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A Research Article on Synthesis of Metal Nano Particles by Chemical Reduction Method

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ABSTRACT

Nanotechnology is an experimental and engineering technology manipulate at the nanoscale, such as in the field of different compound fabric synthesizing, food processing agriculture processing and as well as in medicinal application. Due to their physical and chemical applications the metal nanoparticles have a great interest in research. A variety of physical, chemical and biological method that can be used for the synthesis of the metal nanoparticle. All the methods have positive advantages as well as some obstruction. In this following review we try to explain recent research on the synthesis and various application of metal nanoparticle. We summarized the different chemical reduction method and briefly explain their application.

KEYWORDS: *Metal nanoparticle, chemical reduction method, susceptibility*

INTRODUCTION

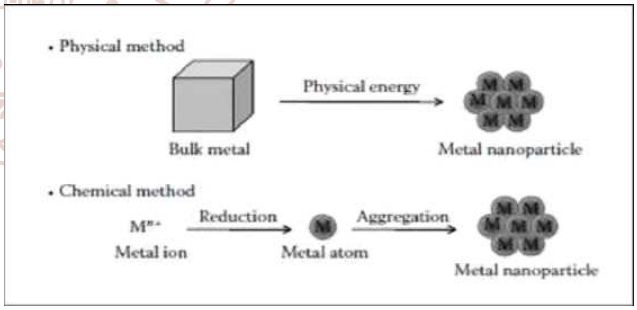
In the current year, increasing the number of publishing paper and show the great interest of engineers and scientist towards the importance of metal nanoparticles such as copper, silver, and gold. The cluster has a particle size of 1-10 nm, which composed of 102-104 atoms. The size of nanoparticles is 10 to 50 which contain in most cases 105-106 atoms however according to the nanoparticles dimension it has a size of 1-9 nm metal clusters are poised of metallic elements it can be single pe of the metallic element or more than one, grouping to the subclass of intermetallic or (nanoalloy) clusters. The establishment of the cluster in the larger size of metal nanoparticles from nanometer to micro dimension known as metal colloids.

Researchers have described different properties metal nanoparticles compared to bulk metals have been discussed are the surface atoms in the cluster, quantum dot and also magnetic properties.

The features of metal nanoparticles

1. The high surface area and volume ratio the presence of surface Plasmon resonance effect; that is important for optical applications.
2. Different physical properties which are respect to the bulk metal. And the surface energy, melting point are particularly receptive to nanoparticle sizes
3. Large surface properties of metal nanoparticles used in nanomedicine for transporting drug in different body tissues and blood cells.

Different chemical method explains in this following review. Most of them are based on the reduction process and they require a precursor that is dissolved in the solvent and reducing agent and the composition depend upon the condition at which reaction is carried out. The surfactant is added to restrict the growing particles from aggregation [1] and it can be divided into two methods for the synthesizing of nanoparticles which are bottom up and top-down. Top-down method mostly used to reduce the size of bulky metals and also in engineering. The other Bottom up method used for the synthesis of nanoparticle which can be combined even in solution or gas phase.



Application of metal nanoparticles in catalysis

Nanoparticle materials have been reviewed in different fields including an electronic, ceramic, colorant, and medical and catalysis. This review is focused on metal catalyst applications Medical technology poised of nanomaterials that is more sensitive, and more flexible when these nanoparticles are used for the purposes of diagnosis or therapy [2]

REVIEW OF LITERATURE

Osman D.and Mustafa M. (2015) [3] studied the synthesis of zinc oxide nanoparticle using Zinc Acetate Dihydrate and Sodium Hydroxide by low temperature aqueous chemical growth method. The hydrothermal technique is low cost for the preparation of good quality and high yield zinc oxide nanoparticle. In hydrothermal technique

Hexamethylenetetramine (HMTA) mostly used as a chemical substance but using Zinc Acetate Dihydrate and Sodium Hydroxide is more affordable cheap and commercially available as compare to Hexamethylenetetramine. This method is simple and does not require calculations after drying. The synthesized nanoparticle is confirmed by the user X –Ray Diffraction method and morphological study of zinc oxide are carried out by Scanning Electron Microscopy (SEM).

Zhang Qiu li et al., (2009) [4] develop a new method in which chemical reduction method used for the fabrication of copper nanoparticles using potassium borohydride as reducing agent. They also studied the effect of temperature, the concentration of CuSO4 and reactant ratio on the size and shape of the synthesized copper nanoparticle. The characterization of the synthesized copper nanoparticle is done by using Scanning Electron Microscopy and size of copper nanoparticle is confirmed by the UV Visible Spectrometer. The temperature of the reaction is maintained at 30 ◦ C and the size of copper nanoparticle is 100nm and spherical shape.

Jingyue H. and Friedrich Bernd [5] studied the synthesis of gold nanoparticle using a chemical reduction method. The gold nanoparticles have a great interest in research due to great properties. The production of gold nanoparticle at a large scale for industrial production is not possible due to the high cost. The chemical method is efficient and simple for the synthesis of purified and spherical gold nanoparticle of good quality and high yield. They studied the citrate reduction process and NaBH4 reduction process in aqueous solution. To improve the purity of the gold nanoparticle Dialysis process is applied as a post treatment. Different technique such as TEM, ICP and Nano trac Wave analyzer used to measure size, shape and high degree purity. The rate of reduction is very important in the synthesis of gold nanoparticle which is controlled by the burst process

Pandey A. and R. Manivannan (2015) [6] studied the synthesis of nickel nanoparticles by chemical reduction technique. In this method hydrazine hydrate act as a reducing agent and PVP as a capping agent. The capping agent PVP concentration increase to decrease the crystal size. The obtained nanoparticle is characterized by X-Ray Diffraction technique and EDX. For the morphological study of nanoparticle used Scanning Electron Microscopy. The SEM analysis state that uniformly spherical particle formed with little trace of oxygen which is analyzed by EDX technique.

Dr. Ritu(2015) [7] studied the synthesis of chromium Oxide nanoparticle's by precipitation method and used ammonia as a precipitating agent. Chromium attracts attention due to different stable oxidation state which formed the different oxide and also important use in science and technology. The characterization of copper nanoparticle's is done by the X-ray Diffraction, Thermo Gravimetric Analysis(TGA), UV-Visible absorption, Infrared Spectroscopy (IR), Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy(SEM). The structure of chromium oxide nanoparticles is hexagonal which is confirmed by the XRD and shape of nanoparticles are carried out by SEM. The size of synthesized chromium oxide nanoparticle's is between 20 to 70nm and thermally stable at 1000◦. These nanoparticles are simple, low cost, highly stable and ecofriendly.

Vellora et. al (2013) [8] develop a new method for green synthesis of copper oxide nanoparticle's using gum karaya which is a natural nontoxic by colloid-thermal synthesis Process. Copper oxide has various extensive properties such as catalytic, electric, optical, photonic, textile and antibacterial activity. The diffusion method used for the study of antibacterial activity of copper nanoparticles. The size and shape of prepared copper nanoprticle's are obtained by the X-ray Diffraction, Scanning Electron Microscopy (SEM) and FTIR. The structure of synthesized copper oxide nanoparticle is monoclinic. The synthesized copper nanoparticle has antibacterial activity, highly stable and environmentally friendly.

RakspunJ et. al (2018) et al [9] the investigation of boron doping at a concentration of 0.5, 1.0 and 2.0 wt %. the presence of monoclinic CU2SN3S7, cubic CU2SNS3 and orthorhombic CU4SNS4 of CTS showed by XRD pattern for the all phase structure of nanoparticles they prefferd the influenced Boron doping and which produced a lattice strain effect and that change in the dislocation density. The concentration of Boron in CTS increase from 0.5wt% to 2.0wt% that reduces bandgap for the all phase of CTS from 1.46 to 1.29 eV and also reduced the optical transmittance. for the B dropped CTS optical constants such as the refractive index, extinction coefficient and dissipation factor also obtain for the dispersion behaviour of refractive index was investigated in terms of a single oscillator model and the physical parameters were obtained for the synthesis of CTS nanoparticle FTIR is confirmed and indicate Boron doping resulted in the p-n junction behaviour for optoelectronic applications.

Rakesh et. al (2013) [10] studied Synthesis of Chromium(III) Oxide Nanoparticles by Electrochemical Method and Mukia Maderaspatana Plant Extract, Characterization, KMnO4 Decomposition and Antibacterial Study. In this method nanoparticle synthesized by two way in first H2SO4 used as a medium and using platinum electrode in the presence of NAHCO3 solution. Chromium doped platinum electrode is using in the second case in the presence of NAHCO3. The characterization of the synthesized nanoparticle is carried out by X-ray Diffraction, UV-Visible microscopy, FTIR and Scanning Electron Microscopy. The antibacterial activity of chromium nanoparticle is studied against E. coli .these synthesized nanoparticle are a good catalyst for the decomposition of KMNO4.

Alex p. et. al (2011) [11] described the synthesis of cobalt nanoparticle in aqueous solution. Their work is based on a synthesis of copper nanoparticle in bulk quantities in aqueous solution and using hydrazine as a reducing agent. The characterization of synthesis copper nanoparticle is done by using various techniques such as XRD, UV- Visible Spectrometer, SEM and TEM. The potency of the fcc phase maintains in the nanoparticle produce at room temperature. The powder of synthesized nanopaticle due to its highly ferromagnetic nature was agglomerated and seems flower like image in SEM.

Redon R. et al (2011) [12] develop a method for the aerobic synthesis of palladium nanoparticle in different solvents with different reduction method. In this method solvent used as a stabilizing and also dispersing agent in the

colloid without any inert atmosphere or special treatment. Dimethylsulfoxide (DMSO), dimethylformamide (DMF), ethylene glycol (EG), ethanol (EtOH), and water (H2O) are the solvents employed for this particular method, all under aerobic conditions. By using this method palladium nanoparticles are successfully formed using a different reducing agent which plays an important role of size and shape of palladium nanoparticles.

Hei H. et al (2012) [13] studied the control synthesis and characterization of noble metal nanoparticles. The polyol reduction method used for the synthesis of well shaped platinum, palladium and rhodium nanopaticle which are capped with polyvinylpyrrolidone in an ethylene glycol solution at the temperature of 190°C under N2. The size and morphological study of these synthesized nanoparticles is done by UV- visible spectrometer, laser scattering particle size distribution analysis (LSPSDA) and Electron transmission microscopy. The shape of the particle is spherical and increase with metal precursor concentration and amount of the pvp. This method is one step synthesis and provides a good way for the synthesis of noble metal nanoparticles.

Nene A. et al (2015) [14] describe a new method for synthesis of Fe3O4 and Fe nanoparticles by chemical reduction of Fe(acac)3 by Ascorbic acid. In this following method they observed that the addition of water during the chemical reduction formed Fe3O4 nanoparticles and in the absence of the water Fe nanoparticles synthesized. The mechanism for the synthesis of Fe and Fe3O4 nanoparticles the addition of water during the reaction acts as an oxygen supplier. The characterization of the synthesized nanocrystal is carried out by EDAX, TEM, SEM and XDP. It was examined that Fe nanoparticles get oxidized to form Fe/iron oxide nanoparticles due to exposure to an air atmosphere.

Tientong et al (2014) [15] studied the synthesis Nickel and Nickel hydroxide nanoparticles by chemical reduction method. The nickel nanoparticles are synthesized by chemical reduction nickel ions with hydrazine hydrate and nickel hydride nanoparticle formed in an alkaline solution of nickel hydrazine complexed by drop wise titration. The size and morphological study of nanoparticles is done by X-Ray Diffraction and FTIR. This is an excited, affordable and simple method for synthesis of nickel and nickel hydride nanoparticles of small size and high yield. The size of obtaining nanoparticle ranging between 7- 14 nm.

SafeeraT et al (2018) [16] used wet chemical method for the synthesis of quantum dots of ZnGa2O4: Eu^{3+}. This synthesis carried out at a low temperature in an aqueous medium and that resulted in a cubic spinel structured.ZnGa2O4: Eu^{3+} of quantum dots and which is confirmed by different techniques such as XRD and TEM. The photolumines cense spectrum contains electric and magnetic dipole. the PL can be used in imagining technique as well as in displays technology.

ThambiduraiM and DangC (2018) [17] approach the synthesis of cdo nanoparticles with different molar concentrations by the two step chemical method. the crystal structure of cdo nanoparticles thin film is in cubic phase and the formation of nanoparticles, spindles and coconut fiber bark shaped cdo nanoparticles flim showed by microscopic image by controlling the molar concentration of cadmium nitrate tetrahydrate and hexamethylenetetramine. These different structures were obtained and increase the size of CDO nanoparticles monotonically with molar concentrations and this chemical synthesis is inexpensive and scalable

Khatoon u. et al (2012) [18] studied the synthesis of silver nanoparticle by chemical reduction method. Silver nanoparticle receives appreciable attention due to its physical and chemical properties. In comparison with other metal have various different properties. . In the synthesis of silver nanoparticle Silver nitrate is used as the metal precursor and sodium borohydride as a reducing agent. The characterization of obtaining nanoparticle is done by the X-Ray Diffraction technique for knowing lattice parameter, UV Visible Spectrometer for confirmation of the size of silver nanoparticle and SEM to know size morphology and composition of the nanoparticle . The energy dispersive spectroscopy (EDS) used to conform elemental silver at the nanoscale.

PatharkarR et al (2013) [19] developed a new approach of synthesis of colloidal Ruthenium nanoparticle from the chemical reduction method. in which reducing agent is Sodium Borohydrate and sodium dodecyl sulfate is a stabilizer and different parameters used for measuring the size of colloidal Ru nanoparticles and the synthesized nanoparticles characterized by a different technique such as TEM and dynamic light scattering (DLS).

GuzmánM et al [20] developed a new approach by the chemical reduction method of silver nano particles. silver nitrate act as the metal precursor and hydrazine act as reducing agent and the determination of silver nanoparticles was characterized by uv-vis spectroscopy which discloses the production of silver nanoparticles which is manifest by the surface plasmonic absorption for the synthesized nanoparticles. we have taken different technologies such as X-RAY diffraction, TEM, UV-VIS, energy dispersive spectroscopy for their characterization. The Kirby Bauer method used for measuring the antibacterial activity of synthesized nanoparticles. the silver nanoparticles exhibit high antimicrobial and bacterial activity.

JainS et al (2014) [21] in this review the chemical reduction method used for the preparation of copper nanoparticles in aqueous medium L - ascorbic acid work as reducing and capping agent. it is the new approach for the synthesis of copper nanoparticles from L- ascorbic acid. the synthesized copper nanoparticles were characterized by a different technique such as SEM, FEM. in copper salts the addition of L-ascorbic acid is determined by FTIR technique . and L - ascorbic acid used for protecting the copper nanoparticle to obtacle the agglomeration

MazarioE at al [2106] [22] in this review for the synthesis of manganese ferrite nanoparticles developed a chemical method. it was carried out by an electrochemical cell that contains anode and cathode. XRD and STEM show the formation of structure and technique such as electron microscopy and X-Ray absorption spectroscopy characterized the shape and size of synthesized nanoparticles and magnetic behaviour determined by the SQUID measurements.

CONCLUSION

The concept of evolved and formed metal nanoparticle by chemical method is excellent and synthesized nanoparticles are highly stable, ecofriendly and great used in almost every field such as medicine, textile and industrial area which supports to create a new way of knowledge towards nanoparticles. Mainly the synthesis of nanoparticle is based on two techniques that is top down and bottom up which is described in this review. The continuous research in this field creates a beginning for generating small and ultrafast devices.

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