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INSPECTION OF COPPER BASED COMPOSITE FABRICATED BY POWDER METALLURGY FOR ELECTRODE PURPOSE USED IN EDM MACHINE

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Abstract: This research is based on the fabrication of copper based composites with the help of powder metallurgy process. As we know about the tungsten is used in the EDM machine for making of electrode but in this dissertation there are three different type of composites is investigated based on their several properties .There are three different types of composites named as Cu-SiC, Cu-WC, and Cu-Gr. Basically it is all about the investigation of microstructure, hardness and effect of the sintering temperature on the composites. Microstructure study is based on the SEM and EDX test and hardness test is done by Rockwell hardness tester. Sintering temperature is kept almost 1 hour at 750 °C. Machining operation is done by VMC machine to know about the slot cutting speed and MRR of each composite. Results are about the uniform microstructure and hardness of Cu-SiC is more than other two composites.

Keywords: Powder metallurgy, Composite Material, SEM, EDS, Hardness & Milling Machining.

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INTRODUCTION

Metal powder is taken in the powder form of micro size before milling process and after the milling it was reduced to less micro size from the original powder form. Three process is involved to make three different type of composites which are milling of powders, compaction and sintering. Copper metals and its nature regarding performance like thermal conductivity, electrical conductivity and sometime mechanical properties are used to be tested for many applications [1-3]. The unveiled property of a copper metal is its ultimate strength, internally corrosion behavior, wear capacity resistance and its specific stiffness capacity. We all know about the copper metal have unique property like electric resistance, electrical conductivity and their ultimate soften property but it is converted into different type of composites automatically due to mixing of hard metal powder like tungsten carbide, silicon carbide [4-6]. The composites undergo in situ process is highly accurate and better efficient process like other composites based on powder metallurgy [7-10].

Experimental

Experimental process consist various experimental procedure like milling of powder, compaction, sintering and in last machining of composites. I have used planetary ball mill for the milling purpose, UTM machine for the compaction process, CVD thermal is used for the sintering purpose and Rockwell hardness tester for the material hardness. After all the result it is found that the hardness of Cu-SiC has higher accuracy of hardness among all the composites. The uniform composition of reinforcement material in the basic metal is found in the Cu-SiC mixing. About the structure there are various test is conducted like SEM and EDX test, in the SEM test the uniform structure is found and in the EDS test the composition of reinforcement is obtained.

Table 1: Milled powder parameter

Milled used	Planetary ball mill
Jar capacity	100ml
Jar material	Tungsten based material
Ball: powder	3:1 (by weight)
Ball diameter	3mm
Milling speed	400rpm
Milling time	10hours
Processing control agent	Toluene
Total milling time	7hours
Cleaning organic agent	Acetone

Fig 1. Milled powder after the milling [Source: MNIT Jaipur]

Compaction & Sintering:

For compaction of composites the each sample takes two minute for the making of compact in high steel Die in the cylindrical shape in the ratio of 54MPa, 40MPa, 40 MPa and takes 1hour each for the sintering at
750 °C.

Fig 2. (a) Die (High speed steel) used for compaction (b) composites sample after the sintering 1) Cu-C
2) Cu - WC 3) Cu-SiC
[Source: SGVU, Jaipur]

SEM and EDX test:

In this test the micrographs has taken in the 2kx view of each sample composites, and it is clearly observed that the distribution of reinforcement material in the sample is higher of Cu-SiC.

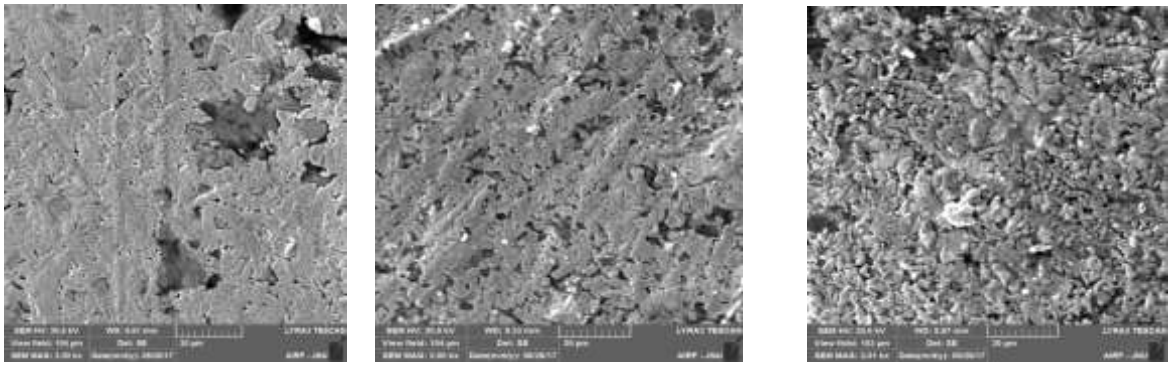

Fig.3. SEM micrographs of (a) copper-graphite (b) copper-silicon carbide(c) copper-tungsten carbide

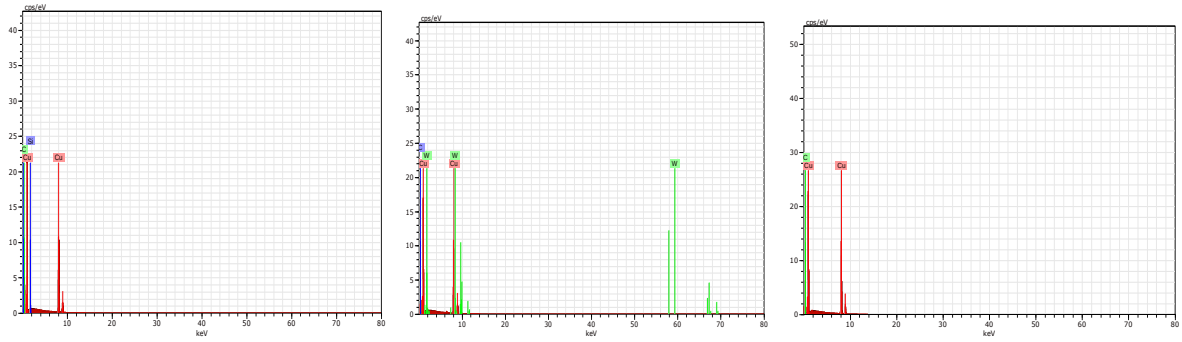

Fig 4. EDS test composition variation graphs(a) copper-silicon carbide(b) copper-tungsten carbide
(c) copper-graphite

Hardness test & Machining at VMC milling

Rockwell hardness tester is used to determine the hardness value of composite material of each composites in the brinell scale from B74 to B78. The copper-graphite habe lowest hardness value which is B74, copper-tungsten carbide have B75 and Copper-silicon carbide have B78, which is almost higher in all composites. The final metal piece have required to detect the material removal rate after the use of VMC machine. To detect the all the cutting parameter it has been taken some use of special parameter on the composites sample.

Table 2. Machining parameter used for slot cutting

Name of composites	Input parameter			Output parameter	
	Speed in rpm	Depth of cut in mm	Feed rate in mm/min	Cutting time in sec	MRR in gm/sec
1)Cu-C	2000	3	100	3.1	.051
2) Cu-WC	2000	3	100	3.2	.068
3) Cu-SiC	2000	3	100	3.4	.058

Fig 5. A) Rockwell hardness test
[Source: SGVU, Jaipur]

RESULTS AND DISCUSSION

To include all the data it is clearly observed that the Cu-SiC composites have uniform structure, uniform composition, and more hardness among in all composites. According to SEM test and EDS test the value of composites graph in Cu-SiC have different structure among in all samples.

CONCLUSION

1. The microstructure has Cu-SiC have more uniform in all composites.
2. Rockwell hardness of Cu-SiC composites is higher.
3. Time taken by VMC machine for slot cutting of composites is higher for Cu-SiC.
4. To consider all the value regarding property of material, the Cu-SiC is best among in all.
5. The best material for the electrode purpose in the EDM machine is Cu-SiC.

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