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Overview on the Methods of Preparation of Nano Particles

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Abstract: ***Nanoparticles are particles between 1 to 100nm in size. Nanotechnology is an interdisciplinary and crossing-over technology. The most important thing is observing and characterizing the phenomena showing in the nanotechnology, but also the practical use of new and unusual properties of nanoparticles. In this present work a comparative study on the different preparation methods of nano materials including Chemical Vapor Deposition, Chemical Vapor Condensation, Mechanical Attrition, Chemical Precipitation, Gas Condensation, Sol-Gel Techniques, Electrodeposition, are studied.***
Keywords: ***Nanoparticles, Preparation, Chemical Vapor Condensation, Mechanical Attrition,*** **Sol Gel Method**

I. INTRODUCTION

The concept of nanotechnology was introduced by physics Nobel laureate Richard P Feynman in his famous lecture entitled 'There's plenty of room at the bottom' at the December 1959 meeting of the American Physical Society. Nanotechnologies are now widely considered to have the potential to bring benefits in areas as diverse as drug development, information and communication technologies, and the production of stronger and lighter materials. The development of nanotechnologies is a modern multidisciplinary science involving the fields of physics, chemistry, biology and engineering, the production of nanoparticles. Nanocrystalline materials can be prepared by combining small clusters or breaking-up of larger material to smaller and smaller particles. There is a variety of methods for preparation of nanostructural materials from the gaseous, liquid or solid phase. In recent years, nanostructured materials have been prepared mainly using the following methods.

II. PREPARATION OF NANOPARTICLES

Nanocrystalline materials can be prepared by combining small clusters or breaking-up of larger material into smaller particles. There is a variety of methods for preparation of nanostructural materials from the gaseous, liquid or solid phase.

A. Chemical Vapor Deposition

This method is designated as chemical due to the fact that a layer on the surface of the coated substrate forms as a result of a chemical reaction of precursors, in contrast to the physical deposition, where physical principles are applied for the formation of a layer.

In the first phase the precursors are gasified at high temperatures and individual molecules are lead to the

cvd reactor, where they are adsorbed on the substrate surface. the coated substrate is during the deposition subjected to effects of one or more volatile precursors, which interact between each other on its surface or they decompose, while the demanded product is originating.

1) Chemical deposition from vapors consists of three basic steps:

transport of atoms, molecules or ions of the precursor to the substrate surface at high temperature.

chemical reactions on the substrate surface involving formation of the new material (chemical reactions).

removing more volatile side products from the substrate surface using a gas stream or vacuum.

het first and the third step are generally dependent on each other, because the diffusion rate of reactants affects the diffusion rate of side products. The second step is usually the most complicated and involves the following reactions: simultaneous adsorption and desorption (chemisorption and physical absorption) and nucleation processes.

It is necessary to prevent the particle homogenous growth in the gaseous phase (in contrast to the chemical condensation from vapors), since it affects considerably the very deposition and results in an uneven layer thickness and deposition of undesirable particles. If the temperature is maintained on a value substantially higher than the temperature of pyrolysis of the reactants, their

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faster decomposition on the substrate surface is ensured, whereas the growth rate is limited by the reactant mass transport onto the substrate surface through the border layers, particularly by its kinetics and a change in the free energy.

B. Chemical Vapor Condensation

Chemical vapor condensation (cvc) is a method for the manufacture of nanoparticles through a modified cvd process. the cvc principle is also based on nucleation in the gaseous phase, however, in contrast to cvd this is the homogenous nucleation and thin films do not form, but particularly fine powders.

In the first step, the carrier gas is bubbled through the precursor reservoir at room temperature, as in the case of the chemical deposition. Follow-up, this vapor stream (of a controlled speed) containing precursor molecules is fed via a needle valve through a heated tubing into the vacuum (reaction) chamber. In the heated tube the induction of chemical reactions among the gas molecules occurs, namely by means of the energy supplied in the form of laser or plasma heating. During a short moment and under specific conditions molecules begin to decompose thermally and coagulate to small clusters and particles. The outlet from the heated tube the beam of clusters or particles extends and by this their growth moderates. In the final phase the particles condensate on a rotating liquid nitrogen cooled substrate, from which the final powder product is scraped off and collected.

C. Electrodeposition

This is a simple and well-established process and can be easily adapted to produce nanocrystalline materials. Electrodeposition of multilayered (1 -D) metals can be achieved using either two separate electrolytes or, much more conveniently, from one electrolyte by appropriate control of agitation and the electrical conditions (particularly voltage). Also, 3-D nanostructured crystallites can be prepared using this method by utilizing the interference of one ion with the deposition of the other ion. This technique was originally used to synthesize small quantities of nanostructured pure metals.

1) The systems using the principle of evaporation and condensation differ in:
a) the method of input of evaporated material
b) the method of supplying energy for evaporation
c) the working medium
d) setup of the condensation process
e) the system for collecting the produced powder.

A method of the condensation of metal vapours in a gas atmosphere is the process of dispersion of a metal by means of an electric arc in a liquid with subsequent condensation of metallic vapours in liquid vapours.

D. Salting Out Method

Salting out based on the separation of a water-miscible solvent from aqueous solution via a salting-out effect, Salting-out is based on the separation of a water miscible solvent from aqueous solution via a salting-out effect. Polymer and drug are initially dissolved in a solvent which is subsequently emulsified into an aqueous gel containing the salting out agent (electrolytes, such as magnesium chloride and calcium chloride, or non- electrolytes such as sucrose) and a colloidal stabilizer.

E. Solvent Displacement / Precipitation method

Solvent displacement involves the precipitation of a preformed polymer from an organic solution and the diffusion of the organic solvent in the aqueous medium in the presence or absence of surfactant. Polymers, drug, and or lipophilic surfactant are dissolved in a semipolar water miscible solvent such as acetone or ethanol. The solution is then poured or injected into an aqueous solution containing stabilizer under magnetic stirring. Nanoparticles are formed instantaneously by the rapid solvent diffusion. The solvent is then removed from the suspensions under reduced pressure. The rates of addition of the organic phase into the aqueous phase affect the particles size. It was observed that a decrease in both particles size and drug entrapment occurs as the rate of mixing of the two phase increases.

F. Mechanical Attrition

Mechanical alloying is a unique process, which can be carried out at room temperature. The process can be performed on both high energy mills, centrifugal type mill and vibratory type mill, and low energy tumbling mill. High energy mills include: Attrition Ball

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Mill, Planetary Ball Mill, Vibrating Ball Mill, Low Energy Tumbling Mill, High Energy Ball Mill.

1) Attrition Ball Mill: The milling procedure takes place by a stirring action of a agitator which has a vertical rotator central shaft with horizontal arms (impellers). The rotation speed was later increased to 500 rpm. The milling temperature is in great control.

2) Planetary Ball Mill : Centrifugal forces are caused by rotation of the supporting disc and autonomous turning of the vial. The milling media and charge powder alternatively roll on the inner wall of the vial and are thrown off across the bowl at high speed (360 rpm).

3) Vibrating Ball Mill: It is used mainly for production of amorphous alloys. The changes of powder and milling tools are agitated in the perpendicular direction at very high speed (1200 rpm).

4) High Energy Ball Mill: High-energy ball milling is an already established technology, however, it has been considered dirty because of contamination problems with iron. However, the use of tungsten carbide component and inert atmosphere and/or high vacuum processes has reduced impurity levels to within acceptable limits.

G. Sol-gel Method

In this chemical procedure, the solution gradually converts into a gel like diphasic system,which contains both liquid phase and solid phase . The morphologies of these two phases range from discrete particles to continues polymer networks . Initially a significant amount of fluid may have to be removed from solution to recognize the gel like properties. Sol-gel method is a low temperature technique and moreover it is cheap. In this method the chemical composition of the product can be controlled .In this method the solution can be doped with organic dyes and rare earth metals. The dopants are uniformly dispersed in the final product. This technique can be used in ceramics processing and producing thin films of metal oxides. Nano materials derived by this method have wide applications in electronics, medicine, separation technology, and optics.

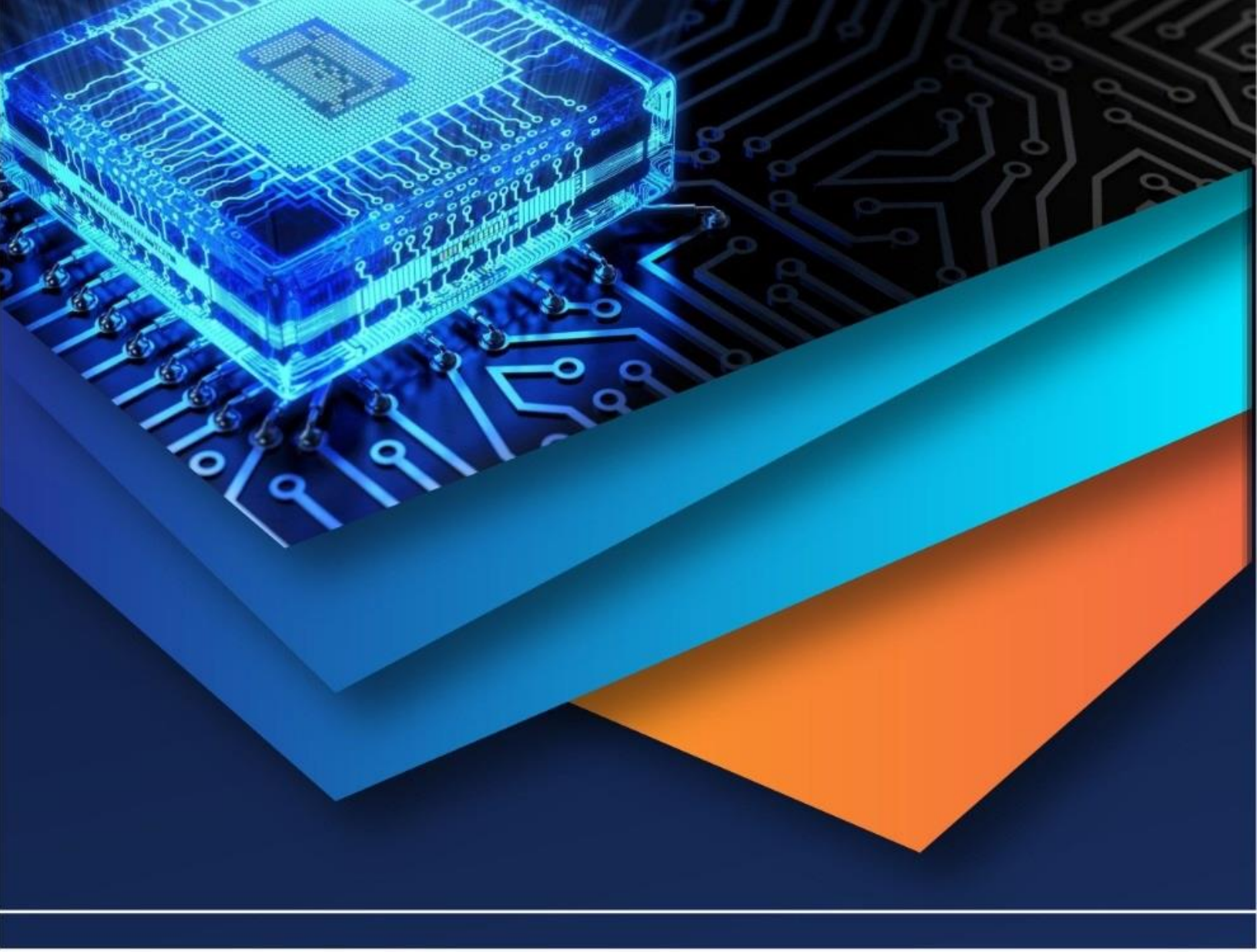
III. CONCLUSION

Nanomaterials have been extensively investigated during the last decade due to their Wide variety of applications. It is observed that field of nanomaterial synthesis is very dynamic. Many process such as gas condensation, chemical vapor synthesis, mechanical attrition, chemical precipitation, Sol-Gel technique, electrodeposition, some other methods widely used are molecular beam epitaxy, ionized cluster beam, liquid metal ion source, consolidation, sputtering and gas aggregation of monomers chemical precipitation in presence of capping agents, reaction in microemulsions and autocombustion are commonly used techniques for synthesis of nanophosphors. Nanomaterials prepared using the processes include a wide variety.

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