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CORROSION AND HARDNESS BEHAVIOUR OF COPPER METAL MATRIX COMPOSITE

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ABSTRACT

Copper finds a wide range of application in automotive field, marine and electronic packaging. Cu-based matrix material produced by the powder metallurgy method has proved to offer excellent heat conductivity and higher anti- Wear properties. They are also broadly used in aircraft, trains, and ship brake systems. The objective of this work is to investigate corrosion and hardness characteristics of newly designed Cu-based material. In this paper report result of corrosion and hardness of carbon nanotube reinforced Copper metal matrix composite is produced by powder metallurgy technique. Micro Hardness improved from 338HV to 413HV.Wear Loss also decreased with increase in CNT volume fraction in the composite. Carbon nanotubes (CNTs) have been considered as an ideal reinforced material to improve the mechanical performance of many materials. CNTs offer an attractive reinforcement material for lightweight a n d high-strength metallic matrix composites.

Key words: *copper, CNT, powder metallurgy*

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INTRODUCTION

The fine powders of copper and carbon Nano tubes used for producing the composite component for application point of view. Reinforcement of Nano particles on the matrix material such as Al, Mg, improves the wear resistance, damping property and mechanical strength of a composite material. CNT improves the strength, stiffness and thermal property of the base metal Al2024, it shows improvement in damping property at high temperature. The quantity of

reinforcement changes the topology and microstructure of the base material. CNT reinforced NiTi composite highly used for a load carrying property. Carbon Nano tube andnickel composite produced by plating method for field emission cathode because it provides good stability and low threshold electric field [1]. To enhance the desire thermal property β- Si_3N_4 whisker reinforced with Cu matrix material, produced by powder metallurgy process. Shows thermal conductivity increased up to 98 w /mK compared to the thermal conductivity of pure copper [2]. Metallic glass powders with cu /Ni base amorphous alloy powders are synthesized by SPS technique shows the improvement in strength compared to monoethilic MGs 10% of strength improved in cu and 20% of strength improved for Ni base alloy [3]. Cu based bulk metallic glass composites reinforced by TiC shows the improvement in yield and fracture strength. Also ductility and hardness was improved up to 25% [4]. Titanium reinforced Cu based composite material developed by powder metallurgy process to achieve the desire thermal conductivity, it gives the suitable thermal conductivity and coefficient of thermal expansion of 5.4 W/m K was obtained [5].Copper/SiC composite material has been produced by powder metallurgy process to achieve the desire hardness and strength. Special sputtering process used to improve the interfacial strength between copper and SiC. SiC was coated by Mo, then the Cu/SiC composite material produced by hot pressing technique [6].Copper based CNT coating provided on the silicon substrate by the technique of super critical fluid deposition and electro chemical plating method. This process reduces the thermal resistance up to 8.4W/m K. In this process both thermal and bulk resistance were decreased [7]. Ni based CNT composite deposited on the carbon steel by coating process to investigate the wear and friction behavior of composite material with the composition of CNT. Wear rate is increased by increasing the content of CNT wt% in the composite material [8]. However its extensive application are limited by the low mechanical property and wear resistance. CNT reinforced copper metal matrix composite has application in electronic field ,wear resistance and heat resistance material, brush and torch nozzle material[9].

MATERIAL CHARACTERISTICS

Copper with purity 99% commonly used in the application of friction components,

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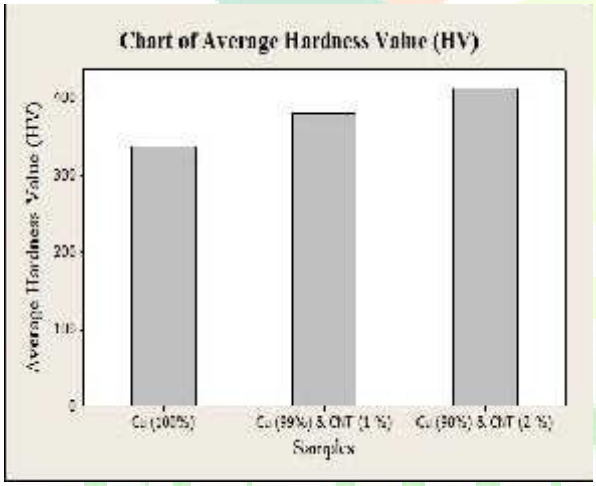
decorative application, thermal management and electrical contact materials. Density of copper is 8.94g/cc, rest of 1% contain Fe components. Particle size of copper around 35 to 40µm.Carbon Nano Tube used as the reinforcement in the composite havingdensity of 0.37g/cc, diameter about7-12nm.

EXPERIMENTAL PROCEDURE

Multi walled CNT were production by chemical vapor deposition method. To improve the CNT dispersion in the composite it was ball milled up to 6 hrs. The composite mixture was then compacted using hydraulic press. The dimension of copper matrix composite after compaction is 30mm×10mm. After



compacting green composite pieces are sintered in presence of Argon gas at 900°C. Micro hardness of the composite determined by Vickers hardness indenter using 0.3kgf load and 5sec dwell time. Corrosion test carried by salt spray method.

RESULT AND DISSCUSSION

Vickers Micro Hardness

Hardness of composite measured using Vickers hardness method under the load of 3kgf.Five measurements were taken along the composite and average hardness value calculated.

Table.1.Examined Vickers Micro Hardness

Volume fraction (%)	Micro Hardness(HV)
Pure Cu	338
Cu + 1% of CNT	381.6
Cu + 2% of CNT	413.4

Result shows CNT reinforcement greatly improves the hardness property. Hardness value of pure copper composite is 338HV. Hardness value improved from 338HV to 413.4HV. CNT reinforcement improves the hardness up 81.7% comparing with pure copper. Cu is a soft material CNT leads it

to harder material. Hardness value of composite tabulated on table1.

Fig.1.Hardness Vs Volume % of CNT

CORROSION BEHAVIOUR

Salt spray corrosion carried out on the specimen for 48 hrs. From this corrosion rate greatly decreases while improving the volume

% of CNT due to its corrosion resistive

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property. Corrosion vale for the specimen given table2.

Table.2.Corrosion Rate of Composite

Volume Fraction (%)	Corrosion rate (gm)
Pure Cu	0.87
Cu + 1% of CNT	0.13
Cu + 2% of CNT	0.05

Corrosion résistance rate improved from 0.87 gm to 0.05gm.

CONCLUSION

Cu based CNT composite were fabricated by powder metallurgy process. Compacting process take place at 400MPa.After this process green composite was sintered at 900°C, due to this hightemperature mechanical property of composite were increased. Hardness improved from 75.4HV. Vickers micro hardness improved with improve in volume fraction of CNT and also corrosion resistance improved with increase in CNT content in the composite.

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