**ABSTRACT**

Nanomaterials are cornerstones of nanoscience and nanotechnology. Nanotechnology is an interdisciplinary area of research found major contributions to Science and Technology in the past few years. This field revolutionized the methods of preparation of materials and functionality of devices. It has already shown a significant influence in the fields like medicinal, technological, biological etc. The reasons for selecting nano scale are the increased surface to volume ratio and quantum confinement (QC) effect. The increased surface to volume ratio increases the chemical reactivity and changes the physical strength of the materials. Further, QC effect can become much more significant in deciding the materials properties leading to unusual behaviors.

Recently, the use of nanomaterials in the field of luminescene has been vastly increased due to its unique optical, electronic, and structural properties. Recent advancement in optical equipments namely display systems, lasers, emergency lighting systems, detection of harmful radiations, multidimensional optical data and image storage units, has inspired to performa lot of work on nanostructured luminescent materials also known as nanophosphors. Nano-structured phosphors can be applied in various fields due to decreased particle size nearer to atomic level, which considerably changes the optical and electronic properties.

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**Nanomaterials**

**Introduction**

Nanomaterials are cornerstones of nanoscience and nanotechnology. Nanostructure science and technology is a broad and interdisciplinary area of research and development activity that has been growing explosively worldwide in the past few years. It has the potential for revolutionizing the ways in which materials and products are created and the range and nature of functionalities that can be accessed. It is already having a significant commercial impact, which will assuredly increase in the future.

**What are nanomaterials?**

Nanoscale materials are defined as a set of substances where at least one dimension is less than approximately 100 nanometers. A nanometer is one millionth of a millimeter - approximately 100,000 times smaller than the diameter of a human hair. Nanomaterials are of interest because at this scale unique optical, magnetic, electrical, and other properties emerge. These emergent properties have the potential for great impacts in electronics, medicine, and other fields

**Where are nanomaterials found?**

Some nanomaterials occur naturally, but of particular interest are engineered nanomaterials (EN), which are designed for, and already being used in many commercial products and processes. They can be found in such things as sunscreens, cosmetics, sporting goods, stain-resistant clothing, tires, electronics, as well as many other everyday items, and are used in medicine for purposes of diagnosis, imaging and drug delivery.

Engineered nanomaterials are resources designed at the molecular (nanometre) level to take advantage of their small size and novel properties which are generally not seen in their conventional, bulk counterparts. The two main reasons why materials at the nano scale can have different properties are increased relative surface area and new quantum effects. Nanomaterials have a much greater surface area to volume ratio than their conventional forms, which can lead to greater chemical reactivity and affect their strength. Also at the nano scale, quantum effects can become much more important in determining the materials properties and characteristics, leading to novel optical, electrical and magnetic behaviours.

Nanomaterials are already in commercial use, with some having been available for several years or decades. The range of commercial products available today is very broad, including stain-resistant and wrinkle-free textiles, cosmetics, sunscreens, electronics, paints and varnishes.

**History of Nanomaterials:**

The history of nanomaterials began immediately after the big bang when Nanostructures were formed in the early meteorites. Nature later evolved many other Nanostructures like seashells, skeletons etc. Nanoscaled smoke particles were formed during the use of fire by early humans.

The scientific story of nanomaterials however began much later. One of the first scientific report is the colloidal gold particles synthesized by Michael Faraday as early as 1857. Nanostructured catalysts have also been investigated for over 70 years. By the early 1940’s, precipitated and fumed silica nanoparticles were being manufactured and sold in USA and Germany as substitutes for ultrafine carbon black for rubber reinforcements.

Nanosized amorphous silica particles have found large-scale applications in many every-day consumer products, ranging from non-diary coffee creamer to automobile tires, optical fibers and catalyst supports. In the 1960s and 1970’s metallic nanopowders for magnetic recording tapes were developed. In 1976, for the first time, nanocrystals produced by the now popular inert- gas evaporation technique was published by Granqvist and Buhrman. Recently it has been found that the Maya blue paint is a nanostructured hybrid material. The origin of its color and its resistance to acids and biocorrosion are still not understood but studies of authentic samples from Jaina Island show that the material is made of needleshaped palygorskite (clay) crystals that form a superlattice with a period of 1.4 nm, with intercalates of amorphous silicate substrate containing inclusions of metal (Mg) nanoparticles. The beautiful tone of the blue color is obtained only when both these nanoparticles and the superlattice are present, as has been shown by the fabrication of synthetic samples.

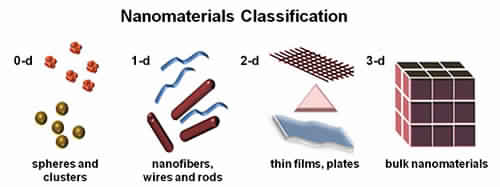
**Classification of nanomaterials**

1. Zero dimensional nanomaterial
2. One dimensional nanomaterial
3. Two dimensional nanomaterial
4. Three dimensional nanomaterial

Nanomaterials have extremely small size which having at least one dimension 100 nm or less.

Nanomaterials can be nanoscale in one dimension (eg. surface films), two dimensions (eg. strands or fibres), or three dimensions (eg. particles). They can exist in single, fused, aggregated or agglomerated forms with spherical, tubular, and irregular shapes. Common types of nanomaterials include nanotubes, dendrimers, quantum dots and fullerenes. Nanomaterials have applications in the field of nano technology, and displays different physical chemical characteristics from normal chemicals (i.e., silver nano, carbon nanotube, fullerene, photocatalyst, carbon nano, silica).

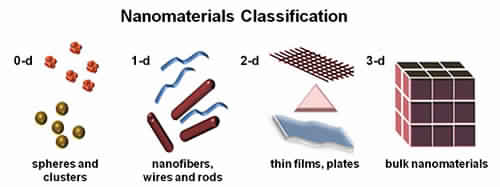
**Zero dimensional nanomaterial**



\* Length,breadth and heights are confined single point.

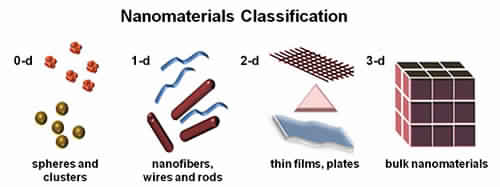
\* Example:nano dots,nano particles

**One dimensional nanomaterial**



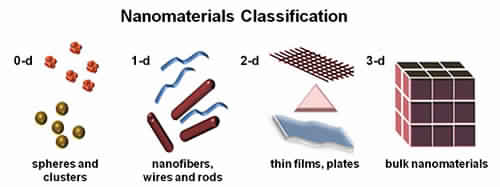
* It has only one parameter length or breadth.
* Example:nanowires and nanotubes.

**Two dimensional nanomaterial**



* It has only two parameter length or breadth or height.
* Example:very thin surface coutings.

**Three dimensional nanomaterial**



* It has all parameter of length, breadth and height.
* Example : crystals.

**Why so much interest in nanomaterials?**

These materials have created a high interest in recent years by virtue of their unusual mechanical, electrical, optical and magnetic properties. Some examples are given below:

* Nanophase ceramics are of particular interest because they are more ductile at elevated temperatures as compared to the coarse-grained ceramics.
* Nanostructured semiconductors are known to show various non-linear optical properties. Semiconductor Q-particles also show quantum confinement effects which may lead to special properties, like the luminescence in silicon powders and silicon germanium quantum dots as infrared optoelectronic devices. Nanostructured semiconductors are used as window layers in solar cells.
* Nanosized metallic powders have been used for the production of gas tight materials, dense parts and porous coatings. Cold welding properties combined with the ductility make them suitable for metal-metal bonding especially in the electronic industry.
* Single nanosized magnetic particles are mono-domains and one expects that also in magnetic nanophase materials the grains correspond with domains, while boundaries on the contrary to disordered walls. Very small particles have special atomic structures with discrete electronic states, which give rise to special properties in addition to the super-paramagnetism behaviour. Magnetic nanocomposites have been used for mechanical force transfer (ferrofluids), for high density information storage and magnetic refrigeration.

PROPERTIES OF NANOMATERIALS

* The nanomaterial have high strength, hardness, formability and toughness.
* These materials exhibit super pasticity even at lower temeratures.
* Size of the grains controls mechanical,electricle,opticle,chemical and magnatic property.
* The magnetization and coercivity are higher.

**APPLICATIONS**

* Nanomaterials are used for the fabrication of single processing elements. such as: filters,delay lines,switches, etc.
* These materials are used to make semiconductor lasers,nanomaterials,memory device.
* Hydrogen-based sensors made by nanomaterials are used in power generation.
* Light source - QD lasers, QC (Quantum Cascade) lasers
* Light detector – QDIP (Quantum Dot Infrared Photo-detector)
* Electromagnetic induced transparency (EIT) – to obtain transparent highly dispersive materials

**ADVANTAGES**

* Low maintenance.
* Fix micro cracking.
* Corrosion-resistance.
* Low life-cycle cost.
* Improve segregation resistance.
* Reduces the thermal transfer rate.

**DISADVANTAGES**

* Require a lot of energy.
* Nanotubes might cause a lung problem.
* The research is in its early stage yet.

**Conclusion**

* Although the existing methods are appropriate to assess many of the hazards associated with the products and processes involving [nanoparticles](https://www.greenfacts.org/glossary/mno/nanoparticle.htm), they may not be sufficient to address all the hazards. Also, the existing methods used for environmental [exposure](https://www.greenfacts.org/glossary/def/exposure-exposed-expose.htm)assessment are not necessarily appropriate. Therefore, the current risk assessment procedures need to be modified for nanoparticles.
* Existing methodologies need to be modified or new ones developed to be able to better determine the physical and chemical properties of nanoparticles, measure exposure to them, assess their potential hazard, and detect their movement inside living systems, be it in human [tissues](https://www.greenfacts.org/glossary/tuv/tissue.htm) or in the environment.
* In general, and in spite of a rapidly increasing number of scientific publications dealing with [nanoscience](https://www.greenfacts.org/glossary/mno/nanoscience.htm) and [nanotechnology](https://www.greenfacts.org/glossary/mno/nanotechnology.htm), there is insufficient knowledge and data concerning the characteristics of nanoparticles, their detection and measurement, their behaviour in living systems, and all aspects of their harmful potential in humans and in the environment, to allow for satisfactory risk assessments for humans and ecosystems to be performed.