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RESEARCH ARTICLE

The Characterization of Nanomaterias Using Scanning Electron Microscopy and Environmental Applications

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Abstract

Nano materials are classes of substances that have structural components smaller than 100nm and this includes nanoparticles with at least 2-D between 1 and 100nm in the Nano scale. Nano materials have small size which having at least 1-D 100nm or less. It can be Nano scale in 1-D, 2-D, or 3-D and exist in single, fused, aggregated forms with spherical, tubular and irregular shape. The samples of Nano materials were analyzed with scanning electron microscopy to provide images of Nano particles and their agglomerates in sufficient resolution that gives images of Nano materials with clearly identifiable particles. Nano materials have significant commercial impacts that can be increased in the future. Nano materials have good potential for developing the ways in which materials are generated that, the range and nature of functionalities can be accessed. Applications of Nano materials in the environment are different from one another depending on the type of devices used such as nanotechnologies in coatings for exterior surfaces, solar cells for renewable energy and de-colorization of dyes by the effect of Nano composites, medicine, textile, household, construction, chemical, automotive, electronics and engineering industries.

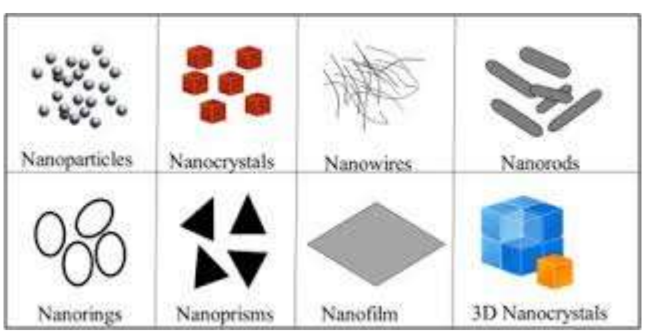
Keyword: Characterization; Nano materials; scanning electron microscopy; applications

Introduction

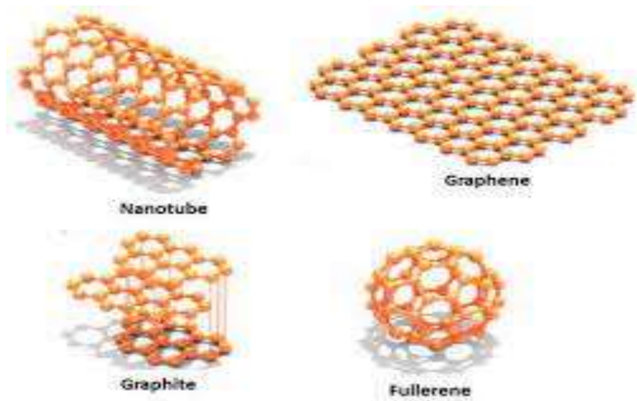
Nano materials depend on a range of 1 to 100nm and it is a new field, it is one billionth of a meter (10^{-9}) precisely. Nano materials have high potential applications in many fields. The pressing challenges nowadays is to look for alternative energy sources which can be used comfortably in the environment that depends on the use of Nano materials in different applications like applications in the field of green chemistry and solar cell (6). The properties that Nano materials have due to their small size, are reasons for their numerous applications (15). Nano material has different application in the environment that depends on the type of device used like nanotechnologies in coating for building exterior surfaces, sonochemical decoration of dyes by the effect of Nano composites and solar cells for clean energy (1). Nano materials from natural inorganic occur through crystal growth from chemical reaction in the Earth's crust and the natural sources of nanoparticles occur from volcanic ash, forest fires, radioactive decay of radon gas. According to (11) nanoparticles have three dimensions on the Nano scale and embedded in a bulk solid to form a Nano composite. Nano materials are grouped into nanoparticle and nanostructured materials. The nanostructured refer to as a condensed bulk materials that are made of grains with grain sizes in nanometer size range (17). Today, nanoparticle generate interest from industries and manufacturers, this then leads to new applications in different fields like medicine, electronics, agriculture and host of others. (8) established three groups of nanoparticle as accident Nano materials which appears as product from industrial or natural processes, such as combustions, cigarettes smokes, fires, and artificial Nano materials which are designed by humans with determined properties and characteristics like Ag nanoparticles in shampoos (9), and virus in living beings. The application of nanoparticle enhanced abilities to remove a variety of both pollutants and mineralization of pollutants and also the design, synthesis, modification of novel nanoparticles allow for enhanced performance for environmental related applications (3). Nano material is slowly gaining interest and becoming commercialized (Eldridge, 2014) and emerge as commodities (12). Materials with Nano scale structure always possess unique optical, electronics, thermo- physical and mechanical properties (14), (7).

Characterization of Nano Materials

The International system (SI) unit term nano as a prefix that shows 10^{-9} part of a unit. Nano materials refers to materials with a dimension between 1 and 100nm, the nanoparticles contain three dimensions in the nanometer range. Quantum mechanical effects can dominate material properties and notable effects can also happened in materials when structures are formed with sizes comparable to any one of many possible length scales. The optical properties of nanoparticles is also a function of the particle diameter, and this effect is shown clearly when the nanometer scale is reached (Wikipedia). When nanoparticles are added to a bulk material, it can strongly influence the mechanical properties of the material like stiffness and elasticity. The polymers can be added to nanoparticles as carbon nanotubes resulting to materials that can be used as light weight replacements for metals. The resulting materials will cause a weight reduction, increase in stability and improved functionality (13). Both the physical and chemical properties of bulk or Nano scale actually depend on its surface properties, but the volume of bulk materials remain unchanged when subdivided into an ensemble of individual Nano materials and the collective surface area is increased (4). According to (16), melting temperature of Nano materials were based on the number of surface atoms and increases of surface to volume ratio which lead to a decrease in particle size and melting point as a result of surface atoms that have greater effect on the chemical and physical properties of nanoparticle. The nature of all materials in bulk has different properties that depends on their structural properties, mechanical, electrical and optical properties like metals, semiconductor and insulators, while nanoparticles have properties that are different from small molecules (1). The physical properties of Nano material are very different from bulk materials which leads to different of new application (5). The electrical properties of nanoparticle material is affected by the microstructure, that is the electrical conductivity which has the value that appears by grain boundary contribution that depends on dc voltages. The grain boundaries in Nano material have great influence on the flow of electronic current. By considering the optical properties of Nano materials, as light incidents on the material from one medium into another, some of the light radiation will be transmitted through the medium and some will be absorbed, some will be reflected at the interface between the two media.



(1)



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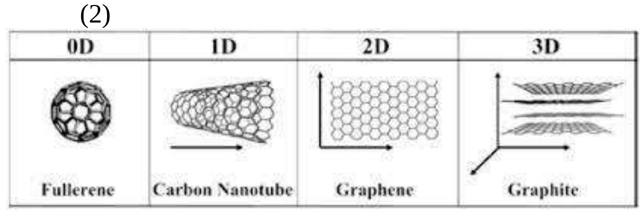

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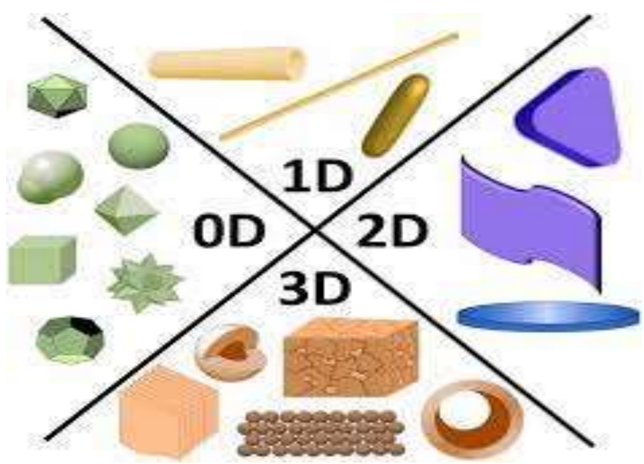

(4)

Figure 3: Pictures 0D, 1D, 2D and 3D Nano materials.

Characterization of Nanoparticles by scanning electron microscopy (SEM)

According to(10) in Ali Salman (2014), scanning electron microscopy (SEM) is an electron microscope that creates images for the sample surface by scanning it with a high energy stream of electrons. In this study, SEM was used to characterize the Nano material (T_i0_2) to reveal information about the surface morphology, the actual composition and sizes of the tested material. The sample was dried, powdered, and then mounted on a sample holder, coating a gold on the surface of the sample. Then, the surface sample is scanned when a high energy stream of electrons is incident on it (9) and the magnified images of less than 3nm in size were produced. But when narrow electron beam was used this gives 3-D characteristics which shows the sample structure. After one image is obtained at the magnification of 50x, the sample is moved one field of view on the x-axis, and the next image is obtained, then at magnifications of 60x, 100x, 200x and 250x, all these produced different images of the sample. The sample position was slightly adjusted to cover particles completely. The sample was also moved in both x and y direction in order to show the zero- point for the coordinate system of the sample. It was found that using this device, the information collected only limited to distribution size, and average population of nanoparticles, that is the composition of the material.

Power	Total Magnifications
5x	50x
6x	60x
10x	100x
20x	200x
25x	250x

Figure 1: The eyepiece and objective lens, and total magnifications.

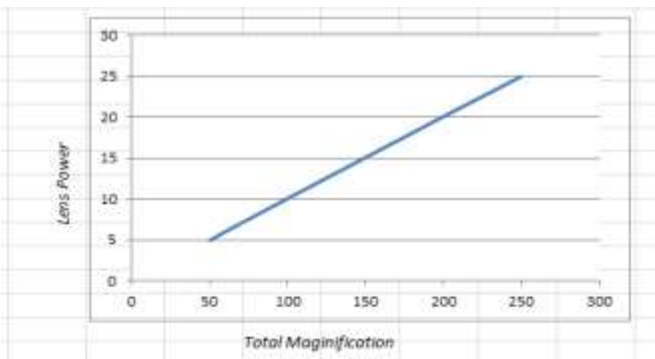

Figure 2: Lens power versus Total magnification.

The eyepiece and objective lens produce power of 5x, 6x, 10x, 20x and 25x that gives total magnifications of 50x, 60x, 100x, 200x and 250x. This means that the images of the particles would appear 50, 60, 100 and 250 times larger than it actually are. From figure 1 and 2. It shows that 5x, 6x and 10x were low power objectives with lower magnification while 20x and 25x are high power objectives with higher magnification.

Environmental Applications

The rapid development in materials and catalysis science and speedy development in technology has led to advances in knowing the usefulness and understanding the controlled synthesis and structure- activity relationship of the Nano materials. The design, synthesis, modification of novel Nano materials allow for enhanced performance for environmental applications (3). The unique properties that Nano materials exhibit due to their small size are strongly responsible for their numerous applications. The 1-D thin film or surfaces of 2-D are very useful in the applications of electronics, chemistry and engineering as thin films at the range of sizes (1-100nm) or monolayer in solar cell or catalysis, these are introduced in different technological applications to include development of sensing system, chemical and biological sensors, fiber- optic systems, magnetic- optic and optical devices (1). T_iO_2 nanoparticles function in solar cell as electrons acceptor. Nano materials are used for data memory, laser diodes, glass fibers, optical switches, filters, conducive and antistatic coatings in the electronic industry. They are also useful for construction materials, flame retardants, building materials for wood, floors, stone, tiles, thermal insulation and other construction materials. Nano materials are very important and useful in both chemical and engineering industries as filters for paint and coating systems which based on Nano composites, magnetic fluids and switchable, adhesives. Also good for wear protection for tools and machines and lubricant- free bearings. Nano materials are also useful in automotive industry for lightweight construction, painting, sensors, coatings for wind screen and car bodies. So many other applications of Nano materials in the environment like in medicine, used for drug delivery system, active agents, medical rapid test, antimicrobial agents and coatings, agents in cancer therapy. In textile, Nano materials are used for surface- processed texiles. Nano materials are very useful in household as storage life sensors, additives, ceramic coating for iron, odors, catalyst, cleaner for glass, ceramic, floor and windows.

Conclusion

Nano materials have numerous applications due to its chemical, physical, mechanical and other properties. It has tunable chemical, physical and mechanical properties due to fine grain size of 1-100nm. It is obvious that nanotechnology has improved and change vision, expectations and capabilities of people to control the world in the field of construction materials. As a result of different production techniques for nanoparticles, no evident with regard to risks associated to potential particle release and if happened at all, the risk of particle release during production process is very low (9). The exposure to nanoparticle could only happen after manufacturing process.

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