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Review on nanotechnology based metallic compound

Aastha Bahuguna, Prince Chaudhary, Ayush Sachin

[1]Department of Physics, School of Applied & Life Sciences, Uttaranchal University, Dehradun, Uttarakhand-248007, INDIA

***Corresponding author**: **narinderkumar@uumail.in**

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Abstract: The study of nanotechnology has the potential to fundamentally alter how humans perceive and influence change in a variety of fields, including mass transfer, biomedicine, agriculture, and water management, among others. The word "Nano" refers to a type of technology that uses tiny particles that can be seen with the naked eye. Working at this size enables more successful creative solutions to special situations. For instance, employing zeolites and nanoclays to improve soil fertility and quality can increase fertiliser effectiveness. The development of intelligent seeds coated with nano-polymers and timed for germination under favourable conditions seems promising. Crops are often categorised according to their nutrient needs when precision farming inputs are used, and with the help of a Nano-biosensor and a satellite system, the distribution of nutrients may be tracked more precisely than with current techniques. This also highlights the creation of nano-herbicides to deal with weed control. Studies exist that show how efficient nano-fertilizers are in increasing the productivity and efficiency of the nutrients, lowering soli toxicity, and reducing potential contamination-related problems. Therefore, nanotechnology has great promise for sustainable agriculture, particularly in underdeveloped nations.

INTRODUCTION

In the past few decades, the scientist attracted most of our attention because of some extraordinary property and behavior of materials at Nanoscale so in the present work we mainly focused on the synthesizing of Nanomaterials by using different techniques (Zang, 2004). Nanoscience is the branch of science by which we can deal with the properties and behavior of materials at Nanoscale. There are two different approach by which the nanoparticle were synthesized firstly the top down approach in which the bulk material are reduces to nanoscale by using some physical method and another approach is the bottom up in which we synthesize the nanomaterial's by chemical methods (Zang, 2008).

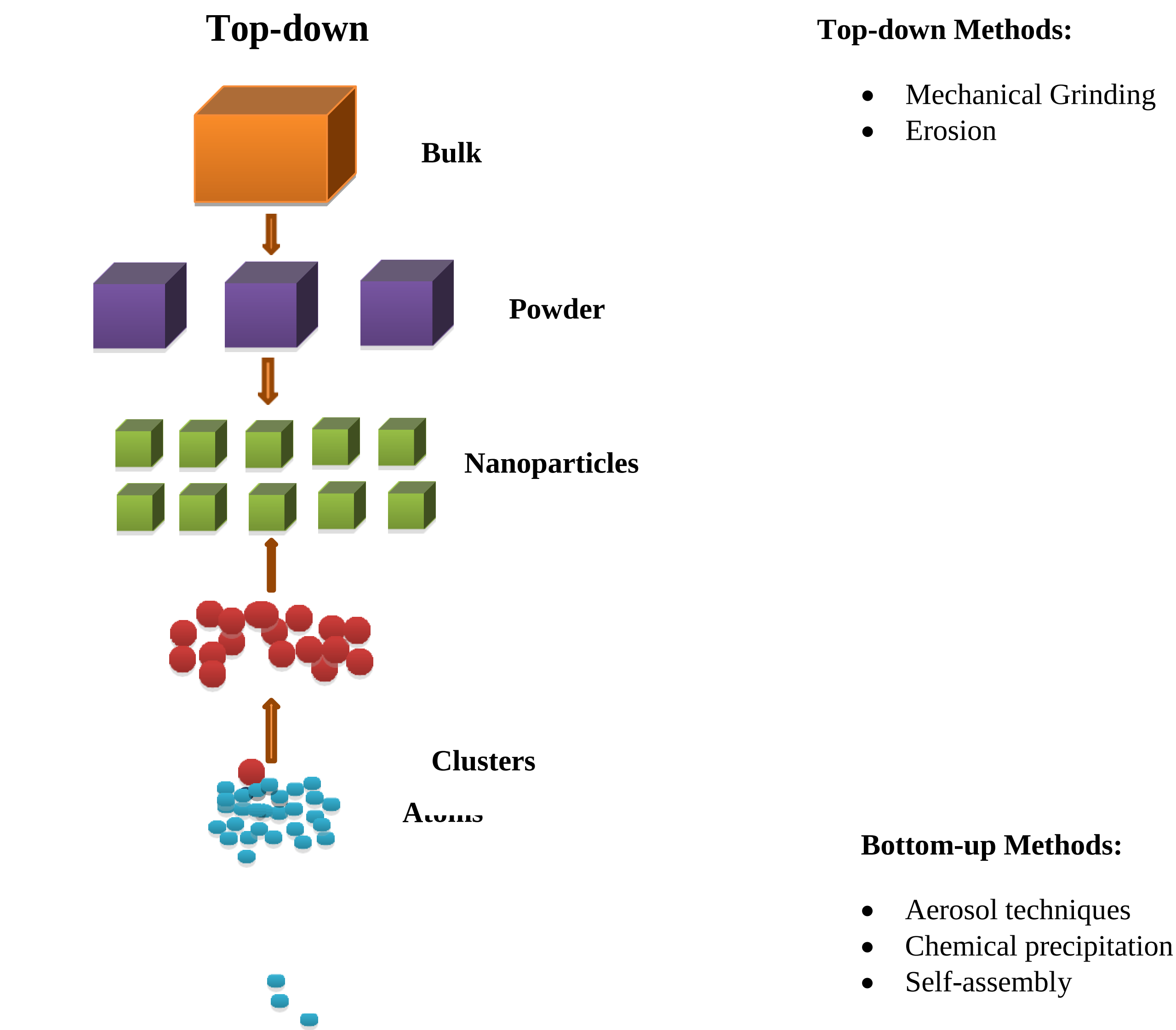

Figure 1: Schematic of Bottom-up and Top-down approaches

The few metals and alloys, the few ceramics, and the natural polymers like wool, cotton, asbestos, and cellulose were more than adequate for many centuries to fulfil the majority of human requirements (Pena, 2003). The late nineteenth and early twentieth century saw the beginning of the new age of materials. All materials share the same characteristic in that they are all made up of atoms. The atoms themselves may differ from one another, yet all known elements' atoms are made up of the same three types of fundamental particles: protons, neutrons, and electrons. The atomic and molecular structure, the degree of order and quality in these structures, and the forces and energy connected with them all have a role in the nature and final qualities of the bulk engineering materials we use on a daily basis (Zhu, 2006).

Nanotechnology is the study of atomic and molecular size manipulation of materials. In general, nanotechnology works with structures that have at least one dimension and a size that ranges from 1 to 100 nm, as well as generating materials that have at least one dimension and a size that range. 100,000 times smaller than the diameter of a human hair, a nanometer is one millionth of a millimetre. Nanomaterials are intriguing because to the unusual optical, magnetic, electrical, and other properties that manifest at this size. These developing qualities will have a significant influence on industries like electronics and medicine, among others. It includes all nanoscale and molecular level technology (Liu, 2008). The field of nanotechnology includes the creation and use of physical, chemical, and biological systems at sizes as small as a single atom or molecule.

Nanomaterials have been employed in industrial processes and products for a while now.

Nanomaterials are utilised widely in commercial products, including wrinkle-free clothes, cosmetics, sunscreens, electronics, paints and varnishes, sports goods, clothing that resists stains, and many other things (du, 2005). These materials are also employed in medical for imaging, medication delivery, and diagnostics. Windows, sporting goods, bicycles, and cars are just a few examples of everyday products that use nanocoating and nanocomposite. Longer-lasting tennis balls made of butyl rubber/Nano-clay composites and innovative UV-blocking coatings on glass bottles that shield beverages from sunlight are also available. Nanoscale silica is used as a filler in a variety of items, including dental fillings and cosmetic products like self-cleaning windows and sunblock creams. Nanoscale titanium dioxide is utilised in a number of products, including cosmetics, sunblock creams, and self-cleaning windows (Zang, 2005).

It demands downsizing and imparts improved electrical, magnetic, optical, and chemical capabilities to a degree that traditional materials are unable to match. Nanomaterials stand out for their tiny size, restricted size range, low levels of collection, and great dispensability. There are many different experimental techniques used to create nanomaterials, including plasma arcing, chemical vapour deposition, electrodeposition, sol-gel synthesis, high-intensity ball milling, etc.

APPLICATIONS OF NANAOMATERIALS

Nanomaterials are crucial components for both general and industrial uses. Following are some examples of current and future uses for nanomaterials, both short-term and long-term.

Fuel cells: A good electrode structure must provide for enough of surface area, maximal catalyst, reactant gas, and electrolyte contact, easy transit of gases, and excellent electrical conductivity. The structure should be able to reduce losses in this way.

Catalysis: Nano-catalysts often have exceptionally high surface activity due to the higher surface area that is accessible with their equivalent nanomaterials. In contrast to bulk aluminium, which is often used in cutlery, the reaction rate at nano-aluminum can be so high that it is employed as a solid fuel in rocket propulsion.

Phosphors for High-Definition TV: The size of the pixel has a significant impact on the resolution of a monitor or television. Essentially, the "phosphors" that make up these pixels illuminate when hit by an electron stream within the cathode ray tube (CRT). The size of the pixel or the phosphors can be decreased while maintaining the same resolution. Sol-gel processes may be used to create nanocrystalline zincselenide, zinc sulphide, cadmium sulphide, and lead telluride, which are possibilities for enhancing monitor resolution. It is intended that the usage of nano phosphors will lower the price of these displays, making high-definition televisions (HDTVs) and personal computers more accessible for purchase.

Paints: Enamel colour paints for pottery have been made with metal nanoparticles. Traditionally, glass has been ground into glass frit using pigments that include a mixture of transition metals. Au nanoparticles might be utilised to create high-quality, transparent red paint in place of transition metal paints.

Medical Treatment: The use of the application to recognise a particular chemical in a living bodily tissue is anticipated. By coating the surface of the cancer cell, for instance, it is now able to tell a healthy cell from a cancer cell by the presence of antibodies bound to the Au nanoparticle. In a healthy cell, the Au nanoparticle and antibody are evenly dispersed, but when a cancer cell is present, the antibodies are primarily concentrated near the Au nanoparticle. Changes in the nanoparticle's structure enable imaging at different wavelengths. Moreover, the Au nanoparticle may be utilised to image cells other than cancer cells if a protein and a functional molecule were attached to it.

TIN(Sn)

The fabrication and functionalization of nanostructure materials have seen several significant advancements. One of the best important metal oxides, tin oxide is used mostly in the fields of catalysis, transparent electrodes, gas sensors, Li-ion batteries, etc.. It has a broad band gap of 3.6 eV. It has low electrical resistance, great transparency in the visible region, and strong infrared reflectance. Tin oxide is a fantastic material for transparent electrodes, liquid crystal displays, anti-corrosion coatings, lithium ion battery anodes, solar cells, and other applications. Are nano crystals, nanobelts, nanowires, and nanotubes are a few of the SnO2 nanostructures that have previously been created and characterised. Due to their size-dependent features, nanocrystals are particularly intriguing in terms of technological applications. Due to the quantum size effect, SnO_2 nanoparticles' optical and electrical characteristics differ dramatically from those of the bulk material when their size is smaller than or equivalent to the exciton Bohr radius [6]. For this reason, the production of high-quality SnO2 nanoparticles is crucial for both fundamental and practical research. In addition to particle size, low degree of collection, homogenous size, and homogeneous arrangement of particles are also required for a variety of applications. These characteristics heavily depend on the method of synthesis. For the production of SnO_2 nanoparticles, several methods have been used, such as spray pyrolysis, the sol-gel method, the hydrothermal technique, physical vapour deposition, the gel-combustion method, and solvothermal. The manufacture of SnO_2 nanoparticles using a wet chemical technique, such as the Sol-gel method, provides a number of benefits over the other techniques mentioned above, including molecular level uniformity and low temperature processing.

Tin chlorides are favoured as a precursor in general because they are simple to handle and need little in the way of chemical input. Because chlorine ions are challenging to eliminate, there are still some ions present that affect the surface and electrical characteristics of tin oxide nanoparticles. To obtain tin oxide nanoparticles devoid of chlorine, tin alkoxides are a superior alternative. The more costly nature of this technique, however, prevents their usage in bulk synthesis at an industrial scale.

STRUCTURE AND PROPERTY OF TIN

At temperatures exceeding 100 °C (212 °F), the grey form quickly transforms into the white. The metal's usage in extremely cold climates is severely hampered by the reverse transition, known as tin pest, which takes place at low temperatures. Small quantities of antimony, bismuth, copper, lead, silver, or gold are typically present in commercially accessible grades of tin and prevent this shift from occurring, which is only quick below 50 °C (58 °F) or when catalysed by grey tin or tin in the +4 oxidation state. Gray tin has a face-centered cubic crystal structure, while white tin has a body-centered tetragonal crystal structure. Tin's crystals collide when it is twisted, emitting an unsettling, crackling "cry." Strong acids and alkalis damage tin, while nearly neutral solutions have no noticeable impact on metal. At normal temperature, fluorine interacts with tin more slowly than do bromine, chlorine, and iodine. At particular temperatures, the connections between the allotropic alterations of tin can be seen as crystal types changing:

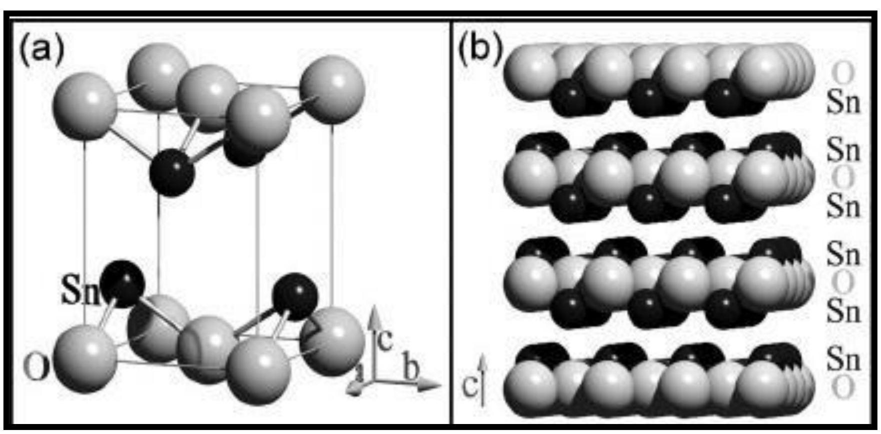

Figure 2: Crystal structure of SnO_2 nanoparticle

There are two oxidation states of tin: +4 and +2. Elemental tin is easily oxidised to the dispositive ion in acidic solution, but many moderate oxidising agents, such as elemental oxygen, may also change this Sn atom into the Sn ion. In most cases, oxidation in an alkaline environment results in the tetrapositive (Sn) state. Dispositive tin (Sn) disproportionates easily to tetrapositive tin and the free element in an alkaline solution.

CONCLUSION

In the modern agricultural sector, the extensive use of agrochemicals to increase agricultural productivity has damaged more than just the topsoil, groundwater, and meat. Increasing agricultural output is essential, but bear Considering the harm to biodiversity It needs to be taken into account. Nanotechnology is gaining in relevance in the realm of\sagriculture since it may be utilised to manufacture insecticides, fertilisers and genetic material. There are salready interesting results and applications using nanomaterials Pesticide and fertiliser dosages are anticipated to be lowered, and regulated, delayed administration is anticipated. As they can securely handle bio control systems and preparations, nano particles can be employed to lessen environmental harm and hazard. A significant barrier to eliminating toxic ûeld That was expensive using traditional techniques. Nanosensors are able to detect infections in extremely small quantities—on the order of parts per billion—and can be used to help minimise persistent pollutants that degrade crops and food. Nanotechnology offers remedies as well. For the benefit of mankind, agricultural engineering should employ powerful nanotechnology approaches to remove toxins from the soil. Techniques in nanotechnology can be utilised to address the pressing ecological and pollution issues. With the use of nanotechnology, existing technologies for environmental detection, sensing, and cleanup might be improved upon.

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