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A REVIEW ON THE THERMAL BEHAVIOUR CARBON NANOTUBES REINFORCED HYBRID METAL MATRIX COMPOSITES

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Abstract— *This review paper focuses on the powder metallurgy pathway for synthesizing carbon nanotube reinforced materials with light material matrix composites. In this paper various forming methods has been utilized for the production of different composite materials. The superplastic forming plays an imperative role in the production of complex shapes in the aluminium alloys is reviewed. It is found that the optimum conditions to attain maximum formability along with minimal forming time.. This paper is also discusses the effect of mechanical and microstructural qualities.*

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Keywords — Carbon Nanotubes; Powder Metallurgy; Multi-Walled Carbon Nanotubes; Sintering

I. INTRODUCTION

Nanotechnology is defined as the study and use of structures between 1 nanometer and 100 nanometers in size. To give you an idea of how small that is, it would take eight hundred 100 nanometer particles side by side to match the width of a human hair. Scientists have been studying and working with nanoparticles for centuries, but the effectiveness of their work has been hampered by their inability to see the structure of nanoparticles. In recent decades the development of microscopes capable of displaying particles as small as atoms has allowed scientists to see what they are working with. The following illustration titled The Scale of Things‖, created by the U. S. Department of Energy, provides a comparison of various objects to help you begin to envision exactly how small a nanometer is. The chart starts with objects that can be seen by the unaided eye, such as an ant, at the top of the chart, and progresses to objects about a nanometer or less in size, such as the ATP molecule used in humans to store energy from food. The ability to see Nano-sized materials has opened up a world of possibilities in a variety of industries and scientific endeavors. Because nanotechnology is essentially a set of techniques that allow manipulation of properties at a very small scale.

II. METAL MATRIX COMPOSITES

A metal matrix composite (MMC) is composite material with at least two constituent parts, one being a metal necessarily, the other material may be a different metal or another material, such as a ceramic or organic compound. When at least three materials are present, it is called a hybrid composite. MMCs are made by dispersing a reinforcing material into a metal matrix. The reinforcement surface can be coated to prevent a chemical reaction with the matrix. For example, carbons are commonly used in aluminium matrix to synthesize composites showing low density and high strength. However, carbon reacts with aluminium to generate a brittle and water-soluble compound Al4C3 on the surface of the fiber. To prevent this reaction, the carbon fibers are coated with nickel or titanium boride

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III DIFFUSION PROCESSES DOUBLE DECOMPOSITION

Dilip S Sundaram,Grant A Risha and Vigor Yang (1) studied that combustion of aluminium-ice mixtures is controlled by diffusion processes across the oxide layers of particles.A multizone theoretical framework is established to predict the burning rate and temperature distribution by solving the energy equation in each zone and matching the temperature and heat flux at the interfacial boundaries. The burning Rates are measured experimentally by burning aluminium-ice strands in a constant-volume vessel. Hongjie Dai (2) studied that the growth directions of the nanotubes can be controlled by Vander walls self-assembly forces and applied electric fields. The patterned growth approach is feasible with discrete catalytic nanoparticles and scalable on large wafers for massive arrays of novel approaches. The unique physical properties of molecular scale or Nano scale solids, when utilized in conjunction with the remarkable biological electronic devices including probes and sensors.

IV DOUBLE DECOMPOSITION

S.lakshmi Reddy, T.Ravindra Reddy and Ray.L.Frost (3) find out that synthesis of magnesium oxalate Nano particles was carried out by double decomposition of magnesium particles. The powder resulting from this method is pure and possesses distorted rhombic octahedral structure. Structural elucidation was carried by employing X-ray diffraction particle size and shapes were studied by TEM. 10 S.Demircipray pyrolysis and sol gel pyrolysis techniques. Particle size, surface area and band gap width can be determined by Xray diffractometer and scanning electron microscope. Both the flame spray pyrolysis and sol , F.Bakal and T.Batar (4) suggested that Nano scale aluminium particles can be synthesized by means of flame s gel method will make the Nano particles degraded under the UV light radiation light with small differences.

V SYNTHESIS OF NANO PARTICLES

Shiva Salem (5) concluded that the study of magnesium nanoparticles is achieved in Nano scale in the wide range of ph 2.5-10.5. The obtained powders were calcinated at 600,800,1000 and 1200°C and characterized by X-ray diffraction ,Transmission electron microscope and elemental analysis method. The results indicated that the physico-chemical characteristics of products are strongly influenced by the ph of the synthesis environment. The Nano sized aluminium powder with negligible amounts of impurities can be synthesized in a neutral environment in a temperature of lower than 1000°C. . Sami Ullah Rather (6) studied that little amount of magnesium nanoparticles formed due to the presence of easy oxidation of magnesium even though all precautions were taken to avoid oxidation of the sample. Recrystallized magnesium nanoparticles were analyzed by TEM, SEM and X-ray diffraction techniques. The peak diameters of particles were estimated from size distribution analysis of morphological data. The difference in the morphology and size of magnesium nanoparticles formed in a different reaction environment is attributed to the structure and binding of the ligands to the metal particles. 11

Dong Ju Moon and Sang Woo Kim (7) studied that magnesium compound Nano architectures with controlled shape were prepared through carbonization reaction of magnesium hydroxide and carbon dioxide in superficial carbon dioxide ethanol mixtures were discussed.the morphologies of the product architectures were artificially controlled by the phase transition driven morphological changes.The magnesium oxide Nano structures with high surface area were formed by decarburization after further heating at 600°C. T.P.Sumangala ,B.N.Sahu and N.Venkataramani (8) studied that stoichiometric and non-stoichiometric

magnesium were synthesized by sol gel combustion method resulting in nanocrystalline powders with size ranging from 10 to 100nm.one part of the powder were calcinated in liquid nitrogen and other part is furnace cooled.Electrical response of these magnesium nano particles was found to be greater than that for the stoichiometric magnesium ferrite.

Charalampos Mandilas and George Karagiannakis (9) confirmed that the aluminium nano particles can be achieved via rapid melting and vapourization of the initial micrometric particles and their subsequent re-nucleation.A custom related mantle system was designed and developed with the aid of relevant simplified CFD simulations. The particles formed were collected with the aid of quartz filter downstream of the plasma flame and the production rate were achieved. 12 N.M. Deraz (10) confirmed that Copper ferrite nano-crystals were synthesized by a combustion route depending upon the glycine–nitrate process and also by ceramic method. The samples were characterized by infrared radiation (IR), X-ray diffraction (XRD), scanning electron micrograph (SEM), transmission electron micrograph (TEM) and vibrating sample magnetometer (VSM) techniques. On the other hand, the combustion method displays magnetic copperferrite in the range of nano-scale comparing of bulk ferrite prepared by ceramic route.

VI MICROSTUCTURE ANALYSIS

Hafeez Ahamed and V.Senthil Kumar (11) studied that High-energy wet ball milling was successfully employed to synthesize nano-crystalline Al 6063 alloy powders reinforced with 1.3 vol.%Al2O3, 1.3 vol.%Y2O3 and 0.65 vol.%Al2O3/0.65 vol.%Y2O3 at nano-size level. Using Williamson–Hall equation, crystallite size and lattice strain of various aluminium composite powders were estimated with broadening of XRD peaks. High-energy wet ball milling method used for the preparation of nano-composite powders with nano particles reinforcement, resulted in refined microstructure and randomly oriented interfacial grain boundaries which is the characteristic of particles at steady-state condition. S.Chandrasekaran (12) confirmed that the copper nanoparticles has the influence of calcined temperature on crystalline size, purity, morphology, structural phase transition and stoichiometric formation of copper oxide powders were investigated by using powder X-ray diffraction, Scanning Electron Microscopy and X-ray Photoelectron Spectroscopy (XPS). The maximum overall conversion efficiency of 0.863% has been achieved from I to V characteristic study in favor of copper oxide 13 nano particles calcined at 400°C. The route utilized makes if possible to produce highly pure materials at greatly reduced production cost, thus offering great opportunities for the sale-up semiconductor nano structured materials.

T.Rajmohan ,K.Palani kumar and S.Arumugam (13) studied that The application of nano-sized particles is increasing because it strengthens the Metal Matrix composites (MMCs) and maintains the ductility of the matrix alloy. The present investigation deals with the synthesis and characterization of hybrid aluminium matrix reinforced with micro SiC particles, and nano copper oxide (CuO) particles prepared by sintering process. Microstructure and mechanical properties such as tensile strength, microhardness and density of the composites are examined. Microstructure of the samples has been investigated by using scanning electron microscope (SEM), X-ray diffraction (XRD) and Atomic Force Microscope (AFM). The results indicated that the increase in weight% of nano CuO particles improves the mechanical properties. S.Demici ,T.Batar and F.Bakal (14) confirmed that nano-scale magnesium oxide particles were synthesized by means of flame spray pyrolysis and sol–gel techniques. In order to determine photo catalytic activity of the nano-scale particles, aqueous methylene blue (MB) solutions were employed. It was found that both flame spray pyrolysis and sol–

gel synthesized MgO nano-scale particles exhibited appreciable photo catalytic activity for the degradation of MB dye under UV light irradiation with small differences. Moreover, the effects of particle size and surface area on the photo catalytic properties were investigated in detail

VII CHALLENGES & CONCLUSION

From the literatures various forming methods has been utilized for the production of different composite materials. From these the superplastic forming plays an imperative role in the production of complex shapes in the aluminium alloys. From this research it is proposed that superplastic forming of composites along with its process parameters can be determined. In addition to that the prediction of failure of the composite materials during superplastic forming is very limited from this research. From this research we can able to find the optimum conditions to attain maximum formability along with minimal forming time.

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