Tikrit University
College of Veterinary Medicine.

Reem.S.Najm 2025\2\11

Subject name: Special Material\Nano

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Lect.1.

Introduction to NanoParticales

1-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.

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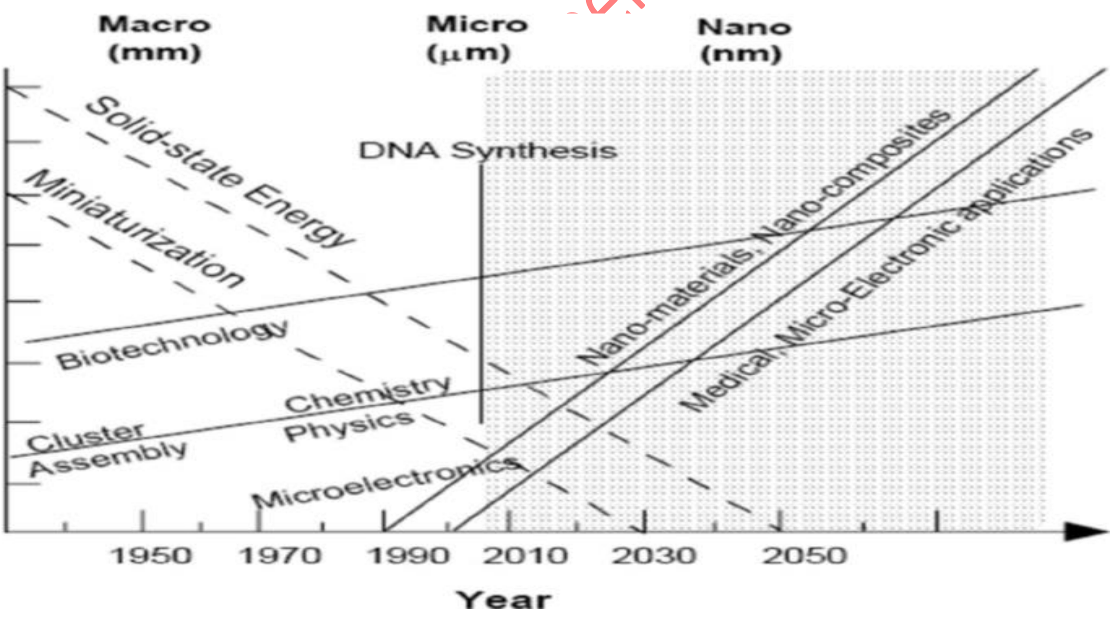

Fig. 1. Evolution of science and technology and the future.

Lect.1.

What,s is Nano

Nano(symbol)is (n) is a unit prefix meaning one billionth.

Used primarily with the metric system, this prefix denotes a factor of (10^{-9} or 0.000000001).

It is frequently encountered in science and electronics for prefixing units of time and length.

Defined Nano

The origin of the word Nano is derived from the Greek word (Nanos).

which means dwarf and means every small thing, and here it means nanotechnology, microscopic technology, or miniature technology.

Because of their very small size, nanoparticles can penetrate very easily through the skin, lungs, and intestinal systems of humans without knowing their impact on human health.

Some experiments have indicated that nanoparticles, when inhaled, can cause inflammation in the lungs more than large-sized particles do, Of the same type.

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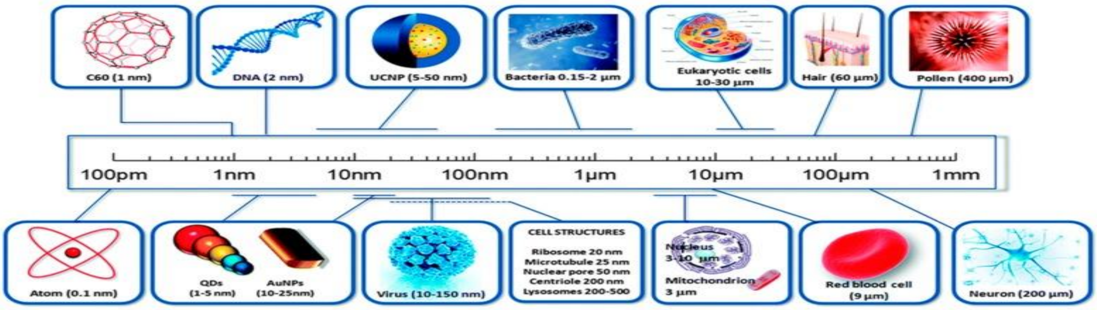

Fig.2. A comparison of sizes of nanomaterial.

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What is Nanotechnology

Nanotechnology is the science and engineering of small things, in particular things that are less than 100 nanometers in size (in one direction).

Nano is an SI prefix and comes from the Greek word for dwarf - Nanos.

One nanometer is 10^{-9} meters or about 3 atoms long.

At first, it can be hard to comprehend the Nano scale because it is so much smaller than our everyday experience.

While we know intuitively that a dime is smaller than a basketball, and even that a red blood cell (which can be observed in the light microscope) is smaller than a marble, we have no experience with objects that are billionths (10^{-9}) of a meter (1 nanometer or nm) in length.

When was the last time you put your hands around a strand of DNA (2.5 nm) or measured the diameter of a flu virus (100 nm), Here are a few comparisons to help understand how small a nanometer is:

1-An average human hair is about 60,000 -100,000 nanometers wide.

2- Your fingernail grows a nanometer every second .

3- A sheet of paper is about 100,000 nanometers thick.

4- In one inch there are 25,400,000 nanometers.

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Defined Nanomaterial's

Nanomaterial's (symbol)is (NMs) are defined as materials containing particles where one or more external dimensions are in the size range of (1–100nm).

What are nanomaterial's .

Nanomaterial's are usually considered to be materials with at least one external dimension that measures 100 nanometers or less or with internal structures measuring 100 nm or less.

They may be in the form of particles, tubes, rods or fibers.

The nanomaterial's that have the same composition as **known materials in bulk form may have different physic-chemical properties than the same materials in bulk form, and may behave differently if they enter the body.**

They may thus pose different potential hazards.

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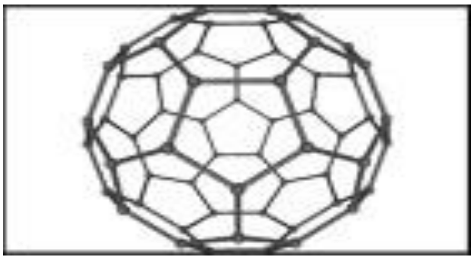

Fig (3) Nanomaterial's.

Lec.1.

Where are nanomaterial's found.

Some nanomaterial's can occur naturally, **such as blood borne proteins essential for life and lipids found in the blood and body fat.**

Scientists, however, are particularly interested in engineered nanomaterial's (ENMs), which are designed for use in many commercial materials, devices and structures. Already, thousands of common products including sunscreens, cosmetics, sporting goods, stain-resistant clothing, tires, and electronics—are manufactured using ENMs.

They are also in medical diagnosis, imaging and drug delivery and in environmental remediation.

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Fig(4). Nanomaterial's

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4-Why are nanomaterials important .

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:

i) Nanophase ceramics are of particular interest because they are more ductile at elevated temperatures as compared to the coarse-grained ceramics.

ii) 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.

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History of Nanomaterials:

Roman glaziers (4th century) made a "Lycurgus cup" of soda-lime glass dyed with Au and Ag nanoparticles that appears green (in reflected light) and red (in transmitted light).

In the Middle Ages: multi-colored window panes of churches were stained with nanoparticles of various metals.

In the 16th and 17th centuries, an extremely strong yet flexible Damascus sword was made using carbon nanotubes and iron carbide (Fe_3C) nanowires.

They were unusually strong, yet flexible enough to bend from hill to tip.

Fig(5).

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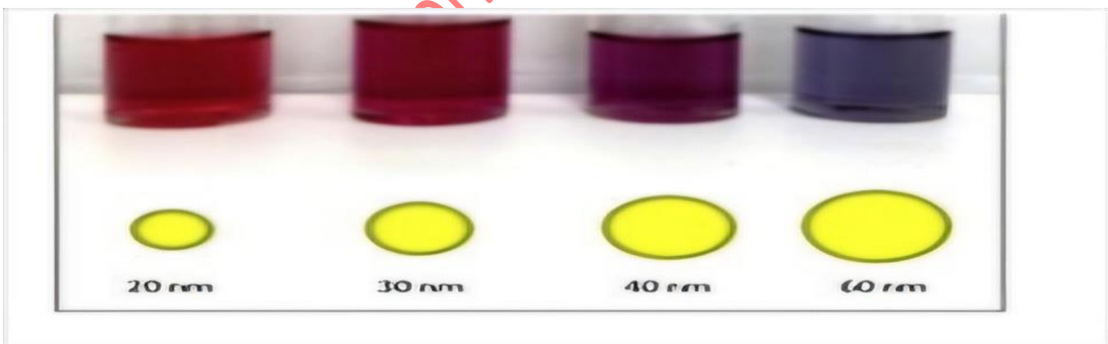
Nanomaterials: History - Optical Properties.

Michael Faraday (1857) attributed the color of stained-glass windows to the presence of metallic nanoparticles.

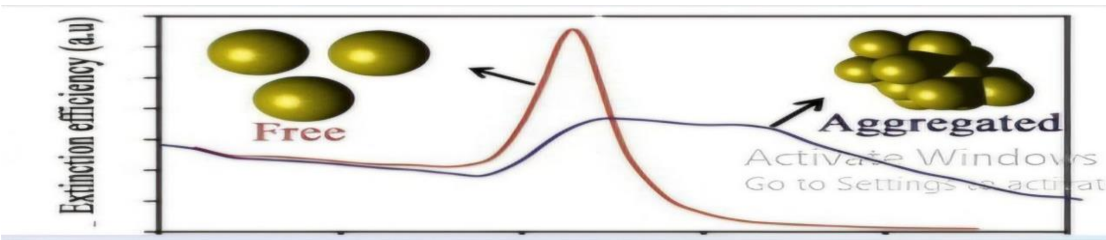
He prepared windows to the presence of metallic nanoparticles.

He prepared red gold nanoparticles (stored at the Royal Institution in London).

G. Mie (1908) explained the change in the color of glasses by the size of metal particles scattered in glasses.



R.A. Zsigmondy (first decade of the 20th century), studied the optical properties of gold and other nanoparticles and received the Nobel Prize in Chemistry in 1926.



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Properties of Nanoparticles

Nanoparticles are important scientific materials that have applications in biotechnology and pharmacology.

They bridge the gap between bulk materials and molecular structures.

While bulk materials have constant physical properties regardless of size, the size of a nanoparticle dictates its physical and chemical properties.

Thus, the properties of a material change as its size approaches nanoscale proportions and as the percentage of atoms at the surface of a material becomes significant.

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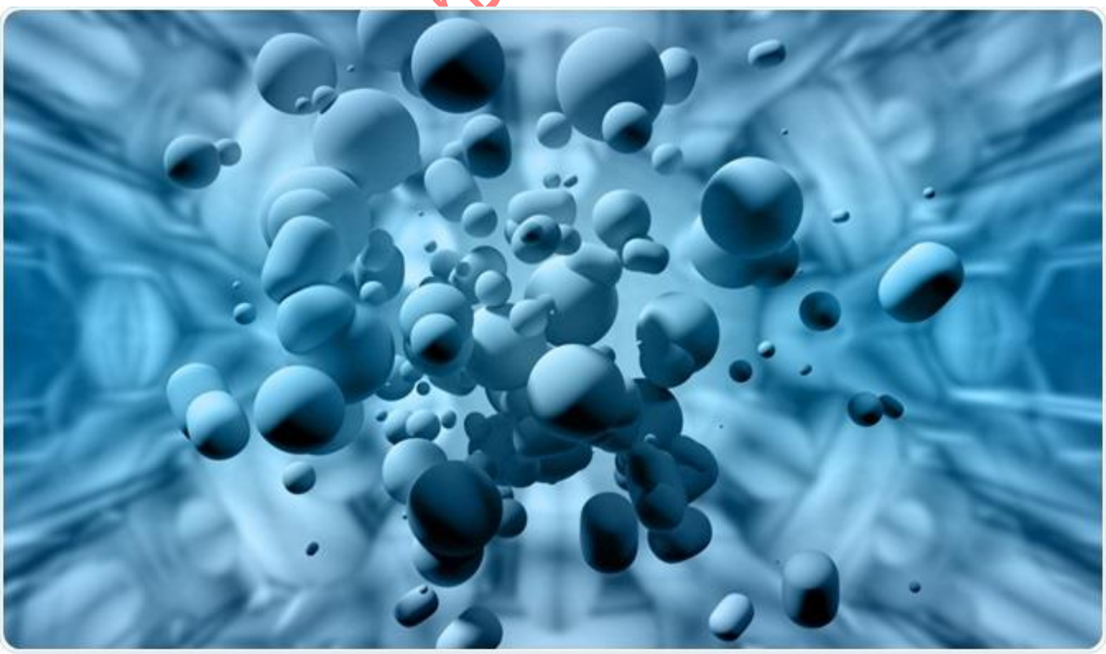

Fig.6.

Lect.1

Chemical Properties of Nanoparticle

Chemical properties include the elemental composition of nanomaterials and its surface chemistry such as zeta potential and photocatalytic properties.

The chemical properties of a material are determined by the type of motion of its electrons, nanoparticles have a very high surface area to volume ratio and make excellent catalysts.

Physical properties of nanoparticles

Nanoparticles consist of three layers: the surface layer, the shell layer, and the core, The surface layer usually consists of a variety of molecules such as metal ion, surfactants, and polymers.

Nanoparticles may **contain a single material or maybe consist of a combination of several materials. Nanoparticles can exist as suspensions, colloids, or dispersed aerosols depending on their The properties of ‹chemical and electromagnetic properties nanoparticles are dependent their size.**

Main differences between nanomaterials and bulk materials:

Nanomaterials are particles that have their size in 1-100 nm range at least in one dimension.

We cannot see their particles through the naked eye.

Moreover examples of these materials include nanozymes, titanium **‹dioxide, nanoparticles, graphene,**

Bulk materials are particles that have their size above 100 nm in all dimensions.

We can see their particles through the naked eye.

The examples of these materials include plaster, sand, gravel, cement, ore slag, salts, etc.

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