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A Review on Nanotechnology

[1]Basetty Mallikarjuna, [2]Divya Sharma
[1][2]Department of Electronics and Communication Engineering, Galgotias University, Yamuna Expressway Greater Noida, Uttar Pradesh
[1]mallikarjuna.basetty@gmail.com

Abstract: Nanotechnology is a molecular-level engineering of functional structures encompasses a wide range of topics and focuses on manipulating and exploiting the structure of matter on a large scale below 100 nanometers. Nanotechnology is forward-looking growth. Every field in its range today, from clothing to food, is something user should promote more for future and for more developments in present life. Nanotechnology will leave no area untouched by its innovative technological advances in a growing field of science and technology. Nanotechnology is an interdisciplinary field, since it combines knowledge from various disciplines, including chemistry, physics, and biology. Nanotechnology is the science of modifying matter on an atomic or molecular scale, which holds the promise of major improvements in environmental protection technologies. This review paper looks at the "Nanotechnology" aspects. This gives a brief description of nanotechnology and its application in different fields like medicine, electronics, robotics, solar cells, food processing etc. It also discusses Nanotechnology's future prospects.

Keywords: Nanotechnology, Nanomaterial, Nanoparticles, Nano science, Nanometer.

INTRODUCTION

Nanotechnology is an applied science, technology theoretical and experimental field. It is functional system engineering at the molecular level, covers a variety of topics and focuses on controlling and exploiting the material structure on a large scale below 100 nanometers. The word ' Nano ' comes from the Greek word ' Nanos, ' which means very tiny or dwarf. In the nanotechnology term the prefix ' Nano ' means a billionth (1 x 10-9)[1]. Nanotechnology is often referred to as technology for general purposes because it has a significant impact on almost all sectors and all aspects of society. In science and engineering, nano science and nanotechnology are recent groundbreaking innovations that are growing at a very fast pace[2].It is based on a desire to develop materials with novel and enhanced properties that are likely to impact nearly all of the sciences of physics and chemistry, biology, and safety. It provides better built, longer-lasting, cleaner, healthier and smarter home, electronics, pharmacy, transport, agriculture, etc. products. Nanotechnology commits the capacity to frame nano-scale size and accurate machine components. In other words, ' nanotechnology ' means the ability designed to build items from the bottom up, using methods and techniques that are defined to produce high-performance products. Nanotechnology is the ability to understand, manipulate and control matter at the level of the individual atoms and molecules, according to the National Science Foundation. Science and engineering are the main players of global technological rivalry[3].Modern science focused on the unifying features of nano scale design provides a new foundation for technology innovation, information and integration. Nanotechnology is sometimes used as a general-purpose technology because it will have a significant impact on almost all areas of society and all sectors in its advanced version. In comprehensive engineering and science fields there is a systematic cycle of convergence and divergence. For example, during the Renaissance the integration of macro-scale sciences was expected, and in the 18th-19th century narrow disciplinary specialization (NDS) in science and engineering was later followed. Nano scale convergence entered its brawn in about 2000, and an expectation of a divergence in the architectures of the nano system in the coming decades[4].

NANOPARTICLES

Particles whose sizes range from 1-100 nm are referred to as nanoparticles, whether distributed into gaseous, liquid or solid media. These are the amount of atoms or molecules bound together between individual atoms and aggregates that are large enough to be considered bulk material. Fig. 1 shows the various nanoparticles

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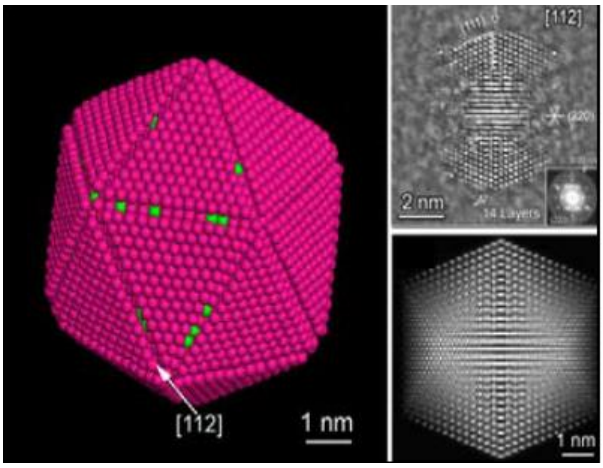

Figure 1: The Figure Shows Various Nanoparticles Which Used for Many Applications

In science and engineering, nano science and nanotechnology are recent, revolutionary developments that are progressing at a really rapid pace[5]. It is driven by a desire to produce products with novel and enhanced properties that are likely to affect nearly all fields of the physical and chemical, biological and health sciences. Because nanoparticles are bigger than actual atoms and molecules but smaller than bulk solids, they do not follow either absolute quantum chemistry or the laws of classical physics and materials in the regime of nanometer scale demonstrate the intermediate behavior between that of a macroscopic solid and that of an atom or molecular system[6].

PROPERTIES OF NANOPARTICLES

Optical properties: When particle size is reduced to nanometer level, they absorb light with a specific wavelength depends on the type of metal nanoparticles and particle size, and because of Surface Plasmon Resonance, i.e., the association of electromagnetic radiation and electrons in conductive band around the nanoparticles they transmit different colors. As a consequence of optical spectrum changes, quantitative and qualitative study of particle size and distributions and particle concentration and the influence of particle shape can be performed. The nanoparticles of gold and silver show the phenomena of color with magnificent tinting strength, color intensity and clarity[7]. Bulk gold, for example, appears yellow in color, but nano-sized gold looks red in color. In addition, because the nanoparticles are less than the visible light wavelength and the light dispersion by the particles is negligible, higher transparency can be achieved with the nanoparticles than with the traditional pigment. As shown in the Raman Effect phenomenon, decreasing particle size will increase the Kubo gap and hence the energy emitted by the photons will change their frequency and color.

Structural properties: The nanoparticles ' large specific surface area is an significant property related to reactivity, solubility, sintering performance etc. and is also related to the transfer of mass and heat between the particles and their surroundings. In addition, in many cases the crystal structure of the particles will vary with the particle size within the nano-sized range. This is due to the compressive force exerted on the particles arising from the particle's surface tension itself. The critical particle size and size effect of the crystal structure vary with the materials[8].

Thermal properties: The atoms and molecules found on the particle surface are important in the order of the nanometer, the material's melting point decreases from that of the bulk material because at lower temperature they tend to move more easily. Reducing the melting point of ultrafine particles is considered to be one of the unique features of nanoparticles related to nanoparticles ' aggregation and grain growth or improvement in the sintering efficiency of ceramic materials. As an end result of their free surface and thickness, the melting point of nano-materials is therefore different from their corresponding bulk materials[9].

Mechanical properties:

With the decreasing crystalline size, the hardness of crystalline materials increases, and the mechanical strength of the materials increases considerably by micronizing or composing the structure of the metal and ceramic material in the nano range.

NANOPARTICLE SYNTHESIS STRATEGIES

*Top-Down and Bottom-Up Approaches:*Technologies are classified into ' top-down ' and ' bottom-up ' strategies for creating nanoparticles. Top-down method is the development of nanoparticles by splitting larger materials into fine particles.The top-down approach has been and still is pursuing the miniaturization of components for the construction of useful devices and machines. For example, miniaturization in computer technology, which relies on silicon-based chips, is becoming increasingly

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apparent. In this process the bulk is machined by lithographic or laser ablation-condensation techniques down to the nanometer length scale. The chemical approaches are more successful from the point of view of the mass production of metal nanoparticles than the physical ones. Fig. 2, Exhibits Schematic diagram of metal nanoparticles preparatory processes.

While the approach to bottom-up (building blocks) is that nanoparticles are made of atoms or molecules. The bottom-up method, which begins from nano- or sub-nano-scale objects to create nanostructures, is an alternative strategy to leverage science and technology at the nanometer scale. In metal colloid synthesis, regulating the shape size is achieved by changing the concentration ratio of the chemicals making the nanoparticles to that of the chosen capping material (e.g., polymers, micelles, surfactants, or dendrimers). This style of synthesis is called the process of' bottom-up.'

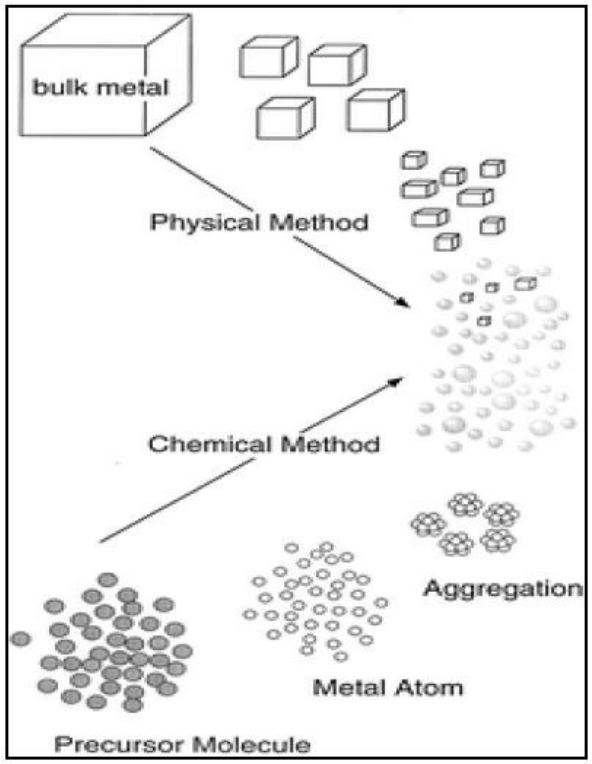

Figure 2: Preparative Methods of Metal Nanoparticles

APPLICATIONS

Nanotechnology in Paints and Coatings: Paints & coating industries are rising around the globe day by day. Paints or coatings not only act as beautification purposes but also as a means of protecting valuable metals and structures from corrosion. Nanotechnology aims to satisfy the desirable properties in paint and coatings. Nano scale silver fights bacterial and fungal growth with new paint technology. Silver nanoparticles in paint prevent mold forming inside buildings and algae growth on outside walls[10]. Silver interferes with different stages of cell metabolism; it can kill a wide range of germs and make resistance production difficult for microbes. Nanoparticles are so tiny that they can tightly ' organize themselves ' and bind together to form a ' molecular ' sealed sheet. The presence and effectiveness of nanoparticles adds many benefits such as improved surface appearance, decent chemical resistance, easy to maintain, fogging, anti-fouling, anti-reflective, anti-fingerprints, UV resistance, hydrophobic & natural oil repellent, fire resistant, high-performance coating, self-cleaning, etc.

Nanotechnology in Textiles and Clothing: The revolution of nanotechnology has illustrated huge potential in the typically very conventional textile and clothing industry. Nanotechnology also has a strong commercial potential for the textile industry. Nano-Tex, a subsidiary of US-based Burlington Industries, has undertaken the first work on nanotechnology in textiles. After sometimes more textile firms started investing in nanotechnology growth. Coating is a common method used to apply nano-particles to textiles. Nanoparticles have a large area-to-volume ratio and high surface energy, as a result of which nanotechnology can provide fabrics with a high durability. The future success of nanotechnology in textile applications lies in areas where new functionalities are integrated into robust, multifunctional textile systems without losing the inherent advantageous textile properties, including process strength, durability and softness. Through nanotechnology, textiles can become multifunctional and create unique functional fabrics including antibacterial, UV-protection, fast washing, water & stain repellent, and anti-odorant.

Nanotechnology in Cosmetics: Nanotechnology and nanomaterial's uses can be used in many cosmetic products like moisturizers, sunscreen items, hair products and make-up. A cosmetic includes different skin or hair products. Nearly all major cosmetic fabrics use non-material in their products. There are currently two

principal uses for nanotechnology in cosmetics. The first is the use of nanoparticles as UV filters. The primary compounds used in these applications are titanium dioxide (TiO2) and zinc oxide (ZnO).The second use is for delivery of nanotechnology. Liposomes and noisome, they are both used as delivery vehicles in the cosmetics industry. Nano crystals, Nano emulsions, solid lipid nanoparticles for cosmetic applications are being examined. Also considered for use were the dendrimers and hyper branched polymers. L'Oreal has a patent for a formulations comprising hyper branched materials or dendrimers which, when deposited on a substrate, form a thin film. This formulation could be extended to a wide range of cosmetics[11].

RISKS

- The numerous nanoparticles have effects on the human body, including harmful effects on human health.
- Nanoparticles are deeply integrated in the matrix that can release and are harmful.
- Concentrations of nanoparticles are harmful both at work and in the field.
- Itshazardous waste can cause diseases such as cancer.

CONCLUSION

In many sectors nanotechnology has potential applications, including prints and coatings, fabrics and garments, beauty products, food science, catalysis, etc. Nanotechnology also presents new possibilities for improving the way user calculate, track and manage. Nanotechnology has developed as a growing field which is changing rapidly. New generations of nano-materials must evolve, bringing new and probably unexpected issues with them. Nanotechnology is the future of life. It's all from clothing to food today that every sector in its spectrum should be encouraged more for future and for more innovations in present life.

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