

Types of Nanomaterials

Non-engineered and engineered NPs.

Nanoparticles are two types:

Non-engineered NPs present in the environment are derived from natural events such as terrestrial dust storms, erosion, volcanic eruption, and forest fires.

Terrestrial dust storms

Dust storms appear to be the largest single source of environmental nanoparticles.

Approximately 50% of troposphere atmospheric aerosol particles are minerals originating from the deserts.

The size of particles produced during a dust storm varies from 100 nm to several microns.

Extraterrestrial dust

Nanoparticles exist widely in extraterrestrial space.

Examples of dust collected from space, from the moon, and on Mars.

The extraterrestrial dust poses major environmental problems for astronauts as well as for equipment.

Forest fires

Forest fires and grass fires are primarily caused by lightning strikes or by human activity.

Major fires can spread ash and smoke over thousands of square miles, and lead to an increase of particulate matter (including nanoparticles) exceeding ambient air quality standards.

Volcanoes

When a volcano erupts, ash and gases containing particulate matter ranging from the nanoscale to microns, are propelled high into the atmosphere, sometimes reaching heights over 18000 meters. A single volcanic eruption can eject up to 30 million tons of ash.

Engineered NPs (ENPs)

They are intentionally produced by man using many different materials, such as:

- Metals (including Au, Ag, Zn, Ni, Fe, and Cu).
- Metal oxides (TiO₂, Fe₂O₄, SiO₂, CeO₂, and Al₂O₃).
- Nonmetals (silica and quantum dots).
- Carbon (graphene and fullerene).
- Polymers (alginate, chitosan, hydroxyethylcellulose, and polyhydroxyalkanoates).
- Lipids (soybean lecithin and stearic acid).

Carbon nanoparticles

CNTs, most simply, are molecules of carbon. CNTs display extraordinary mechanical, electronic, and optical properties. *One of the key advantages of CNTs is their strength.

*CNTs are expected to have huge applications in nanometer-sized electronics, such as one-dimensional quantum wire, or to strengthen polymer materials.

Nanoclay

Nanoclay: a clay consisting of nano-sized particles. There are two origins of nanoclay, firstly, the in situ alteration of volcanic ash, and secondly the hydrothermal alteration of volcanic rocks.

There is interest to use it in food packaging applications such as to make transparent containers and covering films.

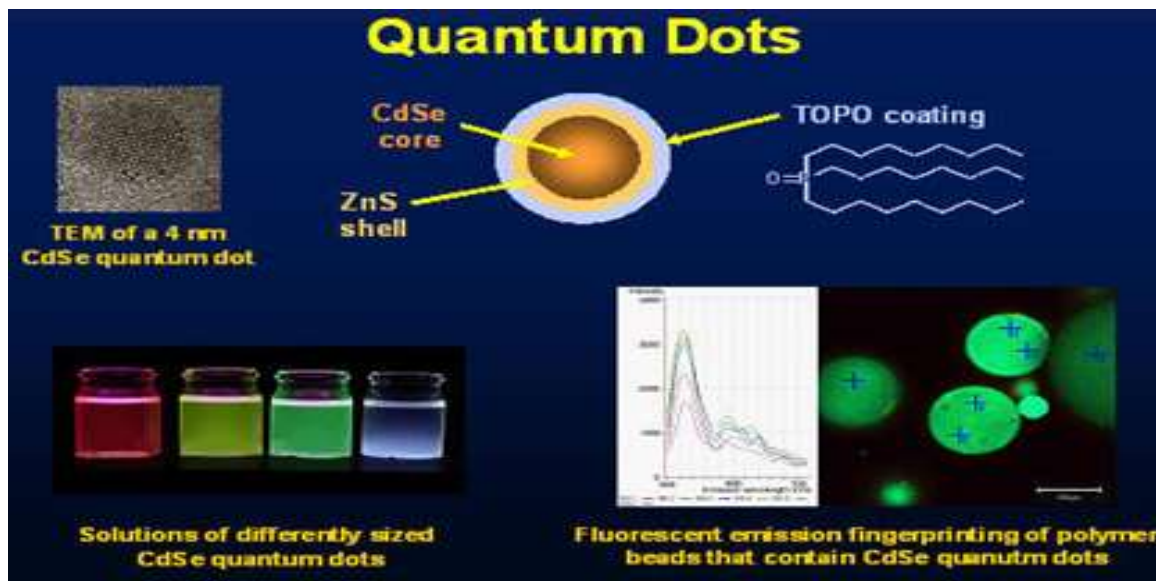
Types of nanoclay

The structure of the nanoclay particles can be divided into two main groups, platelets and halo site nanotubes.

Quantum dots

Quantum dots are one of the most interesting nanotechnology developments.

-About 1 to 6 nanometers in diameter, a quantum dot is a nano-sized semiconductor crystal, and are so small that they are also known as artificial atoms. Quantum dots have a range of remarkable electrical, magnetic, optical, and catalytic properties.



-Quantum dots are spherical or cubic-like in shape and are made up of thousands of atoms. With highly luminous quantum dots, doctors are able to identify cancerous tissue in vivo by using a Mercury lamp. The quantum dots are attracted to cancerous tissue.

Nanocrystals

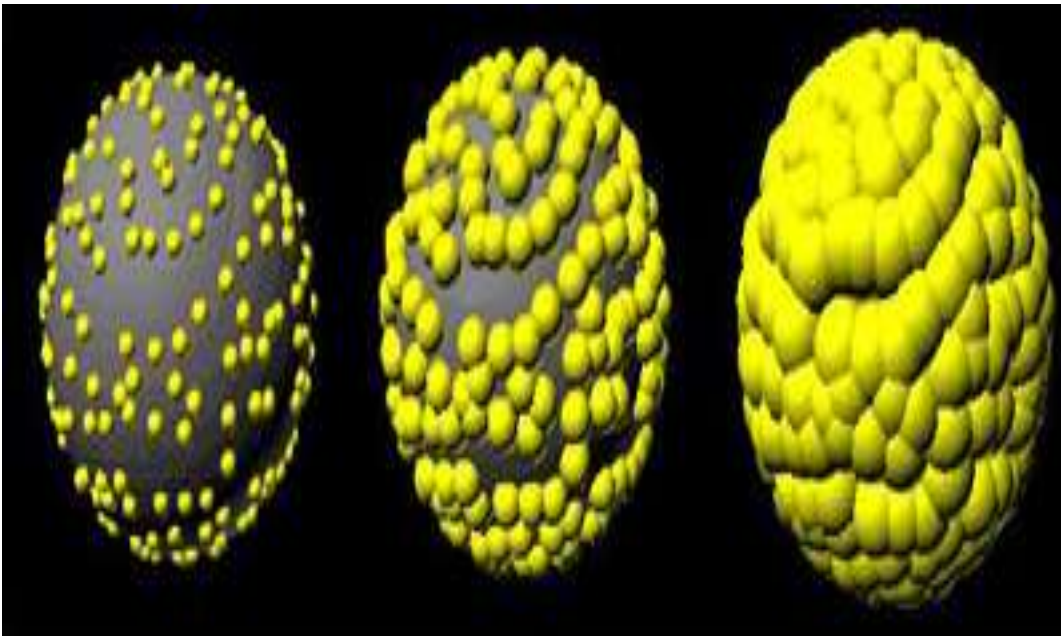
Nanocrystals are grown from inorganic materials. Atoms aggregate into a crystalline form which is known as a cluster. Usually, nanocrystals are grown from metals and semiconductors, however, they have been made from, gold, rhodium, platinum, palladium, and silver. Nanocrystals in diameter are roughly 10 nanometers.

-The most interesting application of nanocrystals may be in the development of solar cells.

Nanoshells

-Nanoshells consist of a silica core, with an ultrathin metallic coating. Nanoshells are ball shaped and about 5% the size of a red blood cell. The core of the nanoshell, which has a diameter of about 100 nm, is non-conducting, while the outer layer, usually gold or silver, approximately 8 to 10 nm is conducting.

Nanoshells can be created with all shapes, and sizes. It can look like rods, balls, or eggs. Non-toxic cancer treatment is the most exciting application of nanoshells. Nanoshells have been injected into the bodies of animals and then illuminated giving off intense heat destroying tumor cells. Scientists can create the optimal sized nanoshell to create the optimal heating which destroys the tumor but not healthy tissue nearby.



Nanowire

A nanowire is simply a wire made of metal, silicon, or other conductor which is nano-sized. Nanowires are also known as quantum wires. Nanowires allow the creation of other nano-sized technologies such as nano-robots. Such nano-sized robots could be used in the medical diagnoses.

Self assembly lipid microtube

Glycero-phosphatidylcholine it can self-assembly into a lipid microtubule structure. The lipid microtubule is a stable structure.

Both lipid microtubules and metalized microtubules can be used as vehicles for encapsulating biological active molecules to control their release and to develop micro-components in biological and mechanical systems.

Peptide nanotubes

Peptide nanotubes consist of cyclic peptide from an equal number of D-amino acid and L-amino acid. The inner diameter of the tube determines by the number of amino acids.

Peptide nanotubes are used as a new type of antibiotics used to treat bacterial infections that resistant to conventional antibiotics. It is Called smart drugs. These cyclic peptides are called nanobiotics .

Magnetic nanoparticles

Magnetic nanoparticles are a class of nanoparticle which can be manipulated using magnetic field. Such particles commonly consist of magnetic elements such as iron, nickel and cobalt and their chemical compounds.

In most cases, the particles range from 1 to 100 nm in size. A wide variety of applications have been envisaged for this class of particles these include:

Magnetic nanoparticles are used in an experimental cancer treatment.

Another potential treatment of cancer includes attaching magnetic nanoparticles to free-floating cancer cells. Application of magnetic nanoparticles are drug targeting Biomedical imaging, environmental remediation and others.

Inorganic Nanocages

Inorganic Nanocages are hollow porous gold nanoparticles ranging in size from 10 to over 150 nm. Gold nanocages also absorb light and heat up, killing surrounding cancer cells. functionalized nanocages with cancer-specific antibodies so they specifically attach to cancer cells.

Nanofoams

Nanofoams of iron, cobalt, nickel, copper, silver, and palladium have been prepared. These foams are effective catalysts and are being investigated for other applications.

Nanofibers

Nanofibers are defined as fibers with diameters less than 100 nm. The most frequently mentioned materials with nanofiber morphology are: titanium dioxide (TiO_2), silicon dioxide (SiO_2), aluminum oxide (Al_2O_3), or platinum (Pt).

In Medical uses: Artificial organ components, tissue engineering, drug delivery, wound dressing, medical textile materials.

Nanomesh

The nanomesh is a new inorganic nanostructured two-dimensional material. It was discovered in 2003. The nanomesh looks like an assembly of hexagonal pores at the nanometer scale.

The distance between 2 pore centers is only of 3.2 nm, whereas each pore has a diameter of about 2 nm and is 0.05 nm deep. interesting applications of the nanomesh in areas like nanocatalysis, surface functionalisation, etc.

Nanoflowers

These crystalline nanostructures of silicon carbide are grown from droplets of gallium on a silicon surface.

These nanoflowers will be used in new applications, such as water repellent coatings or new types of solar cells.