment
↓
Preparation of MMC's by weight volume ratio
↓
Melting and casting
↓
Machining samples for testing
↓
Analyses of SEM & OM samples

Experimental Set Up

Fig:2 Shows experimental setup in workshop

III. RULE OF MIXTURES BY WEIGHT/ VOLUME RATIO

Following compositions as given in the table 1 to table 5 were considered for preparing the test samples with variable ingredients of matrix ranging from Al SiC, Al6061, with and without husk as particulate reinforcement having Fly Ash as common particulate Reinforcement. One sample having TiB_2 is also considered instead of Husk. These samples are machined to make the dimensions of 16cm x 4cm x 3cm with volume of $192cm^3$.

Table 1: Metal Matrix Composite: AlSiC + Fly ash+ Husk

S .No	Material Const-ituents	%by Vol-ume	Volume Occu-pied (cm^3)	Density (gm./ cm^3)	Mass (gm.)
1	Al SiC	76%	147.84	2.9	428.73
2	Fly ash	12%	15.36	1.02	15.66
3	Huak	3%	3.84	1.42	5.45
4	Al_2O_3	3%	5.76	3.97	22.87
5	Mg	2%	3.84	1.47	5.64
6	Hexa Chloro methene	4%	7.68	1.2	9.22

Table 2: Metal Matrix Composite: Al 6061 + Fly ash

S.No	Material Const-ituents	%by Vol-ume	Volume Occu-pied (cm^3)	Density (gm./ cm^3)	Mass (gm.)
1	Al 6061	74%	142.08	2.74	389.30
2	Fly ash	6%	11.52	1.01	11.63
3	Al_2O_3	3%	5.76	3.97	22.87
4	Mg	2%	3.84	1.47	5.64
5	Hexa chloro methene	4%	7.68	1.2	9.22

Table 3: Metal Matrix Composite: Al 6061 + Fly ash+ Husk

S.No	Material Const-ituents	%by Vol-ume	Volume Occu-pied (cm^3)	Density (gm./ cm^3)	Mass (gm.)
1	Al SiC	73%	140.16	2.71	379.83
2	Fly ash	8%	15.36	1.01	15.51
3	Husk	6%	11.52	8.908	102.62
4	Al_2O_3	3%	5.76	3.97	22.87
5	Mg	2%	3.84	1.47	5.64
6	Hexa Chloro methene	4%	7.68	1.2	9.22

Table 4: Metal Matrix Composite: Al SiC + Fly ash

S.No	Material Const-ituents	%by Vol-ume	Volume Occu-pied (cm^3)	Density (gm./ cm^3)	Mass (gm.)
1	Al SIC	80%	153.6	2.9	445.44
2	Fly ash	11%	23.04	1.01	23.27
3	Al_2O_3	3%	5.76	3.97	22.87
4	Mg	2%	3.84	1.47	5.64
5	Hexa Chloro methene	4%	7.68	1.2	9.22

Table 5: Metal Matrix Composite: Al Sic + Fly ash + TiB_2

S.No	Material Const-ituents	%by Vol-ume	Volume Occu-pied (cm^3)	Density (gm./ cm^3)	Mass (gm.)
1	Al SIC	77%	147.84	2.9	428.73
2	TiB_2	6%	23.04	4.52	104.14
3	Fly Ash	8%	15.36	1.01	15.51
4	Al_2O_3	3%	5.76	3.97	22.87
5	Mg	2%	3.84	1.47	5.64
6	Hexa Chloro methene	4%	7.68	1.2	9.22

IV. RESULTS

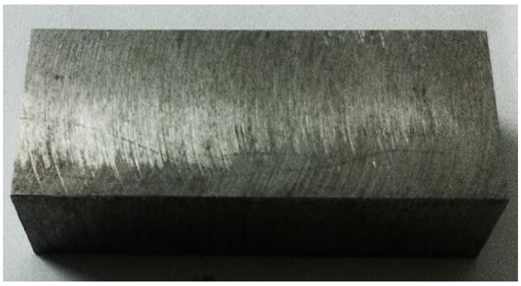

Fig:3
Sample: 1 ALSIC-76%,Husk-3%,Flyash-12%, Al_2O_3-3%,Mg-2%&Hexachloromethene-4%

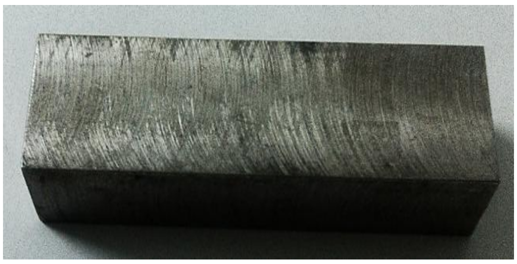

Fig:4
Sample: 2 Al6061-77%, Flyash-8%, Husk-6%, Al_2O_3-3%, Mg-2%&Hexachloromethene-4%

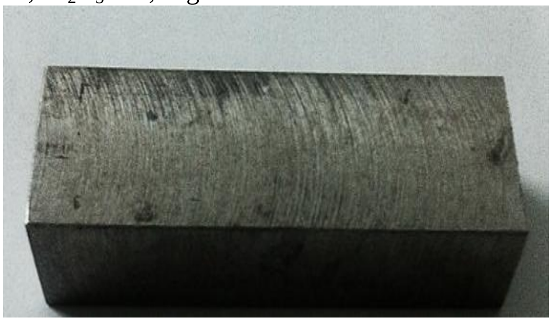

Fig:5
Sample: 3 Al6061-79%, Flyash-12%, Al_2O_3-3%, Mg-2%&Hexachloromethene-4%

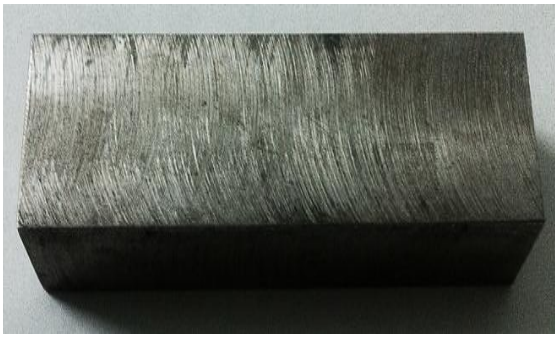

Fig:6
Sample: 4 ALSIC-80%, Flyash-11%, Al_2O_3-3%, Mg-2%&Hexachloromethene-4%

Fig:7
Sample: 5ALSiC-77%, TiB_2-6%, Flyash-8%, Al_2O_3-3%, Mg-2%&Hexachloromethene-4%

V. SEM AND OM RESULTS

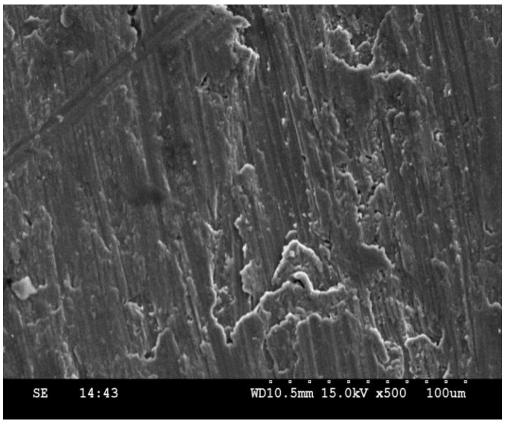

Fig: 8 Shows the sample 1 at Magnification=500

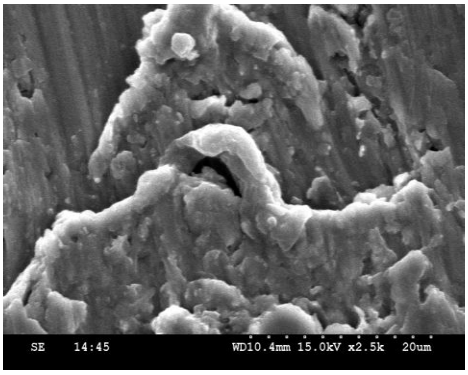

Fig: 9 Shows the sample 1 at Magnification=2500

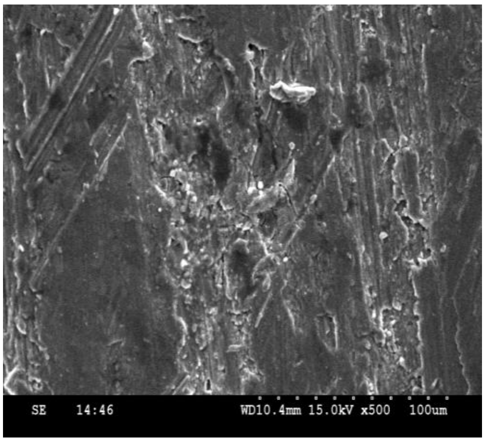

Fig: 10 Shows the sample 2 at Magnification=500

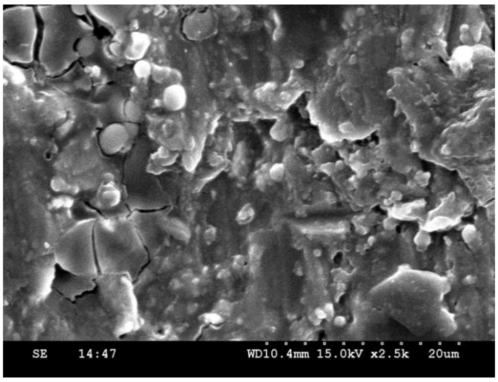

Fig: 11 Shows the sample 2 at Magnification=2500

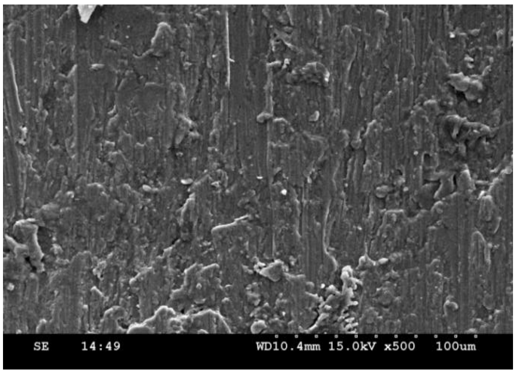

Fig: 12 Shows the sample 3 at Magnification=500

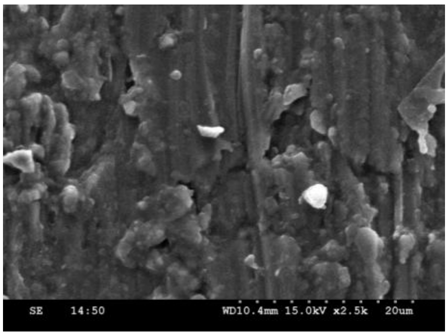

Fig: 13 Shows the sample 3 at Magnification=2500

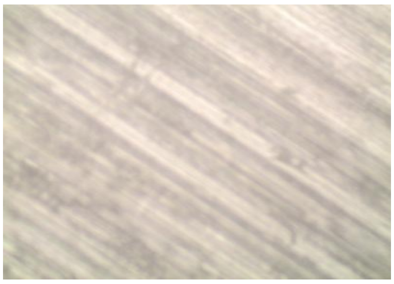

Fig: 14 Sample 1 surface image layers at 300 x

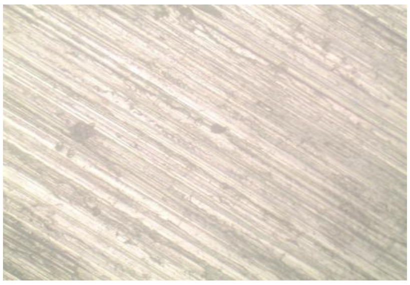

Fig: 15 Sample 2 surface image layers at 300 x

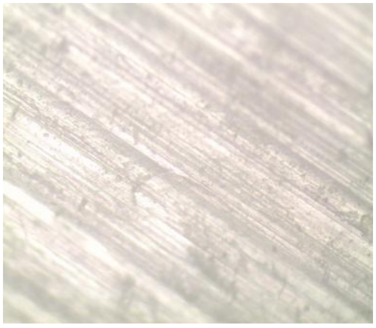

Fig: 16 Sample 3 surface image layers at 300 x

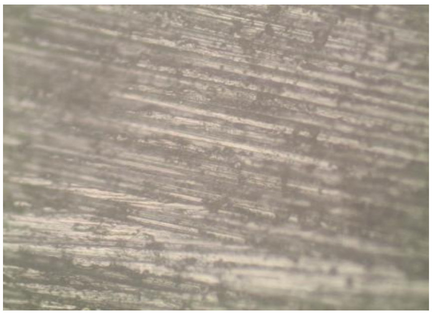

Fig: 17 Sample 4 surface image layers at 300 x

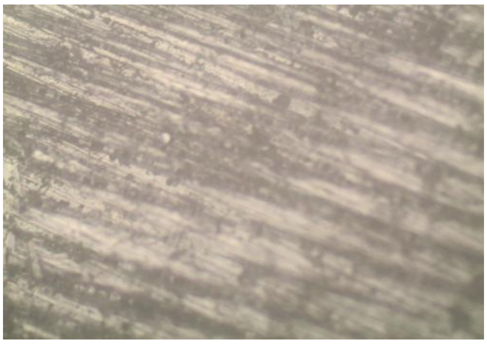

Fig: 18 Sample 5 surface image layers at 300 x

TABLE: SEM IMAGE SETTINGS

Magnification=500x,2500x
Accelerating Voltage=15000 Volt
Emission Current=13000 nA
Working Distance=10400 um
Sub Vacuum=High
Sub Accelerating Voltage=15000 Volt
SEM Version=10-07

VI. DISCUSSIONS

As per the above analysis of work it is observed that stirrer velocity of blade would give optimum fabrication levels which can be observed in sample 3. The micro structural analysis showing that there is no deposition of any material at one area in stir casting process. The molecules distributed with appropriate practical sizes and no blow holes or gaps were found in the fabrication. The surface finish of the objects is good by checking OM images and the same are presented. The above presented inspection data can further be used in thermal conductivity studies of carbon NANO tubes. NANO fly ash given better results than before because of its fine structure as compared to normal fly ash.

VII. CONCLUSIONS

By taking volume weight ratios in to consideration it is easy to mix the volume ratios of alloy matrix and stir casting is one of the prominent processes of matrix fabrication because of its stirring capacity . The blade velocity will give good mixing and molecular bonding will give an excellent casting than normal casting process.

1. From the study it is concluded that we can use fly ash for the production of composites and can turn industrial waste into industrial wealth. This can also solve the problem of storage and disposal of fly ash.
2. Fly ash upto 10% by weight can be successfully added to Al by stir casting route to produce composites.

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