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Different Synthesis Route for Nanoparticles

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Abstract—*Nanoparticles are particles of sizes ranging from 1 to 100nm with one or more dimensions. The nanoparticles showing enhanced properties such as high reactivity, strength, sensitivity, stability, etc. because of their small size. The nanoparticles are synthesised by various methods for research and commercial uses that are classified into three main types namely physical, chemical and mechanical processes. Various methods of preparing nanomaterials including Chemical Bath Deposition, Spin Coat, Chemical Vapour Deposition (CVD) and Molecular Beam Epitaxy, Sol-Gel Techniques, Electrode position etc. are discussed. This paper presents a review on nanoparticles, their types, properties, synthesis methods and its applications in the field of environment.*

Keywords: *PVD, CVD, MBE, NANOPARTICLES.*

INTRODUCTION

The concept of Nanotechnology was first appointed, in 1959 in the California Institute of Technology (CaItech), by Professor Richard Feynman. The nanotechnology materials open a new door to what we know about the behaviour of matter. Nanotechnology involves the design, creation, handling and study of all technologies and sciences that are applied to a nanoscale level. Nanotechnology scale goes from 1 nm to 100's of nm, this involves so many different possibilities, from the manipulation of simple atoms, or molecules, to the manipulation of virus, bacteria etc. Several phenomena become pronounced as the size of the system decreases, statistical mechanical effects or quantum effects. Materials reduced to nanoscale can show different properties compared to macroscale.All this reasons inspired the nano-science community to develop nanotechnology fabrication Methods.

Fabrication Methods

Chemical Bath Deposition

In this process, thin films are deposited on a solid substrate. By the nature of their preparative conditions, these films are generally not of high purity. This method depends on the deposition of thin films from aqueous solutions either by passing a when it is immersed into a dilute solutions of one or more metal salts (MP+), a source of chalcogenide, X (X=S, Se, Te) ion and a suitable complexing agent in an aqueous solution. In this technique it is possible to control the film thickness and chemical composition by varying the deposition parameters such as temperature, precursor concentration, complexing agents used and the pH of the solution [5]. The ability of this method to coat large areas in a reproducible and low cost process is the most attractive advantage. In this method first of all Establishment of equilibrium between water and the complexing agent take place then Formation of metal-complex species take place. Hydrolysis of the chalcogenide source and finally Formation of the solid film on the substrate take place [6].The formation of metal-complex ion controls the rate formation of solid metal hydroxides which leads to the formation of solid film.

Chemical Vapour Deposition

Chemical Vapour Deposition is a process in which a solid material is deposited from a vapour by a chemical reaction. In this process Convective and diffusive transport of reactants to the reaction zone take place [1].After that step by step process such as Gas phase reactions ,Transport of reactants to the substrate surface, Chemical and physical adsorption , Surface reactions leading to film formation Desorption of volatile by-products take place . In this process high growth rates, can deposit materials which are hard to evaporate, good reproducibility and can grow epitaxial films [2].

Physical Vapour Deposition

PVD processes are deposition processes to deposit thin films by the condensation of a vaporized form of the material onto various surfaces. [3]PVD processes are used to deposit films with thicknesses in the range of a few nanometres to thousands of nanometres. This process can also be used to form multilayer coatings, graded composition deposits, very thick deposits and freestanding structures [4].

Molecular Beam Epitaxy

In this process the constituent elements of a semiconductor are deposited onto a heated crystalline substrate to form thin epitaxial layers in the form of 'molecular beams'. The 'molecular beams' are from thermally evaporated elemental sources. To obtain high-purity layers, the material sources be extremely pure and that the entire process be done in an ultra-high vacuum environment. Gowth rates are typically on the order of a few Å/s and the beams can be shuttered in a fraction of a second, allowing for nearly atomically abrupt transitions from one material to another. In this process three main vacuum chambers: a growth chamber, a buffer chamber, and a load lock. The main work of load lock is used to bring samples into and out of the vacuum environment and the buffer chamber is used for preparation and storage of samples [12] .The buffer chamber on the MBE system also acts as a transition tube to allow samples to be transferred under vacuum to two different growth chambers.

Sol-Gel Techniques

Sol or colloidal solution is a solution where distribution of particles takes place in a liquid in which the only suspending force is the Brownian motion. A gel is formed when solid and liquid phases are dispersed in each other. In this process colloidal particles are dispersed in a liquid forming a sol. The particles in the sol are left to polymerize by removing the stabilizing components and further produce a complex gel [7]. The remaining components pyrolyze in the end by heat treatments to form amorphous or crystalline coatings. Sol-gel comprises of alcoholic group hydrolysis and its condensation. Sol which is obtained can be given a desired shape. It can also be deposited on a substrate to form a film by or spin coating [10].

Spin Coat

Spin coating is a process of coatings a surface by a thin liquid film facilitated by a fast rotation of the surface. Spin-coater is essentially a turntable maintained under vacuum conditions [9]. In this process of spin coating, a substrate is placed on the turntable and then a liquid is deposited at the center of the substrate [8]. This is followed by a very fast (thousands of RPMs) rotation of the turntable. The liquid spreads outwards to the edge of the substrate and forms a thin film of a relatively uniform thickness. It is important to understand effect of various control variables on the film thickness and uniformity since manufacturing of semiconductor devices requires smooth and uniform photoresist films of predictable and reproducible thickness.

Electrode position

Electrode position is process that allows the preparation of solid deposits on the surface of conductive materials. Electrodeposits are formed by passing of an electric current in an electrochemical cell. This cell is a device that consists of two conductive or semi-conducting electrodes immersed in an electrolyte. The electrodes are called the working electrode (cathode), consisting of the object where electrode position is planned, and the counter-electrode (anode), necessary to complete the electrical circuit. Electrolytes for electrode position are usually aqueous solutions containing positive and negative ions, prepared by dissolving metal salts. The electric current that flows between the two conductive electrodes due to presence of an external voltage is because of the motion of charged species, towards the surfaces of the electrodes. In this process at the surface of the electrodes, the conduction mechanism must change from ionic to electronic interface process mediated by the occurrence of electrochemical reactions that promote the reduction or the oxidation of the ionic species [11].

Conclusion

The paper describes various methods used for synthesis of nanomaterials .The advantages and disadvantages of these methods are also discussed. The most appropriate technique used for synthesis of nanomaterials basically depends on the material to be used for synthesis

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