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Synthesis MgO nanopowder using Sol-gel technique: A critical review

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Abstract

During the last decade, it has realized that when materials are synthesized to nanoscale dimensions, they will show new and remarkably improved physical and chemical properties. Due to its wide and major applications, in-depth investigations have been carried out on metal oxide nanomaterials. A significant amount of research is going on in synthesis and characterization of MgO/PVA nanocomposites. Some of the literature has been reviewed to get the idea about the synthesis and characterization of MgO/PVA nanocomposites using sol-gel technique.

Key words: Nano materials, Characterization, Sol-gel

1. Introduction

The investigation was focused on the preparation of MgO nanoparticles due to its significant bactericidal execution because of the development of O^{2-} anions at its surface in the watery arrangement. It shows high bactericidal movement against microscopic organisms, spores, and infections [1-2]. The upside of MgO nanoparticles is that it has high surface vitality, which could be dispersed in organic solvents and matrix effortlessly. On consolidating the MgO nanoparticles into a polymer like polyvinyl liquor (PVA) not just it improves the quality.Furthermore, it totally changes the physical conditions of the polymer. [3] As a result of these properties shown by MgO nanoparticles and then formed MgO/PVA nanocomposite, it can be efficiently used as new antibacterial materials for orthopedic tissue engineering applications as it enhances orthopedic tissue recovery and lessens bacterial infection. In addition to MgO, NiO nanoparticles were also prepared as these particles possess wide band gap has an extensive variety of utilizations because of its high chemical stability and also for its unusual optical and electrical properties and

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catalytic properties and thus finds great applications for the anode layer of solid oxide fuel cells, cathode material in alkaline batteries, as a catalyst and many more. However, pure NiO has low conductivity and is therefore not suitable for applications requiring rapid electron transport. Therefore, some conductive additive materials are often used to improve the conductivity of the electrode material and used in supply chain industries. [4-7]

Several procedures have been found to synthesize metal oxide nanoparticles like sol-gel method, solution by combustion, microemulsion method, solid state method, mixed solvent spray pyrolysis, hydrothermal precipitation, and lot of others simple technical procedures. Control of synthetic parameters such as temperature, pH, and materializing agents is an important issue in controlling the size, shape, and morphology of nanoparticles.

All of above state methods; the sol-gel technique has acknowledged much attention in the synthesis of metal oxides that have unambiguous structural and microstructural features. This is very simplest and lower cost technologies for synthesizing metal oxides with comparatively high detailed surface areas at minimum temperatures. By choosing suitable precursors and surfactants, plus reasonable calcination procedures, metal oxide nanoparticles of uniform shape and size can be obtained. [8] It has numerousbenefits including excellent chemical homogeneity, high purity, minimum calcination temperature, and controlled particle size.[9]

2. Nanomaterials and its application

Nanotechnology is defined as the behaviour of the influence of substance on an atomic and molecular scale. In general, the size of structures processed by nanotechnology varies from 1 to 100 nm in one length and includesrising the smallest one-dimensional material in dimensional changes. It covers a wide range of areas, from the development of materials with nanoscale dimensions to the verification of whether we can control substances at the atomic level. Ready to produce several new materials with multiple uses, for example in medicine, biomaterials, natural philosophy and energy invention. Nevertheless, nanotechnology increases issues related to the harmfulness and effect of nanomaterials on the surrounding environment [10], and their impact on the universal economy.

A subclass of ultrafine particles with a length larger than 1 nm and less than approximately 100 nm in two or three dimensions, and may or may not show size-associated improvements.[11]

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By this definition, there is only one reason Nano object of their sizes ranging from 1 to 100 m to be classified as nanoparticles, although other sizes are available in the area. (A lower limit of 1 m finally obtained the right to use nuclear bond is 0.1 m). [12] If the nanoparticles are formed from nanoparticles circle, the diameter changes in the properties of many common materials, because the change is greater in size than the surface of the nanoparticles is usually larger surface of the particles. This makes other reactive molecules. The use of is the use of nanoparticles in the many fields of its General Calendar. [13]

Therefore, the power of knowledge nanoparticles matter what size they are stored or molecular structures of nuclear power.

There are three main physical properties of nanoparticles, which are connected: [14]

(1) And the Free State have a very high mobility.

(2) Due to its Nanoscale size, have a very high specific surface areas.

(3) Cannot do this because they are small enough to limit the effects of electrons. For this reason it is unexpected and optical properties. For example, gold nanoparticles appear in the solution or dark black. [15]

2.1 Magnesium oxide (MgO)

Magnesium oxide (MgO) or magnesium oxide is a white hygroscopic active mineral that generally appears in the form of periclase and is a source of magnesium. It has an empirical formula for MgO and consists of a bionic network of Mg^{2+} ions and O^{2--} ions.

Magnesium hydroxide forms near water,

$MgO + H2O \rightarrow Mg(OH)_2$

However, it can be changed by heating to separate the water.

Although "magnesium oxide" is often called MgO, magnesium peroxide MgO2 is also known as a compound. According to the evolutionary prediction of the crystal structure, MgO2 is thermodynamically stable when the weight exceeds 116 GPa (gigapascals), and the new low-priced Mg3O2 oxide semiconductor oxide is a thermodynamic constant greater than 500 GPa. Due to its robustness, MgO is used as a model framework to examine the vibration characteristics of crystals. [16]

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Extensive classifications divide the methods into bottom-up, atomically, or top-down methods constructed using methods that involve the process of removing or rearranging atoms to create the desired structure.

a) Top-down approach

b) bottom-up approach

Why use the sol-gel method?

• This is one of the simplest and cheapest of technologies for the production of pure metal oxides having a relatively high specific surface area at low temperatures.

• By choosing suitable precursor and surfactants can be obtained in addition to the calcination the metal oxide nanoparticles out of shape and size. This method also has the potential advantages, including ease of use, highly productive of purity and the high efficiency, low power consumption, and lack of special equipment in the work.

• It has many advantages as well as need uniformity, high purity, the less calcination temperature and controlling the particle size.

• One of the most successful way to nanoparticles to create a system of control of the pore structure. This process includes two steps: hydrolysis of the metal precursor and condensation of the gel particles. Is converted into the crystalline calcination of zinc hydroxide is accustomed to the fact that the matter to be unformed. But it typically occurs in the particles of the agglomeration of matter, the degree of calcination, which can lead to the system in a matter of a great lay.

Sol gel method

Infection process of the process of the sun, and in the production of solid materials from small molecules for the recovery of metal oxides, fourth (Fig. 1). The method consists of the conversion of monomers in colloidal solution (sol) is used, which is the precursor of integrated network (or gel), discrete particles or network polymers. Infection also can be said that the sun, "polycondensation precursor in the formation of high molecular midday related connection systems."

"Sol-gel process in which the composition is solid nanoparticles dispersed in a liquid (sol), and also in continuous three-dimensional network."

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A sol can be a stable dispersion of a mixture or polymer in very solvents (the shape is so small that there is no attractive force, only van der Waals forces and surface charges are present). The particles can also be amorphous or crystalline. Associative aerosols are very gaseous particles, while suns are very liquid particles. [17]

A gel can be a semi-rigid substance. Once the solvent from the sun begins to evaporate and the remaining particles or ions also begin to bond in a very continuous network, a semi-rigid substance will form.

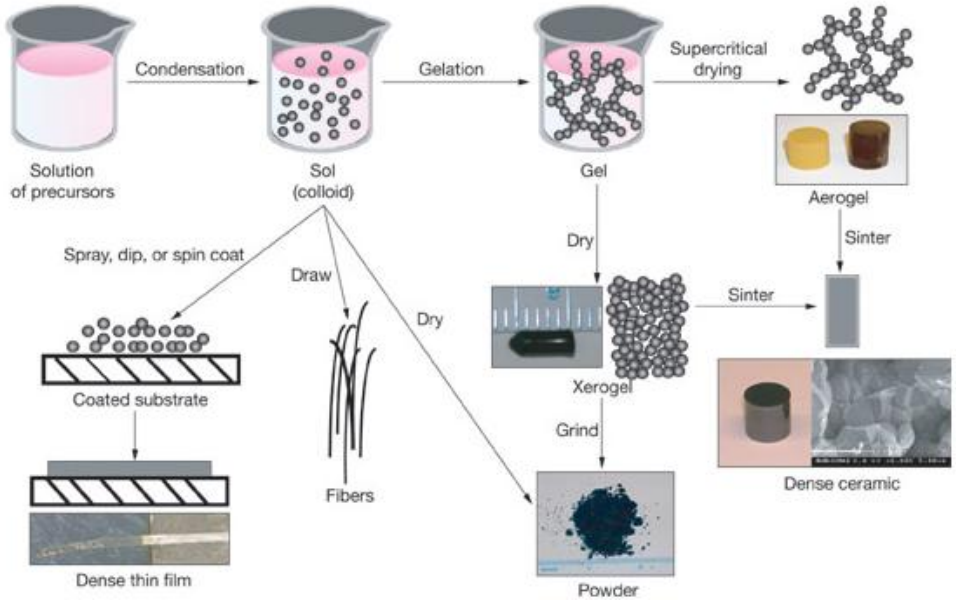

Fig..1: Sol-Gel Technique [17]

2.2 Sol-gel Processing:

(1) The sol-gel process, the wet-chemical process that chemical solution (in short, a solution is said to be) or colloidal particles (nano-scale particles of the same) can be used to form an integrated (gel) network will provide.

(2) Metal alkoxides metal chlorides and lousy run. But go to form Colloids hydrolysis and polycondensation motion, the system of nanoparticles dispersed in a solvent. It is usual for inorganic, and the continuous line in diameter that contains the liquid phase (gel).

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(3) The first point of the metal oxide compound includes compound of the metal center with oxo(M-O-M) or hydroxyl (M-OH-M)a bridge in a metal oxygen and metal hydroxyl polymer to form in the solution.

(4) Remove dried in the right portion of the gel. Then, heat treatment (calcination) is carried out to promote a polycondensation and enhance mechanical properties.

3. RECENT RESEARCHES:

Several scientists have worked on the development of MgO/PVA nanocomposite thin films for use in industrial and medical applications and various analyses have been carried out about the alterations (or) changes in the properties of PVA by doping of individual nanoparticles. Many combinations of nanocomposites have been developed for enhancement of properties of nanoparticles havebeen studied.

Mahdi Aleahmad, Hamidreza gafurius Talegani, Hossein Eisazade (2011) demonstrated that the successful synthesis of the save / mo nanocomposites use the chemical process using various surfactants conductivity. Thermal structure and the need to secure high stability different state. The study showed that the concentration of the Nio, sharpe and which has a major impact on the electrical conductivity, thermal stability, morphology, and the conversion to save / mo nanocomposites. The thief show the results indicate that the level of doping of bread / mo pending

R. E. Nemade S.A. Waghuley (2013) mixed in the studies used for the synthesis of solving Sprühpyrolysetechnologie MgO nanoparticles. Well MgO nanoparticles are synthesized by spray pyrolysis in a solvent mixture. The 10 confirmed cristalina pattern formation MgO, the best time for crystal structure. The Debye Scherrer equation is used to determine particle size, and found that particle size of 9.2 m.

Sindhu Honmut, Arunkumar Lagashetti A. Venkataraman (2013) report the synthesis and analysis of nanocomposites and nanocomposites films polyaniline films mo polyvinyl alcohol (PVA, bread Union) obtained with respect to the aniline polymerization in order to PVA matrix with ammonium persulfate (APS) as the oxidant.

Chivukula Srikant, Chakradhar Sridhar B., B. And Nagabhushana R.D. Uniroyal (2014) and constant conductivity doped dream of a new nanocomposites (PVA) was examined. Having saved loss. 10 cristalina analysis (XRD), Fourier transform infrared spectroscopy (TEM) and

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fungi (SEM) were used to confirm and characterize the obtained PVA Revolutions in their compounds, NIO presence of polyvinyl dream bow or the formation of compounds.

Gunasekaran Venugopal, George Rosilin, Nivea Shrinivas S. Raghavan, Arun Dakshinamurti: Anu Jacob and Paul Marahatta Anant Babu (2015) Studies on the structure and properties of MgO-mechanical PVA nanocomposites films. MgO nanoparticles are obtained need ambition. In ultrasonic method would be to increase the nanoparticles MgO (2%) PVA suspension and nanocomposites films are obtained by solving forms.

Shahbaa F. Bdevi, omedia Ch. Abdullah, Bakhtyar C. Aziz3, Ayad A.R. Change (2015) Synthesis, structure and optical properties embedded in a matrix PVA MgO Nanocrystals have been killed. In this work, magnesium chloride, sodium hydroxide, and the string is the precursor and the use of gelatin for Stabilizer. Nanomagnesiumoxid (MGO) was prepared by moisture need medication.

Agrawal R, Charp SD, and FC Raghuwanshi Lamdhade GT (2015) magnesium nanoparticles having a molar ratio of 1: 1 was synthesized using the right time. Magnesium hydroxide, sodium nitrate and raw materials that are used. MGO) nanoparticles kind of liquid time. 10 cristalina analysis showed that the size of Nanocrystalline MgO, a molar ratio of 1:1

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4.Conclusion:

The following conclusions made by results are as follows:

- MgO and NiO nanoparticles MgO/PVA &NiO/PVA nanocomposites were successfully synthesized by asol-gel method, followed by characterization of the same nanoparticles and films.

- Structural analysis obtained by SEM reveals that the MgO and NiO nanoparticles formed consists of nanoclusters formed with aggregates of the respective nanosizedparticles while that of MgO/PVA and NiO/PVA thin films also shows agglomerated nanosized particles with a nearly uniform distribution of MgO nanoparticles doped in the PVA matrix.

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