Mechanical Properties of Aluminium And Magnesium With The Effect of 6% Zinc Oxide Nano Particles

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Abstract- *In the present scenario nanoparticles had wide range of applications which encourages the need for synthesizing them but, the normal methods are usually unsafe and hard. This leads to pay attention on green synthesis of nanoparticles which are capable, non-polluting and energy saving. In this analysis the green synthesis of zinc oxide nanoparticles was achieved by using peels extract of Pomegranate as a reducing agent and their antimicrobial activity. The nano synthesis was observed with different ranges of temperature, time period and concentration of peels extract. This method has been used as a reducing material as well as surface stabilizing agent of the synthesis of spherical shaped zinc oxide nanoparticles.*

The developed zinc nanoparticles were mixed with the Aluminum, generally Aluminum have low-density and weightless. To increase the bearing strength and thermal conductivity of Aluminum, the Zinc nanoparticles were mixed with different weights (1.0%, 3.0%, and 6.0%) with Aluminum are to determine the Mechanical properties by the performance test. The performance test was achieved by comparing the mixed Zinc nanoparticles to the Aluminum with the pure Aluminum metal. By examining the result acquired from Mechanical properties (Wear test) future applications can be developed

Keywords- nanoparticles, Aluminium,Magnesium, ZnO , Punica granatum

I. INTRODUCTION

Nanotechnology emerges from the physical, chemical, biological and engineering sciences where new techniques are being developed to probe and manoeuver single atoms and molecules for multiple applications in different field of scientific world. In nanotechnology, a nanoparticle is defined as a small object that behaves as a whole unit in terms of its transport and properties. The science and engineering technology of Nano systems is one of the most exigent and fastest growing sectors of nanotechnology.

In the recent years, due to the advancement in Science and technology researchers have attempted to synthesize nanoparticles within the size range of 100 nm and this extensive research and concern on nanoparticles is widening due to their potential application in wide areas of science and technology. Zinc oxide belongs to the class of metal oxides, which is characterized by photo catalytic and photo-oxidizing capacity against chemical and biological species.

The progress of technology and quality of life of mankind has always been closely knit with the progress in material science and material processing technology. Most techniques applied in material processing are based on breaking up large chunk of a material into desired shapes and sizes, inducing strain, lattice defects and other deformations in the processed material. Recent developments and findings in nanotechnology and the demonstration based on various quantum size effects in Nano scale particles, reveals that most of the novel work and devices of the future will be based on the properties of nanomaterial. Each nanoparticle contains only about 3-107atoms/molecules. The traditional material processing techniques that induce lattice defects and other imperfections will no longer be diluted for synthesis of nanoparticle by unmitigated number of atoms. Furthermore, the application of traditional approach imparts difficulties for synthesis of such small particles in a desirable size range.

Alternative synthetic technique for nanoparticles involves controlled precipitation of nanoparticles from precursors mixed and dissolved in a solution. A micro suspension can also be formed using surfactants between two immiscible liquids, with the reactionary isolated inside a colloid, through hydrophobic versus hydrophilic forces. The resultant nanoparticles form a micro colloidal suspension. Various factors such as thermodynamic determinant as well as Vander-Waal’s forces induce particle growth and accumulation, resulting in bigger particles that settle

II. LITERATURE SURVEY

studied the green synthesis of zinc oxide nanoparticles was carried out using peels extract of Punica granatum as a reducing agent and their antimicrobial activity. The Nano synthesis was monitored under different range of temperatures, radiations, time periods and concentration of peels extract. The optimized Nano zinc thus obtained was quantified and characterized using UV-Visible Spectroscopy, Scanning Electron Microscopy. Stability of reduced zinc oxide nanoparticles was analyzed using UV Visible spectra shown that the absorption peak, occurring due to surface Plasmon resonance, exists at 364nm and their antimicrobial activity was screened against microbial culture.

It can be seen that the percentage of Magnesium is also varying a lot across the samples, especially in the samples which were cast later. This is a significant variation given the fact that no Magnesium was added during casting. However, this may be due to the Magnesium already present in the Aluminium taken for the study and separation of the same during melting in the furnace.

From the above literature survey we conclude that the use of the compositions of the resultant alloys was varying across different samples especially with respect to Magnesium content. The presence of higher amount of Manganese in the Aluminium-Magnesium alloy had a positive result on wear test.

III. MATERIAL AND METHODOLOGY

PREPARATION OF NANOPARTICLES

1. In terms phase of medium for preparation
Gas phase/ Liquid phase/ Aerosol phase/ Solid phase
2. In terms of method of "monomer" preparation

1) Physical/Chemical Read already published work in the same field.
2) Goggling on the topic of your research work.\

PHYSICAL PREPARATION ELECTRICALLY

1)Heated generators
2)5-500Torr

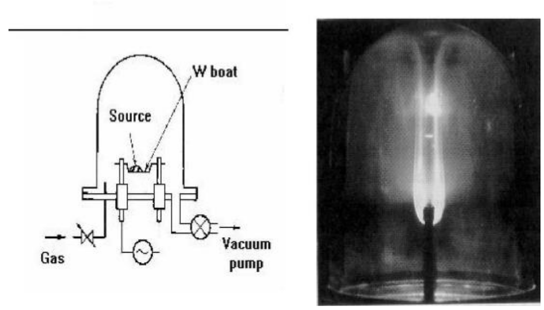


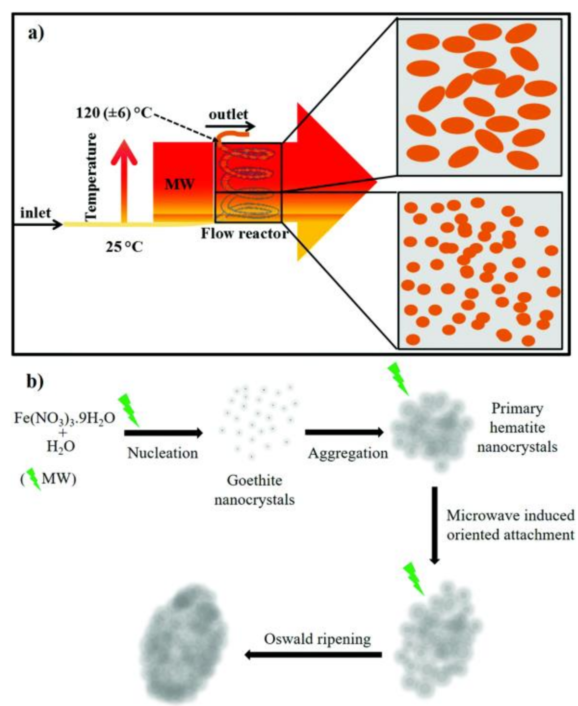
Fig: -Systematic Diagram of Physical Preparation Method

- Electrical heating for evaporation of bulk materials in tungsten h pressure inert gas (He, Ne, Xe).
- Transported by convection and thermophoresis to cool environment.
- Subsequent nucleation and growth.
- Suitable for substances having a large vapour pressure at in term up to about 1700℃.

Disadvantages

The operating temperature is limited by the choice.

Evolved to flow process using tubular reactor placed in electricity.

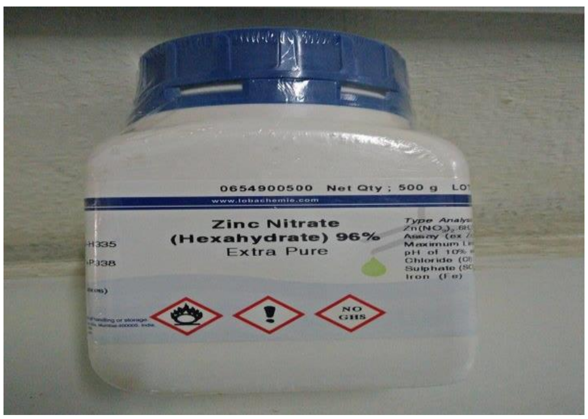


Process for the Preparation of Nanoparticles by Physical Method

III. EXPERIMENTAL SET UP AND PROCEDURE OF ZINC OXIDE NANOPARTICLES PREPARATION

Material Used for Preparation of Zinc Oxide Nanoparticles

Dry Punica Granatum Peels



Zinc Nitrate

Properties of Zinc Nitrate

Zinc nitrate is an inorganic chemical compound with the formula $Zn(NO_3)_2$. This white, crystalline solid is highly deliquescent and is typically encountered as a hexahydrate $Zn(NO_3)_2 \cdot 6H_2O$. It is soluble in both water and alcohol. Zinc nitrate is usually prepared by dissolving zinc in nitric acid, this reaction is concentration dependent, with a reaction in concentrated acid also forming ammonium nitrate:

$$Zn + 2\,HNO_3\ \text{(diluted)} \rightarrow Zn(NO_3)_2 + H_2$$

$$4\,Zn + 10\,HNO_3\ \text{(concentrated)} \rightarrow 4\,Zn(NO_3)_2 + NH_4NO_3 + 3\,H_2O$$

On heating, it undergoes thermal decomposition to form zinc oxide, nitrogen dioxide and oxygen.

$$2\,Zn(NO_3)_2 \rightarrow 2\ \text{Zinc oxide} + 4\,NO_2 + O_2$$

Zinc nitrate has no large scale application but is used on a laboratory scale for the synthesis of coordination polymers,[1] its controlled decomposition to zinc oxide has also been used for the generation of various Zinc oxide based structures, including nanowires. It can be used as a mordant in dyeing. An example reaction gives a precipitate of zinc carbonate:

$$Zn(NO_3)_2 + Na_2CO_3 \rightarrow ZnCO_3 + 2\,NaNO_3.$$

Procedure for Preparation of Zinc Oxide Nanoparticles

Punica granatum peels powder weighing 5gm were thoroughly washed in distilled water, and mixed in to 100ml sterile distilled water and filtered through Whatman No.1 filter paper.

For the synthesis of nanoparticles 50ml Punica granatum of peels aqueous extract was taken and boiled to 60-80˚C using a stirrer heater. 5 grams of zinc nitrate was added to the solution as the temperatures reached 60˚C.

This mixture is then boiled until it reduced to a deep brownish yellow colored paste. This paste was collected in a ceramic crucible and heated in an oven at 90˚C for 8 hours. Turmeric yellow colored powder was obtained and this was carefully collected and packed for characterization purpose. The material was mashed in a mortar-pestle so as to get a fine nature for characterization.

Product Formation Mechanism

$Zn(NO_3)_2$ and the peel extracts of Punica granatum were mixed in distilled water. When this mixture was heated to 60-80 °C, initially the wet powder undergoes thermal dehydration followed by decomposition of zinc nitrate. Then it ruptures into a flame and yields porous, agglomerated powders. The reaction was self–propagating and the temperature produced was sustained for a length of few seconds.

The probable reaction mechanism of formation of Zinc oxide is as follows Phytochemicals present in peel fruit extracts→reaction with zn ions plant extracts act as reducing and stabilizing agents

EXPERIMENTAL SETUP

5 Grams of Punica Granatum Powder

Filtration of Punica granatum in 100ml Distilled Water

Samples Of Zinc Oxide Nanoparticles

IV. EXPERIMENTAL INVESTIGATION

INTRODUCTION OF ALUMINIUM

Aluminium (In Commonwealth English) or Aluminum (In American English) is a chemical element in the boron group with symbol Al and atomic number 13. It is a silvery-white, soft, nonmagnetic, ductile metal. Aluminium is the third most abundant element in the Earth's crust (after oxygen and magnesium) and its most abundant metal. Aluminium makes up about 8% of the crust by mass, though it is less common in the mantle below. Aluminium metal is so chemically reactive that native specimens are rare and limited to extreme reducing environments. Instead, it is found combined in over 270 different minerals. The chief ore of aluminium is bauxite.

Aluminium is remarkable for the metal's low density and for its ability to resist corrosion due to the phenomenon of passivation. Structural components made from aluminium and its alloys are vital to the aerospace industry and are important in other areas of transportation and structural materials, such as building facades and window frames. The most useful compounds of aluminium, at least on a weight basis, are the oxides and sulfates.

Despite its prevalence in the environment, no known form of life uses aluminium salts metabolically. In keeping with its pervasiveness, aluminium is well tolerated by plants and animals. Owing to their prevalence, the potential beneficial (or otherwise) biological roles of aluminium compounds are of continuing interest.

4.1.1 Introduction of Aluminium (6063- T6) Series

A 6063 is an aluminium alloy, with magnesium and magnesium as the alloying elements. The standard controlling its composition is maintained by The Aluminum Association. It has generally good mechanical properties and is heat treatable and weldable. It is similar to the British aluminium alloy HE9.

6063 is mostly used in extruded shapes for architecture, particularly window frames, door frames, roofs, and sign frames. It is typically produced with very smooth surfaces fit for anodizing.

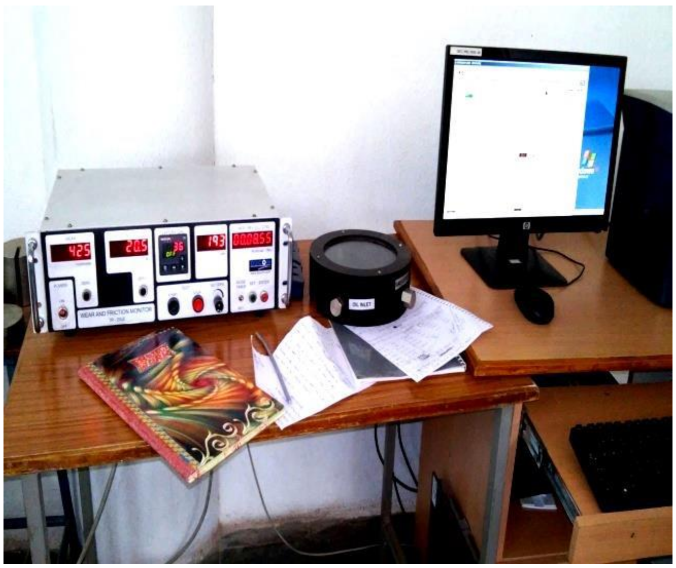
4.1.2 Chemical Composition 6063-T6 Series

Composition	Weight(%)
Al	97.5
Cr	0.1
Cu	0.1
Mg	0.45-0.9
Mn	0.1
Fe	0.35
Si	0.2-0.6
Ti	0.1
Zn	0.5

FIGURES FOR PREPARATION OF SAMPLES

28g of Aluminium

Melting of Aluminium in a Furnace



Display System of Wear and Friction Machine

V. RESULT AND DISCUSSIONS

TRIBOLOGICAL STUDIES

Al-Mg alloys and zinc oxide nanoparticles composites are been used in automobile parts since years. Hence it is required to study the tribological behavior and improvement for such materials. Aiming at these aspects sliding and erosion wear behavior has been investigated

VI. CONCLUSION

Zinc oxide nanoparticles were successfully synthesized by using biological green synthesis method using Punica granatum peel extract. The SEM analysis confirms the formation of Zinc oxide nanoparticles with spherical size of diameter ranging 15 to 20 nm. The XRD study confirms the structure of Zinc oxide nanoparticles and the formation of narrow peaks. At the Bragg's angle of $2\theta=10$ to 90° suggests the face centered cubic nature of the Zinc oxide nanoparticles.

- It has been observed that the tetragonal intermetallic compound Al and orthorhombic intermetallic compound Al-Mg formed across the whole range of Mg additions.
- With increased amount of Mg in the alloy, the average values of dendrite arm spacing and grain size decreased in as cast condition.
- In the range of Mg additions tried, the sample containing 1.5% is seems to be most favourable alloy in terms of wear treatment and friction conditions.
- XRD patterns confirmed the formation of hexagonal Wurtzite structure of ZnO. In addition, XRD results indicates that the crystallite size as well as the intensity of ZnO influenced by its shapes.
- The variation of ZnO nanoparticles in Al-Mg content significantly influenced the friction wear.
- The compositions of resultant alloys were varying across different samples especially with respect to Mg content. This was due to the fact that during melting, the elements got separated and heavier metals move to the lower end of crucible. As a result, the content of this metal was lower in castings done earlier.
- The wear and friction of resultant alloys increased with the addition of Mg.

Finally the addition of nanoparticles will increases the mechanical properties of alloy metals which can be used for preparation of mechanical components, aircrafts. The most important application of nanoparticles is in the automobile manufacturing industry to reduce production costs.

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