



Tikrit University
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Lect.2.

Introduction of Types Nanoparticles

the name, nanoparticles are very small size particles.

The size of nanoparticles is in the range of 1 -100 nanometers.

So any particles below 100 nm in size can be termed nanoparticles.

These particles are found to be **composed of a few hundred atoms.**

These small-sized particles of any material possess some distinct properties and qualities that are significantly different from the bulk material.

Due to the very small size, the ratio of surface area to volume is much more in the case of a nanoparticle.

This feature attributes to some unique optical, chemical, and physical properties.

For example, particles of a metal having size less than 50 nm have different performance in terms of ductility as compared to the larger size of the same metal.

Lect.2.Types of Nanoparticles

Nanoparticles can be of different types depending on their size, texture, and properties.

Generally, they are classified into the following groups:

1-Carbon-Based .

These nanoparticles are made up of carbon components and are used for strengthening structures as an alternative to steel.

Carbon-based nanoparticles include two main materials: carbon nanotubes (CNTs), and fullerenes.

2-Ceramic-Based

These are made up of oxides, carbonates, and phosphates.

They show good resistance to chemicals and heat.

3-Metal-Based ..

These nanoparticles are prepared from metals using chemical and electromechanical processes.

These nanoparticles have applications in research fields, detection and imaging of biomolecules, and environmental and bioanalytical applications.

For example in SEM gold nanoparticles are used to coat the sample before analysis.

This is usually done to enhance the electronic stream, which helps us to get high-quality images.

Lect.2

4-Semiconductor-Based

These nanoparticles have properties similar to many metals and non-metals. Its usages are in photocatalysis, electronics devices, photo-optics, and water splitting.

5-Polymer-Based .

These are particles obtained from organic materials.

They have applications in drug delivery and diagnostics.

Drug delivery with polymeric nanoparticles is highly biodegradable.

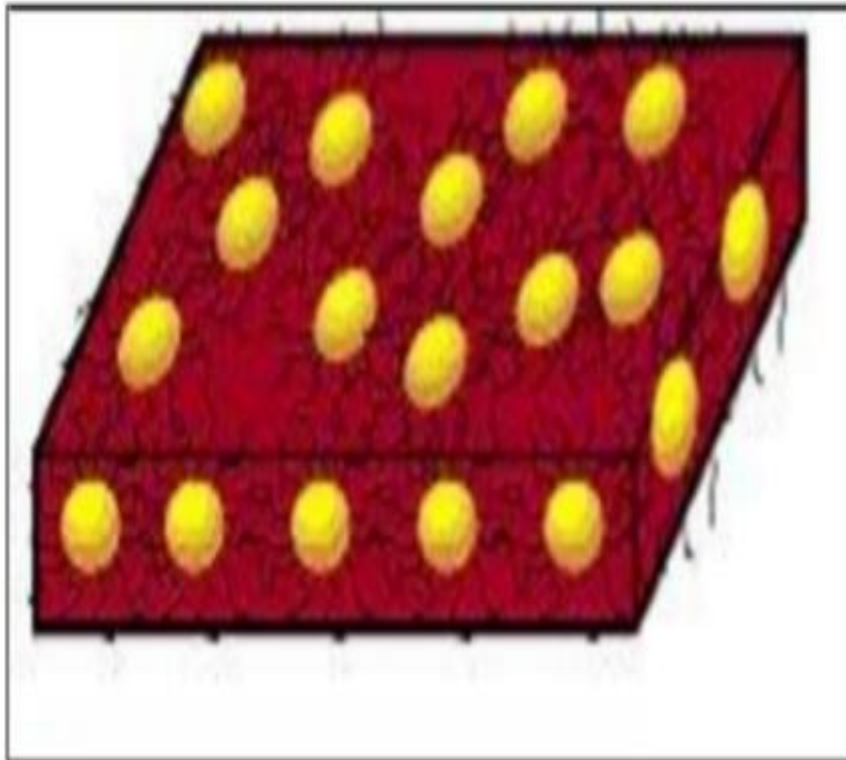
Assistant professor Dr. Reem.S.Najm 2025/2/18

Lect.2

Forms of nanomaterial's

1- Quantum Dots

Quantum dots are tiny particles or Nano crystals of a semiconducting material with diameters in the range of 2-10 nanometers (10-50 atoms).



Quantum Dots

Lect.2.2-Fullerene

A nanostructure, which is a molecule composed of 60 carbon atoms and symbolized by the symbol C₆₀.

The fullerene molecule is spherical in appearance and looks exactly like a football, containing 12 pentagons and 20 hexagons.

Since the discovery of how to manufacture fullerene in 1990, it has been prepared in commercial quantities.

It was also possible to obtain molecules with a different number of carbon atoms, such as C₃₆, C₄₈, and C₇₀, but scientists showed special interest in the C₆₀ molecule.



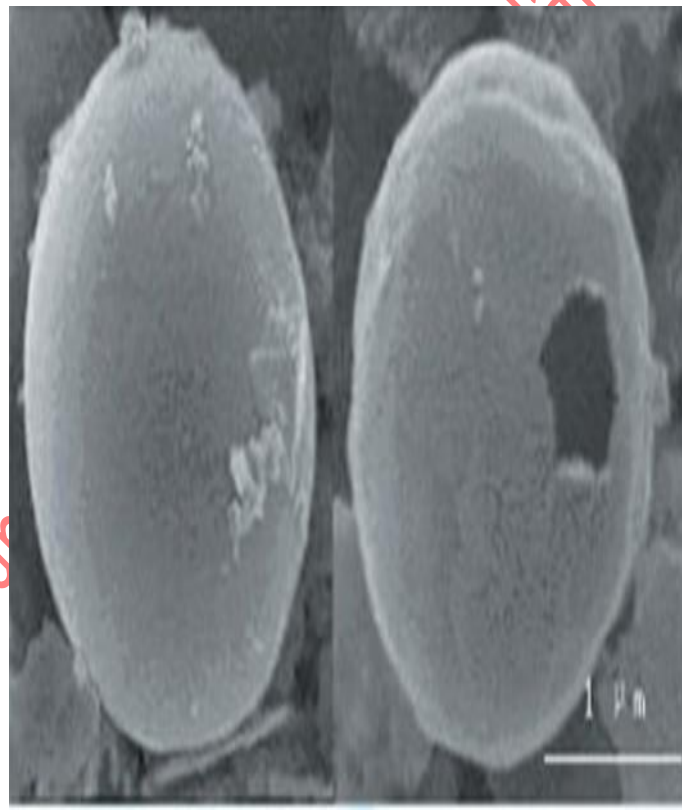
Fullerene.

Lect.2.**3-Nano balls**

Carbon Nano spheres belong to the class of fullerenes, C₆₀, but differ slightly from them in structure as they are multi-shelled.

They are also vacuolar, unlike nanoparticles, while there are no gaps on the surface as in multi-shell nanotubes.

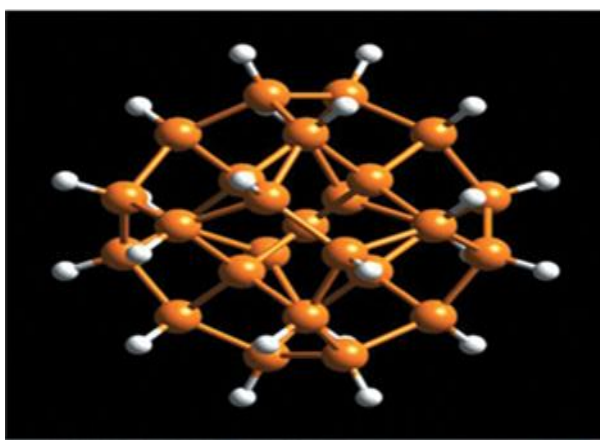
Because their structure resembles an onion, scientists called them (bucky onions), and the diameter of the Nano spheres may reach 500 nanometers or more.



Nano balls

Lect.2.4-Nanoparticles

Nanoparticles are microscopic atomic or molecular aggregates ranging in number from a few atoms (molecule) to a million atoms, bound together in a roughly spherical shape with a radius of less than 100 nanometers.



Nanoparticles

Lect.2.5-Nanotubes

Nanotubes come in many shapes, they may be straight, spiral, curvy, bamboo, conical, etc.

These tubes also have unusual properties in terms of strength, hardness, electrical conductivity, etc.

Nano carbon also has other forms such as Nano spheres and nan fibers.

The wall of the tube is either single atoms, and in this case it is called a single wall nanotube (SWNT), or two or more, and it is called a multi-wall nanotube (MWNT), and the diameter of the tube ranges from less than one nanometer to 100 nanometers (smaller than the width of 50,000 times the length of a head hair), while its length may reach 100 micrometers to form a nanowire.

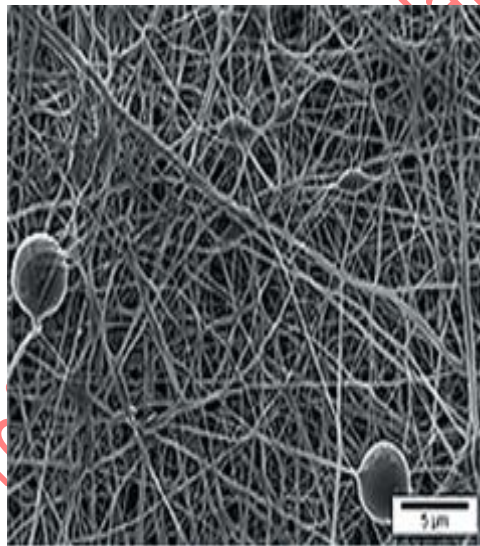


Nanotubes

Lect.2.**6-Nanofibres**

Nano fibers come in many shapes, such as hexagonal, helical, and corn-shaped fibers. The side portion of a sheet or tubular Nano fiber has a hexagonal shape, for example, rather than a cylindrical shape.

The most famous Nano fibers are those made from polymer atoms. The ratio of surface area to volume is large in the case of Nano fibers, as well as nanotubes, as the number of surface atoms is large compared to the total number, and this gives these fibers distinctive mechanical properties such as hardness, tensile strength, etc.



Nano fibers.

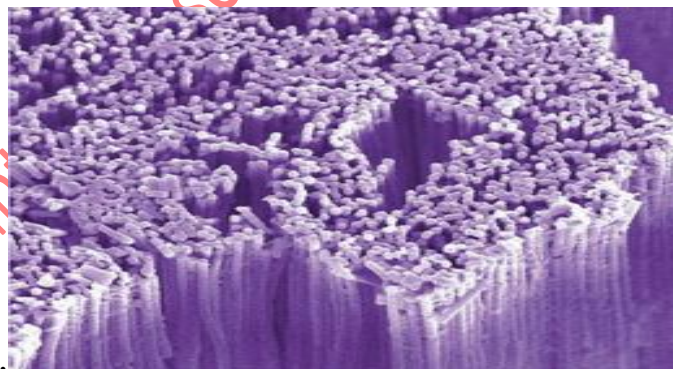
Lect.2.7-Nanowires

They are wires with a diameter of less than one nanometer and different lengths, that is, a length to width ratio of more than 1000 times, so they are attached to one-dimensional

materials, and as expected, they outperform traditional (three-dimensional).

wires Nanowires have many shapes, they may be spiral or symmetrical, pentagonal in shape. When prepared in the laboratory, nanowires may be in the form of wires hanging from their upper end or deposited on another surface.

One of the methods used to produce attached wires is to chemically abrade a large wire or bombard a large wire with high-energy particles.



Nanowires

8-Nano composites

They are materials to which nanoparticles are added during the manufacture of these materials, and as a result, the nanomaterial shows a significant improvement in its properties.

Adding carbon nanotubes changes the electrical and thermal conductivity properties of the material.

Adding other types of nanoparticles may improve optical and dielectric properties as well as mechanical properties such as hardness and strength.

The volume percentage of nanoparticles added should be very low (in the range of 0.5% to 5%) because the surface area to volume ratio of nanoparticles is high.