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DEVELOPMENT AND CHARACTERIZATION OF HYBRID COMPOSITES (TiC-SiC-C) REINFORCEMENT ON AL USING POWDER METALLURGY

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Abstract— Metal matrix composites possess significantly improved properties such as a high specific strength, specific modulus, damping capacity and good wear resistance compared to unreinforced alloys. MMCs could produced by the variety of methods such as Stir cast, Liquid Infiltration and Powder metallurgy. Among this Powder Metallurgy Processing is one of the effective of manufacture MMCs with the high volume reinforcement with fairly uniform distribution. The present investigation deals with the production of SiC, TiC and C particle reinforced Aluminium powder and composite through powder metallurgy route with conventional sintering as well as microwave sintering. An attempt was made to optimise process parameters such as sintering time, sintering temperature and compacting load. The Aluminium powders and SiC particle (20 microns) and TiC(15microns) and C(21microns) at a volume fraction of 5-20% of SiC and 20% of TiC-10%C was processed. Compacting load was varied between 4000kg to 8000kg.Sintering was performed in Microwave furnace .Hardness test was conducted in Rockwell testing Machine. In Al-20%SiC-10%TiC composition corresponding to the 7000 kg load, the Hardness 80 (Rockwell C-scale) was obtained.

Keywords -- Metal matrix composites, Powder metallurgy, Al, Tic, Sic, C.

I. INTRODUCTION

During the past two decades in metal matrix composites have drawn the attention of much research due to their low density, excellent wear resistance, High specific strength and high specific modulus [1]. Metal matrixes composite increasingly become attractive material for advanced aerospace application because their properties can tailor through the addition of selected reinforcement [2]. Metal matrix composites have a market has increased because of environment issue. Examples a component that have been manufactured using metal matrix composites include the piston for diesel engine and connecting rod [3]. These materials have also been shown to possess high potential for application in the brake discs for railway brake equipment. Aluminium–based metal matrix composites has received increasing attention in recent decades as engineering materials, The reinforcement that have been tried out to develop aluminium matrix composites are graphite, silicon carbide and titanium carbide [4]. The addition of hard reinforcement such as titanium carbide, silicon carbide and graphite improves hardness, strength and wear resistance of the composites [5]. Hence the present work has taken up to focus on the understanding of the development and characterization of (Tic-Sic-C) reinforcing on aluminium [6]. Metal matrix composites (MMCs) are engineering materials in which a hard ceramic component dispersed in a ductile metal matrix [7]. These materials have the characteristics that superior to those of the conventional monolithic metallic alloys, required for aerospace and automobile industries. In most of the MMC, aluminium is the most frequently used metal matrix material due to its low density and excellent castability [8].

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II. EXPERIMENT DETAILS

The powder Metallurgy is a process of making the component from metallic powders. Initially, it used to replace castings for metals which difficult to melt because high melting point. The development of technique enabled us to produce a product economically, and it occupies an important place in the field of metal process. The numbers of material products made by powder metallurgy is increasing and include tungsten filaments of lamps, contact points. Self-lubricating bearings and cemented carbides for cutting tools.

1) Mixing of Powders

The mixing of powders is essential to the uniformity of the product. Lubricants are added to the blending of powders before mixing. The function of the lubricant is to minimise the wear, to reduce friction. Different powder in correct proportions is thoroughly mixed either wet or in a ball mill. The majority of powders are mixed with other powders, binders and lubricant to achieve the desired characteristics in the finished product.

2) Compacting

The required amount of Graphite, Titanium Carbide, and Silicon Carbide along with zinc stearate weighed with the digital weighing machine. The weighed powders are manually blended. The blended powder is filled uniformly in the die cavity, and load is gradually applied. Now, the green compacted component is ejected from the die cavity. This procedure is repeated to get different green component of different composition of powders.

3) Sintering Process

Sintering involves heating of the green compact at high temperatures in a controlled atmosphere. Sintering increases the bond between the particles and therefore strengthens the metal powder compact. Sintering temperature and time is usually 0.6 to 0.8 times the melting point of the powder.

In the case of mixed powders of different melting temperature, the sintering temperature will generally be above the melting point of one of the minor constituent and other powders remain in the solid state. The important factors governing sintering are temperature, time and atmosphere.

4) Prepared Component

(Al-composites with, % of TiC, SiC, Graphite).

Figure 1 Top view of composite

Figure 2 Front view of composite

III. Result and Discussion

1) Hardness Test

The hardness test was conducted for the samples (Al-composites with, % of TiC, SiC and Graphite). Hardness the average Rockwell hardness values of Al-TiC-SiC-C composites measured on the polished surfaces of the samples using B scale on Rockwell hardness tester.

The indenter is moved down and touches the component. Set the 4000kgf load on the machine then hold the dwell button then move the indenter upward. By using the microscope, note reading on the linear scales.

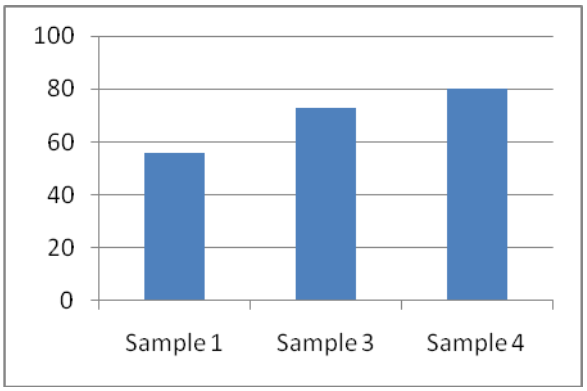

Figure 3 hardness of the (Al-Tic-Sic-C) Metal matrix composites

Thus, the reading was noted and the graphs were plotted.

2) SEM Analysis

Electron microscopy of the composite surface was carried out to know the morphology of the composite. The composite samples which indicate that the mixture was uniform because there was no segregation of TiC, SiC, C particles.

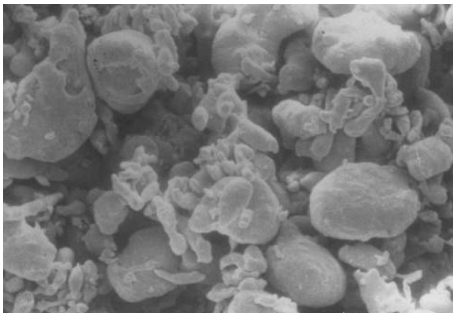

Figure 4 (a)

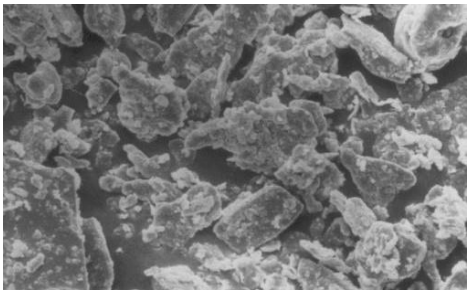

Figure 4 (b)

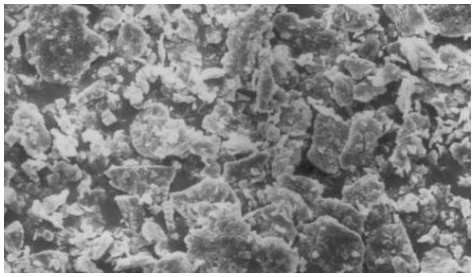

Figure 4 (c)

Scanning microscope image(Al-TiC-SiC-C)Metal matrix composites.

The surfaces of the composite specimens are examined directly by scanning electron microscope. Then the composite samples are mounted on stubs and the eroded and uneroded surfaces observed.

IV. CONCLUSION

The following concluding remarks were drawn from the present investigation:

1) The scanning electron micrograph revealed a reasonably non-uniform distribution of Tic, Sic, Gr particles in the matrix.
2) The present work has shown that Al-Tic-Sic-C composite materials with different weight percents of ceramic particles, have high values of hardness and good wear resistance as a comparison of the matrix.
3) The Aluminium powders and SiC particle (20 micron) and TiC(15microns) and C(21microns) at a volume fraction of 5-20% of SiC and 20% of TiC-10%C was processed.
4) Compacting load was varied between 4000kg to 7000kg of the metal matrix composites.The Load is increases hardness also an increased of the metal matrix composites(Al-Tic-Sic).

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