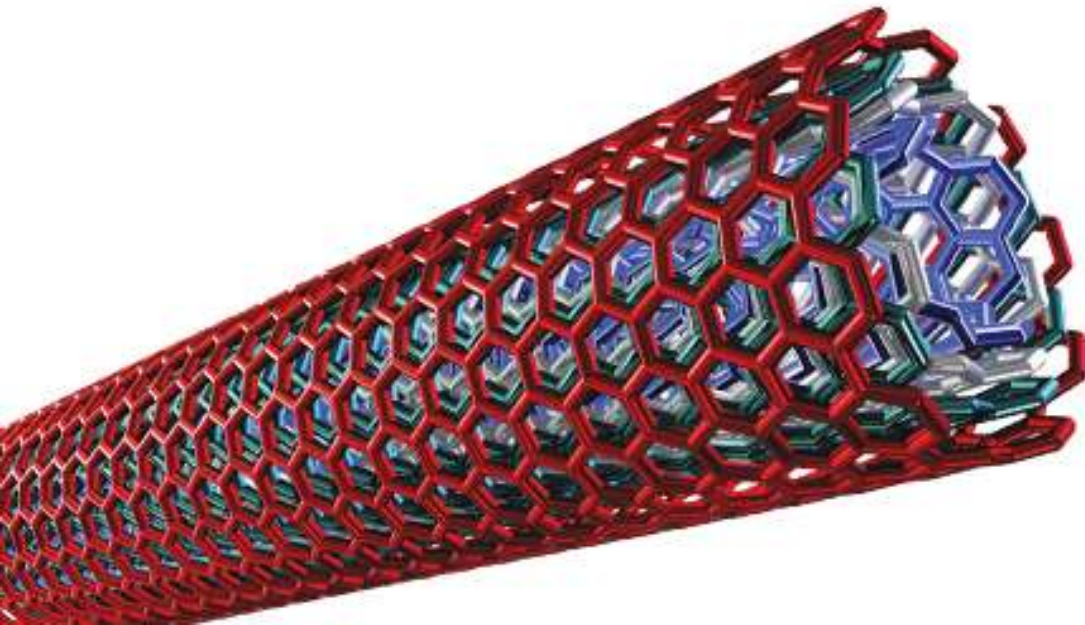


NANOMATERIALS



Ziad zohdy

What is nanomaterial

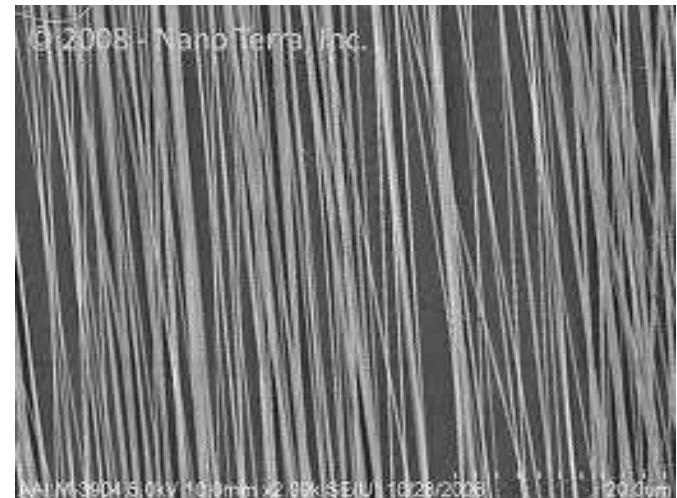
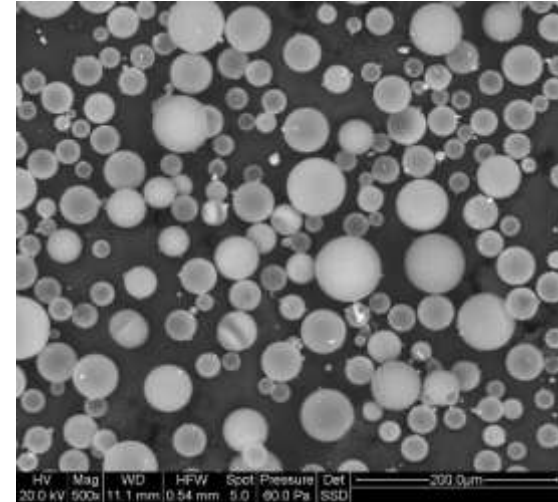
- Nanomaterials are commonly defined as materials with an average grain size **less than 100 nanometers**
- Nanomaterials have extremely small size which having at least **one dimension 100 nm**
- **One billion** nanometers equals **one meter**

- The average width of a **human hair** is on the order of **100,000 nanometers**
- A single particle of **smoke** is in the order of **1,000 nanometers**

Nanomaterial shapes

- nanomaterials can be nanoscale in **one dimension** (surface films)
- **Two dimensions** (strands or fiber)
- **Three dimensions** (particles)

- They can exist in single or fused forms with spherical, tubular, and irregular shapes.



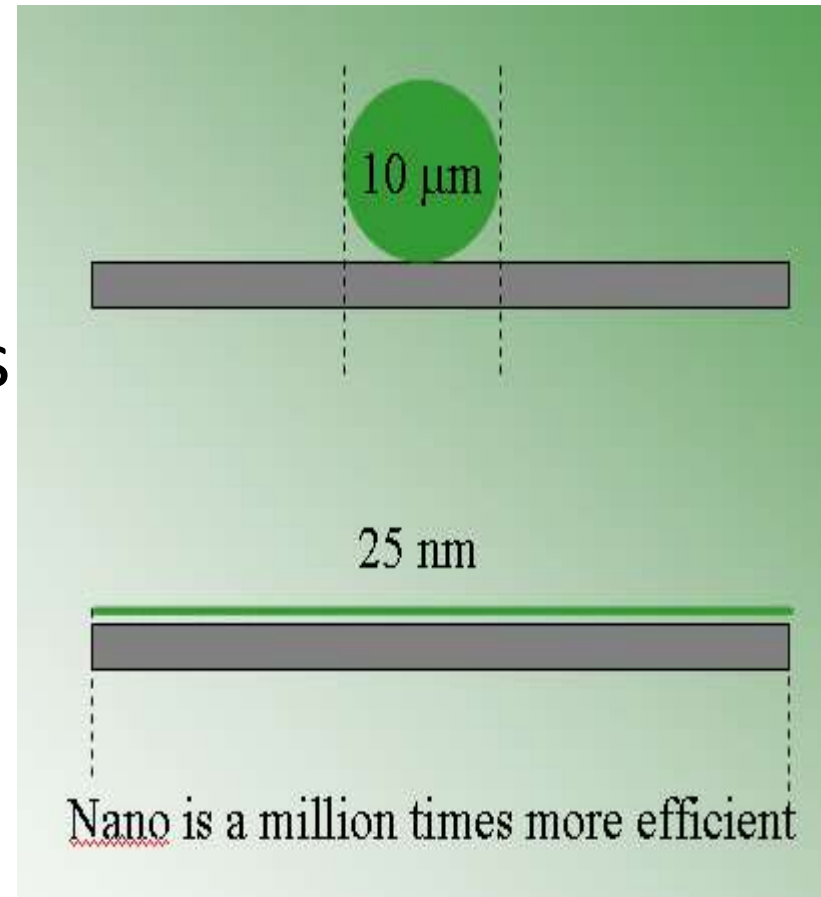
Why nanomaterials ?

- Nanotechnology exploits benefits of ultra small size, enabling the use of particles to deliver a range of important benefits
 - Small particles are **'invisible'** :
 - **Transparent Coatings/Films** are attainable
 - Small particles are **very weight efficient**:
 - Surfaces can be modified with minimal material

- the behavior of nanomaterials may depend more on **surface area** than particle composition itself.
- Relative-surface area is one of the principal factors that enhance its reactivity, strength and electrical properties.

Weight efficient and Uniform coverage

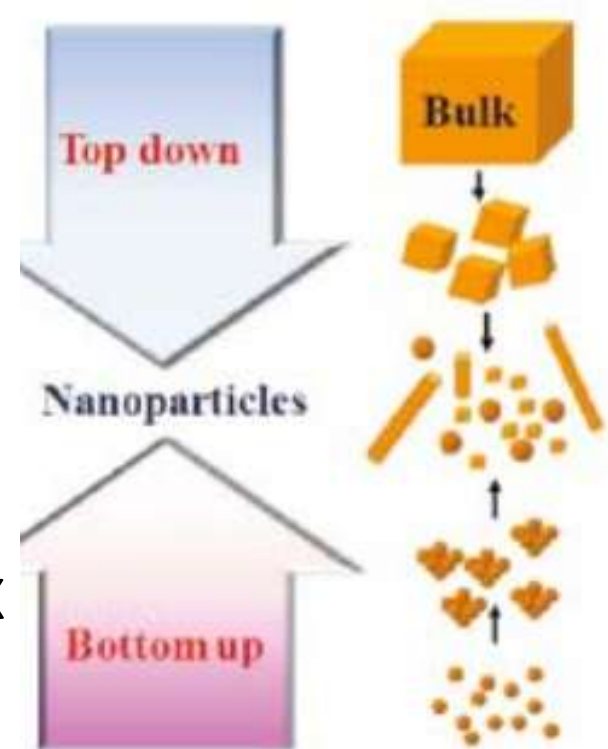
- Large spherical particles do not cover much surface area
- Nanoparticles Equal mass of small platelet particles provides thorough coverage (1 x 10⁶ times more)



- by patterning matter on **the nano scale**, it is possible to vary fundamental properties of materials **without changing the chemical composition**

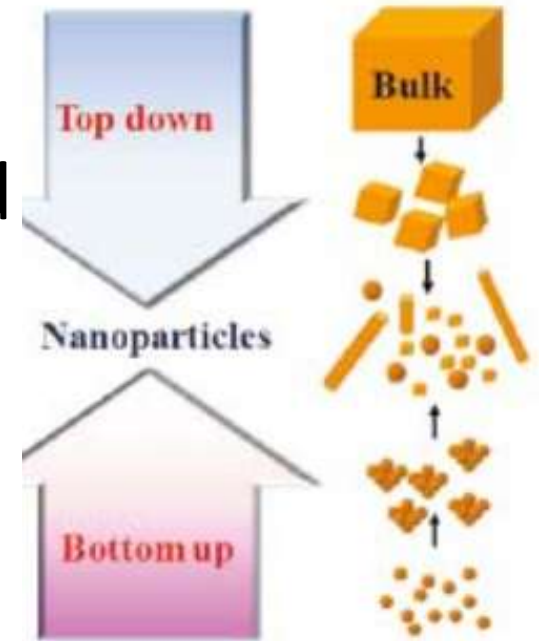
Approaches

- **Top-down** – Breaking down matter into more basic building blocks. Frequently uses chemical or thermal methods.
- **Bottoms-up** – Building complex systems by combining simple atomic-level components.



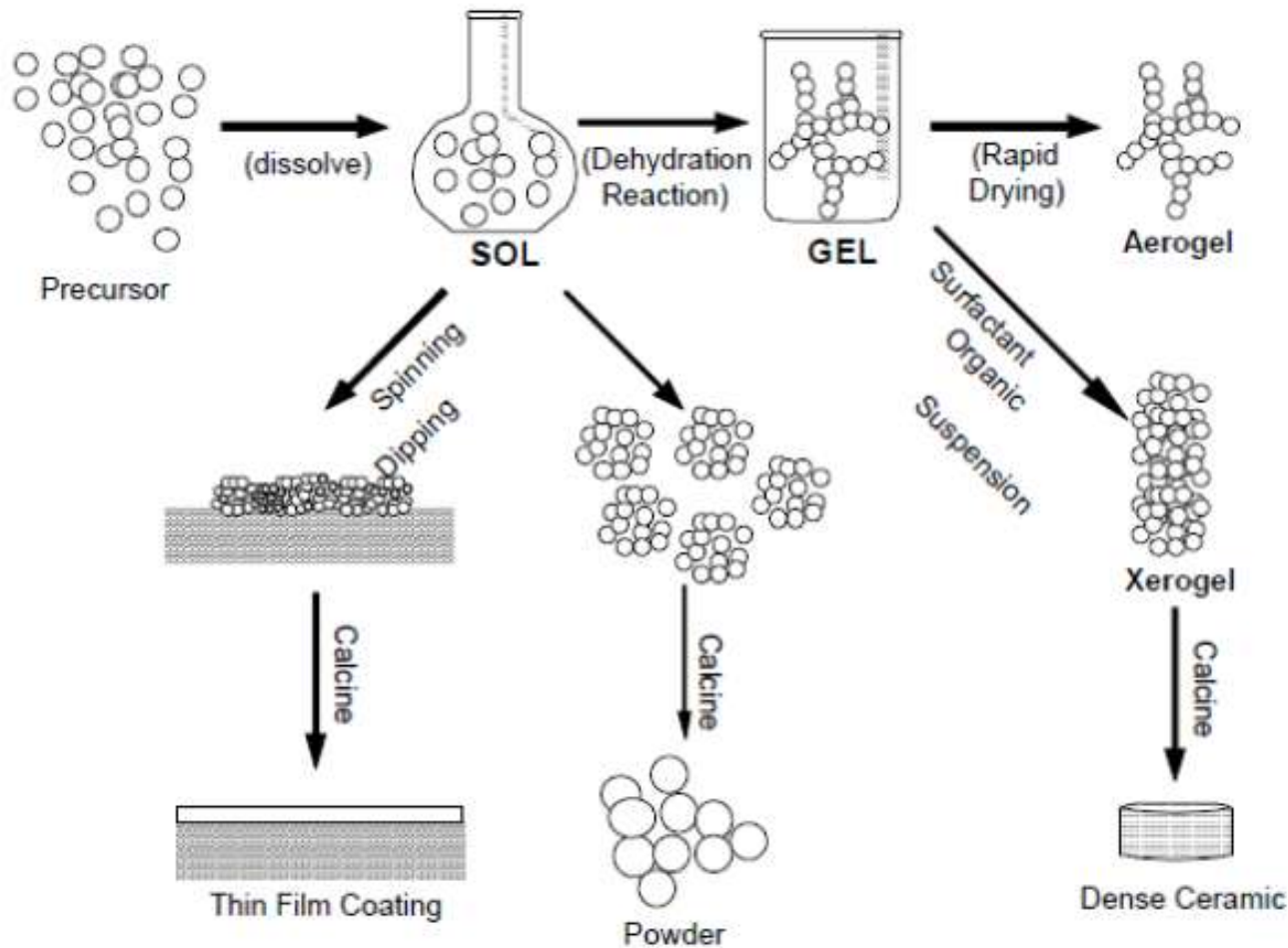
Methods for creating nanostructures

- **Mechanical grinding**
example of (top-down) method
- **Wet Chemical**
example of both (top-down) &
(bottom up)



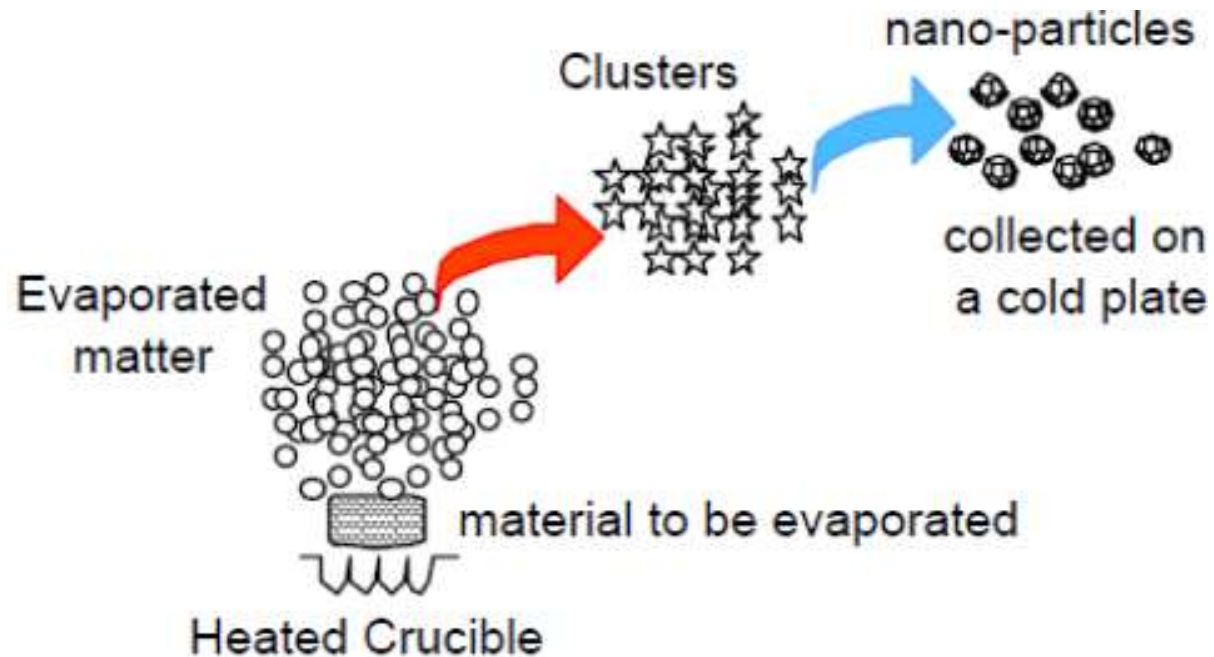
Methods for creating nanostructures

- **Sol-gel process**



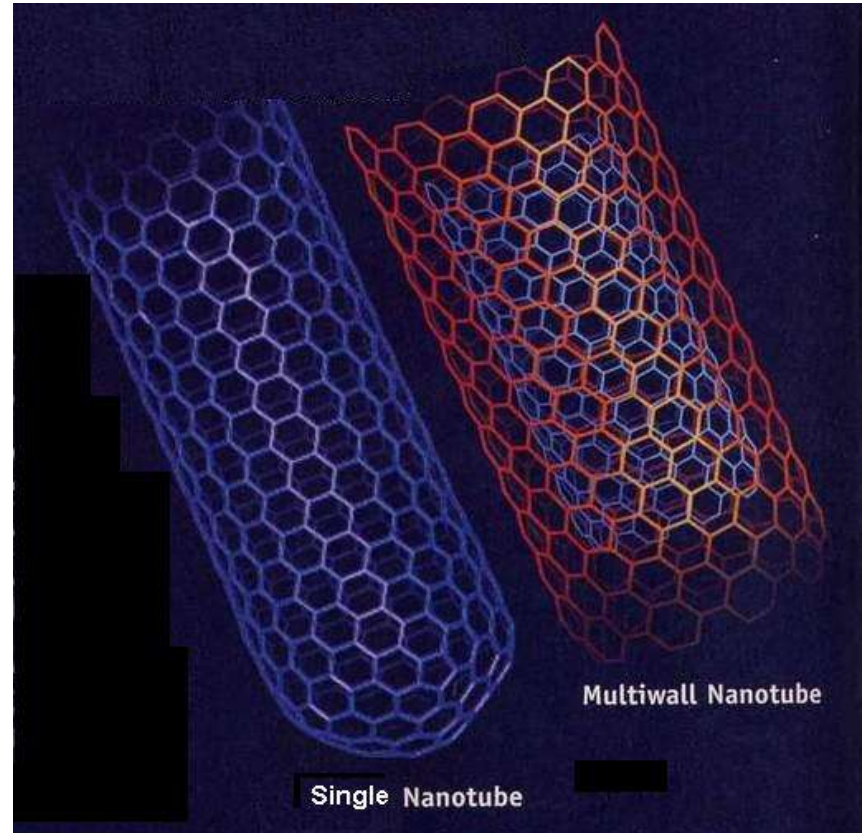
Methods for creating nanostructures

- **Gas Phase (furnace)**



Different types of Nanomaterial

- **Nanopowder**
- **Nanotube :**
tiny strips of graphite sheet rolled into tubes



Why are nanomaterials important

- These materials have created a high interest in recent years by their high **mechanical, electrical, optical** and **magnetic** properties.

Applications of nanomaterials

- nanophase ceramics
- nanostructured semiconductors
- Nanosized metallic powders
- Single nanosized magnetic particles
- Nanostructured metal-oxide thin films

Thank you

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