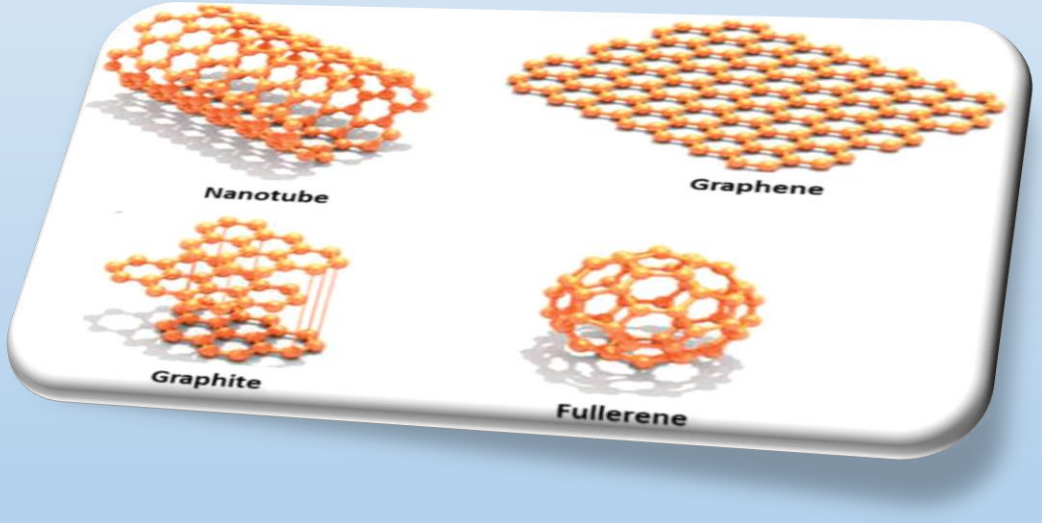
Lec2\ Various types of nanomaterials



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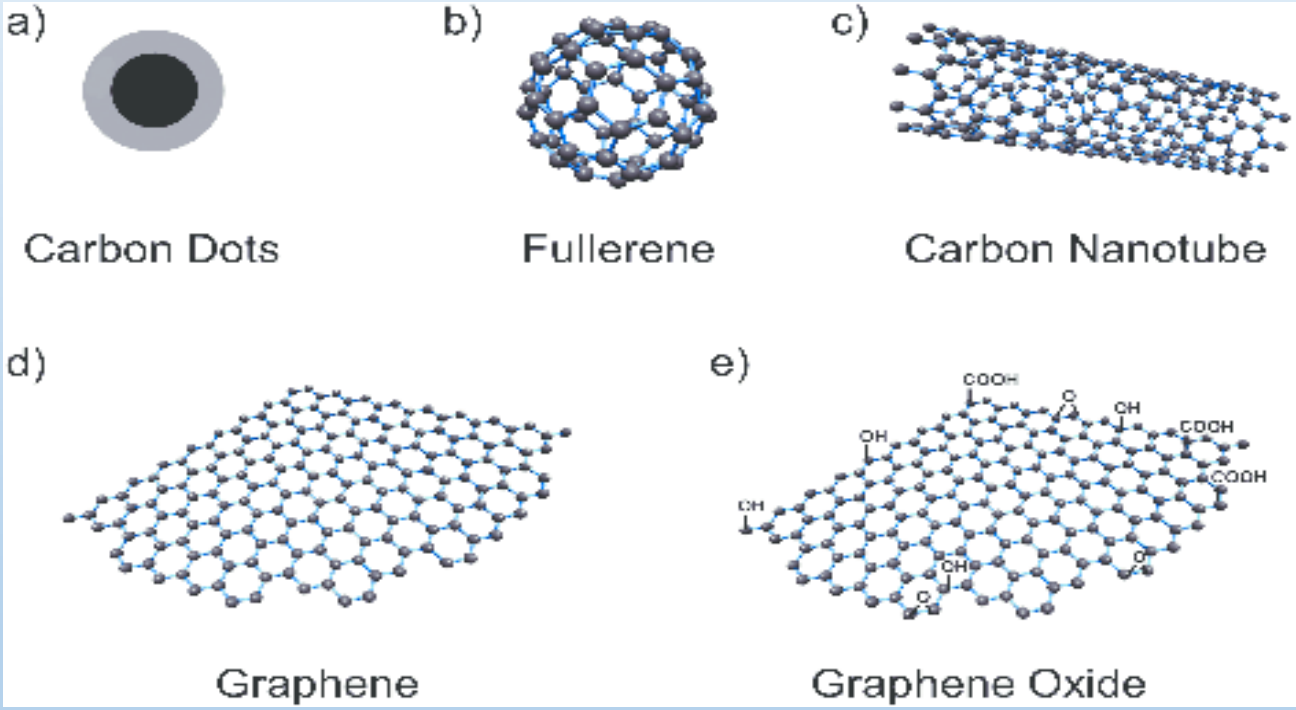
Nanomaterials are cornerstones of nanoscience and nanotechnology. Nanostructure science and technology is a broad and interdisciplinary area of research and development activity that has been growing explosively worldwide in the past few years. It has the potential for revolutionizing the ways in which 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.

Nanomaterials can be classified according to their dimensions into:

- **Zero-Dimensional Nanostructures**
- **One-Dimensional Nanostructures:**
- **Two-Dimensional Nanostructures:**
- **Three-Dimensional Nanostructures**



Zero-dimensional nanomaterials (0-D)

These materials refer to the more specifically defined class of zero-dimensional nanomaterials, which refers to materials whose dimensions are all within the nanoscale (that is, there are no dimensions Larger Than 100 nm), i.e. the number of dimensions greater than 100 nm is Zero-dimensions 0-D .

It includes Zero-dimensional Nanomaterials of the following types

Nanoclusters

nanodispersions

D0 -Nanotechnology characteristics

*Be amorphous or crystalline بلورية

* Be single crystalline or polycrystalline بلورية منفردة او متجمعة

* Be composed of single or multi-chemical elements مكونه من مادة او اكثر كيميائية

* Exhibit type shapes and forms اشكالها مختلفه

* Exist individually or incorporated in a matrix تكون مغردة او متجمعة

* Be metallic, ceramic, or polymeric تكون معدنية او سيراميكية او بوليمر

One--dimensional nanomaterials (1-D)

These nanomaterials differ from zero-dimensional nanomaterials in that **they have only one one-dimension 1-D dimension that lies outside the Outside The Nanoscale.** And this difference or difference in the dimensions of the material leads to **obtaining needle-like** shape nanomaterials .

It includes One-dimensional Nanomaterials of the following types:

- Nanotubes
- Nanorods
- Nanowires

D1 -Nanotechnology characteristics

* Amorphous or crystalline
* Single crystalline or polycrystalline
* Chemically pure or impure
* Standalone materials in within another medium
* Metallic, ceramic, or polymeric

Two-dimensional nanomaterials (2-D)

In general, it is difficult to classify two-dimensional 2-D nanomaterials. **It refers to nanomaterials that have two-dimensions outside the nanoscale** (that is, they have two dimensions that are not confined to the nanoscale). As a result, two dimensional nanomaterials **show platelike shapes**)

It includes Two-dimensional Nanomaterials of the following types:

- Nanofilms
- Nanolayers
- Nanocoating

D2 -Nanotechnology characteristics

* Amorphous or crystalline
* Made up of various chemical compositions
* Used as a single layer or as multilayer structures
* Deposited on a substrate
* Metallic, ceramic, or polymeric

Three-dimensional nanomaterials (3-D)

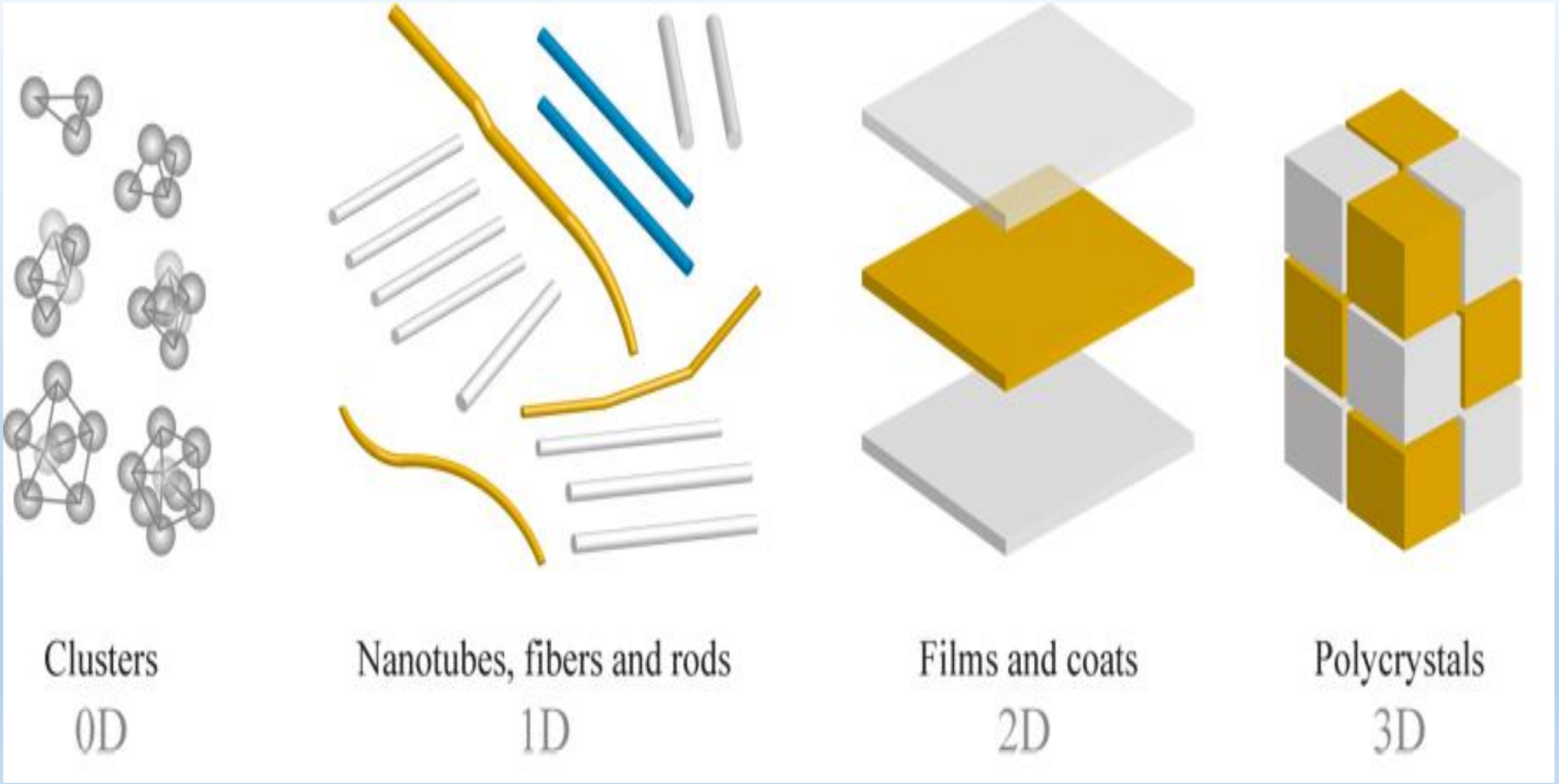
These nanomaterials are **also called bulk nanomaterials**. It is relatively difficult to classify these materials. **These materials are called bulk nanomaterials because their dimensions are all outside the nanoscale range <100 nm**, meaning that all dimensions are not confined to the nanoscale range. Materials with three dimensions have a scale located above the nanoscale 100 nm

It includes Two-dimensional Nanomaterials of the following types:

- Nanoparticles
- Bundles of Nanowires
- Nanotubes
- Multinano Layers

D3 -Nanotechnology characteristics

- Amorphous, Crystalline
- Chemically Pure , Impure
- Used as a single layer or as multilayer structures
- Metallic, ceramic, or polymeric


Clusters
0D
Nanotubes, fibers and rods
1D
Films and coats
2D
Polycrystals
3D

Size Effects

Surface-to-volume ratio versus shape.

One of the most fundamental differences between nanomaterials and large-scale materials.

Traditional large-scale materials properties most often they are completely determined (**completely dependent**) from Materials. Considering the relatively small contribution of the area bulk materials properties. It is inverted in the **case of surface-to-volume ratio size materials** and as a result, the large surface area of nanomaterials comparison with volume its play a big role in obtaining important properties.