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STUDIES ON MECHANICAL AND DRY SLIDING WEAR BEHAVIOR OF NICKEL COATED MULTIWALLED CARBON NANOTUBE (NMWCNTs) REINFORCED ALUMINUM (7075)

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Abstract - *Recent demands on advance engineering domains are satisfied by the new generation of hybrid nano metal matrix composites (HNMMCs). The demands are reached due to their improved performance characteristics, reduced production cost and optimistic weight reduction factors. The behavior of these hybrid-nano metal matrix composites is depends on the mechano-chemical combination of different reinforcing particles with the metal matrix also the process parameters are associated while synthesis of composite materials.*

This research work is an attempt to study the series of different combinations of Nickel coated multiwalled carbon nantotube (NMWCNTs) (0.5 to 1.5 wt.%) reinforced aluminum 7075 prepared by stir casting process and major development of) characterization techniques on control of mechanical and tribological properties, microstructure study and also corrosion behavior are discussed and also the improvement on this research field are suggested.

Key Words: Multiwalled Carbon Nanotube, Hybrid Nano Metal Matrix Composite, Aluminum Al(7075)

1. Introduction to MWNCNT & Al- (7075)

Alloy 7075, a cold finished aluminum wrought product, has the highest strength of all aluminum screw machine alloys. The -T6 and -T651 tempers have a typical tensile strength of 83 ksi, which is higher than many mild steels. Due to its very high strength, alloy 7075 is used for highly stressed structural parts. Applications include aircraft fittings, gears and shafts, fuse parts, meter shafts and gears, missile parts, regulating valve parts, worm gears, keys, and various other commercial aircraft, aerospace and defense equipment. Rod and bar product forms can be machined on multi-spindle and CNC machining equipment[1-2].

Multiwalled nano-tubes (MWNT) incorporate to the numerous bowled layers or concentric tubes for the graphene. From the football version off multiwalled nano-tubessian Doll ideal, sheets of graphite are prepared in concentric cylinders, e.g., a (0,8) unmarried-walled nanotube (SWNT) interior the graphite are of 3.4A rangly.

2. Literature Review

Wanhill RJB [1]:-In his paper he mentioned about the fatigue fracture homes of aerospace aluminum alloy the determined that combination of alloys with aluminum suggests the specific and superb bring about power of fabric, melablity of fabric so the chart of the mixture of alloy and there fatigue fracture residences in metallic shape guide of fatigue crack propagation in metal systems

Hatch jon E [2]:-In their paper He particularly contributed to speak approximately metallurgy & homes of aluminum alloys taking the refrences of Wanhill RJH . He found that boom in carbon ratio of MMC in Al7075.

B.S Pravin Kumar [3]:-In their paper he evaluated the mechanical homes to aluminum alloy 7075 might be covered through many different substances however mainly they concentrated approximately matrix and reinforcements as Al7075, Sic & crimson dust respectively with having an percentage (zero.zero%-2.0%) respectively as the proportion of reinforcement changed into growth from one grade to any other grade there was growth in hardness of material

Vinitha and B. S. Motgi [4]:-In their paper, understanding to mechanical houses of Al7075 may be bolstered through many different materials however especially they focused about matrix and reinforcements as Al7075, Sic, Flyash, & red dust respectively with having an percentage (zero.zero%-2.0%) respectively as the percentage of reinforcement become increase from one grade to any other grade there has been increase in hardness of materialInt

Brenner and Riddel [5] :-This paper gives a review and Discussed about the electroplating and electroforming process using coating as hypophosphite reduction. Process using sodium borohydride reduction were developed. The deposition coating on both metal and non-metal was investigated Interest in electroless nickel plating has continued unabatedly since itsinvention

Zeeler R.L III andSalvati [6]:- The small amounts of additives are usually used toprovide improved deposition rate, throwing power and brightness, finer grain structureand better corrosion resistance. Since electroless nickel plating

process is chemical reduction of nickel ions to the nickel results from the presence of reducing agent in this solution, it always concerns with hydrogen evolution during the plating process and formation of porous surface. Toward remove these hydrogen from the surface of substrate and to produce pit free nickel deposits

Wurtz [7]:- He discovered the deposition of power form metallic nickel from an aqueous solution of its salts reduction of sodium hypophosphite. He started to develop a practical system led to application of the electro less nickel technology.

Veeresh Kumar [8]:- They mainly concentrated that the micro-hardness (HV) of Al 6063-SiC and Al 7075-Al2O3 composites increased with the percentage of filler addition and that of Al 7075-Al2O3 composites was observed more as compared to that of Al 6063-SiC composites.

R. Rox; Karp, Jeffrey M [9]:-Approximately 10% of the population in the USA suffer from nickel allergy, and many are unable to wear jewellery or handle coins and other objects that contain nickel. Many agents have been developed to reduce the penetration of nickel through skin, but few formulations are safe and effective. Here, we show that applying a thin layer of glycerine emollient containing nanoparticles of either calcium carbonate or calcium phosphate on an isolated piece of pig skin (in vitro) and on the skin of mice (in vivo) prevents the penetration of nickel ions into the skin. The nanoparticles capture nickel ions by cation exchange, and remain on the surface of the skin, allowing them to be removed by simple washing with water..

Gennett, Dillon, Alleman, Jones, Hasoon et al. 2000 [10]:- Deposition of aligned bamboo-like carbon nanotubes via microwave plasma enhanced chemical vapor deposition. Their research is in the area of field emission and field-enhanced ionization properties of the CNTs. Their work suggests that CNTs form via a continual growth and renucleation mechanism that is taking place. There appear to be two competing processes: the growth of the multiwalled segments, and renucleation of subsequent segments

Smith and Luzzi. [11]:- He discarded Although various fullerenes can be produced using different ways of vaporizing carbon, followed by condensation of the tiny clusters, the presence of an electric field in the arc discharge seems to promote the growth of the long tubules. In addition, a small amount of transition metal powder (i.e. cobalt, nickel, or iron) seems to favor growth of SWNTs. Here the metal clearly serves as a catalyst, preventing the growing tubular structure from wrapping around and closing into a smaller fullerene cage. The presence of the catalyst also allows one to lower the operating temperature.

Cohen, Rein, Vaykhansky and Porter [12]:- IN his research he found that. At low concentrations, the amount that was used was too low to produce an efficient coating and induce electrostatic repulsions that could counterbalance the interactions. At too high of concentrations, suspensions occurred and the material was multiple phase. At intermediate concentrations, the SWNTs were homogeneously dispersed and formed a single phase. Ribbons were washed and the additives desorbed. From this material they made fibers with diameters ranging from a few micrometers to 100 μm. The SWNT fibers exhibit plastic flow at RT before they break, possibly from the displacement of the NTs within the fibers. In the elastic regime found that the E ranged from 9 to 15 GPa – although far weaker than the modulus of individual NTs, an order of magnitude greater than that of high-modulus bucky paper.

Che, Lakshmi, Martin and Fisher [13]:- Controlled synthesis of vertically aligned carbon nanotube patterns, grown under patterned metal layers on silicon substrates by combining chemical-vapor deposition and conventional lithography. We show that the metal patterns lift up by vertically aligned nanotubes during growth. This lift-up growth links the thin-film metal patterns and the silicon substrate via nanotube assemblies, giving the possibility of creating nanotube architectures in 3 dimensions

Eklund and Saito.[14]:- An economic way to produce massive CNT arrays is the CVD process using a precursor of a carbon source and a metal catalyst containing metallocene. This method does NOT require predeposition of the catalyst and tubes grow everywhere on the substrates. If one needs to adapt this method to growing NTs in well-specified locations on the substrate (for example, for field emission and other device applications), then the idea of substrate-site selectivity needs to be explored.

Yakobson and Smalley.[15]:- Rice group used laser vaporization of carbon target, with a cobalt-nickel catalyst, and achieved 70-90% efficiency. They used two laser pulses 50 ns apart so that the growth conditions can be maintained over a larger volume and for a longer time. This method of NT production has had the largest impact on the field.

Petit et al.[16]:- He coupled the effect of Electric-arc technique to make SWNTs close-packed in bundles. High-yields (70-90%) of SWNTs close-packed in bundles can be produced by laser ablation of carbon targets. The method (electric-arc) used here is cheaper and easier, but previously had only low yields of NTs. They show that it can generate large quantities of SWNTs with characteristics similar to those obtained by laser ablation. Synthesis times for their method is 2 minutes.

Vencl A et al.[17]:- in this paper MMc was made using A356 aluminum alloy one of the most common alloy. He used Sic-graphite mixture the MMc shows different behavior than A356 which has has strength than A356.

Mainly he discovered that as the ratio of graphite-Sic increased in the ratio there directly relation in hardness of MMC

B.K. Prasad.[18]:- they study mainly on the Microsturcture and dry sliding wear test on MMC. Which is made up of Matrix & reinforcement as Al7071 with Sic and Carbon Nano Tube. The magnification is of certain load with electrodeposition of nickel on it. Mainly he discovered that as the ratio of graphite-Sic increased in the ratio there directly relation in hardness of MMC

M.D. Berm [19]:- They wrote an excellent review paper about the theoretical analyses Microsturcture and dry sliding wear test on MMC. Which is made up of Matrix & reinforcement as Dry and lubricated wear resistance of mechanically-alloyed aluminum-base sintered composite the magnification is of certain load with electrodeposition of nickel on it. Mainly he discovered that as the ratio of graphite-Sic increased in the ratio there directly relation in hardness of MMC

S.A. Sajjadi et al.[20]:- He gave nice review on the topic of Microstructure and mechanical properties of Al– Al2O3 micro and Nano composites fabricated by stir casting. Where he discovered that ctir casting process may contain more voids than other casting process. EDM shaping of material was carried out but due to much voids in MMC manufactured through stir casting.

3. CONCLUSIONS

As the ratio (percentage) from 0.0% to 1.5% the wear rate is decreases as respectively .The time vs wear, coefficient of wear, frictional force shows the actual idea of the wear ratio. As we know that the hardness test, corrosive test, wear test shows high dry sliding between MMC prepared. Due carbon nanotube in mixture there is mixture there is much and good results in hardness, corrosive and wear test the SEM of the wearied specimen of 0.0% and 1.5% is given with magnification of 250,500, 1000, 1500 with minimum and maximum ratio obtained. Though the From the first three graphs of time vs wear rate, coefficient of fiction, frictional force, using condition A we understand the fact that the wear rate is comparatively higher. Al7075 0.0%CNT has wear 1047 micrometer and friction force 5.46 while coefficient of a friction is 0.2984 as given in study. Al7075 1.5% CNT has maximum coefficient of friction while Al7075 0.0% CNT shows lowest among the specimens in both condition A & B

As we know that Al7075 1.5% CNT has maximum coefficient of friction while Al7075 0.0% CNT shows lowest among the specimens in both condition A & B so scanning electron microscopic study was undertaken the pictures here is obtained at 250,500,1000,1500 magnifications

REFERENCES

[1] Wanhill RJB Techno-economics of carbon nanotubes manufactured by exposed air arc discharge technique by, S. SenthilP Saravanan, S.P. Kumarsh Babu*, K. Sivaprasada, M. Jaganatham

[2] Hatch jon E- American Society for metallurgy & engineering (ASME), Metals Park, OH, u.s.1998

[3] Ajaayan, P.M.C, Ebbesen, T.W, Chawala, Ichihasi, T., Iijima, S., Tanigaki ,K., Hura, H. BS Praveen kumara 1993. Inaugural carbon nanotubes through oxygen besides implications for filling, Nature, Vol. 362, pp 522-525.

[4] Height M.JB., Howard texter J.B., Tester J.W W., Vander Sande J.B. 2004. Spark combination of single-walled carbon nanotubes, Carbon, Vol.42, 5, pp 2295–2307.

[5] The deposition coating on both metal and non-metal was investigated in1957-1958. by Brenner and Riddel (Riedel, 1991).

[6] Zeeler R.L III andSalvati Safety and Conservational for producing MMC Safety,Vol.324(2006),P.$35(in Chinese)

[7] WenYU-xingWang., Wurtz Electroplating and Dying, Vol.337(2011),P.42(in Chinese)of Engineering Research and Applications, Vol. 2, Issue 2, Mar-Apr 2012, pp.111-114.

[8] Perotti G, Kapai N (1990) Roll pass design for round bars. CIRP Ann Manuf Technol 39(1):283–286

[9] Nickel Electroplating by way of George Di Bari in the ASMDDHB Handbook, Volume 5, Surface finishing Engineering, issued by ASMDDHB Universal, Materials Park, OH 440738, 1994, page 201, and reproduced with the permission of the publisher.

[10] Chena,W.X.; Tuy, J.P.;Wanng, L.Y.; Ganu, H.Y.; Xu, Z.D.; Zhuang, X.B. in 2003 October 17, TOKYO, JAPAN 2003

[11] Hsu,R SW.K., Hare, J.P., Terrnes,M., Kroto, H.W., WaltonD,D.R.M., YHarris,P.J.F. 1995. Summarized stage nanotubes, Nature, Vol.377, pp 687.

[12] Hahnis J., Hamis J.H., YooFuu J.-E., Jung H.Y., Suhsa J.S. 2004. New continuous gas-phase combination of high concentration carbon nanotubes by a thermal plasma jet, Carbon, Vol.42*,, pp 877–883.

[13] Jouurnet, C., Maser, W. K., Bernier, P., Loiuseau, A., Laumy de la Chappelle, M., Lefyrant, S., Deniatrd, P., Lee, R. Fischeer, J. E., 1997. Large scale production of singlewalled carbon nano-tubes by the electric-arc technique Nature, Vol. 388, pp 756-758.

[14] S.K. Sajjjadi and S.M. Zebaarjad, 8 (2010) "Powder Metallurgy" 71–78.

[15] Yakobson and Smalley ASMDDHB Handbook, Volume 5, Surface finishing Engineering, issued by ASMDDHB Universal, Materials Park, OH 440738, 1994, page 201

[16] Petit et al. (2011) Microstructure and studies related to ASME Vol. 2, Issue 2, Mar-Apr 2012, pp.111-114

[17] Vencl A et al , Mazahery A et al., (2011) "Development of high-performance A356/nano-Al2O3 composites", Mater Sci Eng; 518:61–4

[19] M.D. Bermudez et al., (2001) "Dry and lubricated wear resistance of mechanically-alloyedaluminum-base sintered composites" Wear 248; 178–186.

[20] S.A. Sajjadi et al., (2011) "Microstructure and mechanical properties of Al– Al2O3 micro andnano composites fabricated by stir casting" Materials Science and Engineering A 528; 8765– 8771..