



SNS COLLEGE OF TECHNOLOGY

Vazhiampalayam, Coimbatore-35

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DEPARTMENT OF CHEMISTRY

COURSE NAME : 19CHB101- CHEMISTRY FOR ENGINEERS

I YEAR / I SEMESTER

UNIT : 2. NANOCHEMISTRY

TOPIC : 4. NANOWIRES AND NANORODS



CLASSIFICATION OF NANOPARTICLES

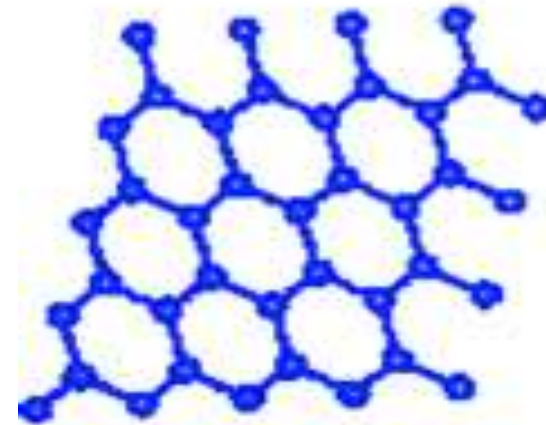


- Nano wires
- Nano rods
- Nano clusters
- Nano tubes

2D



**Nanosheets
Nanoplates**

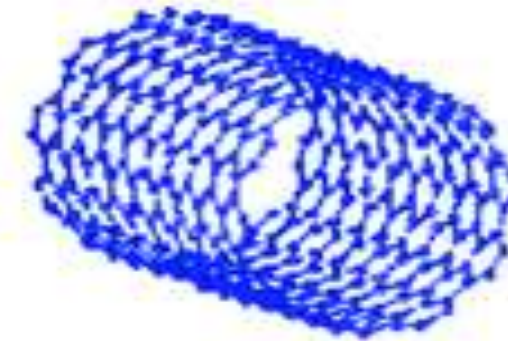


Graphene

1D



**Nanorods
Nanofibers
Nanotubes**

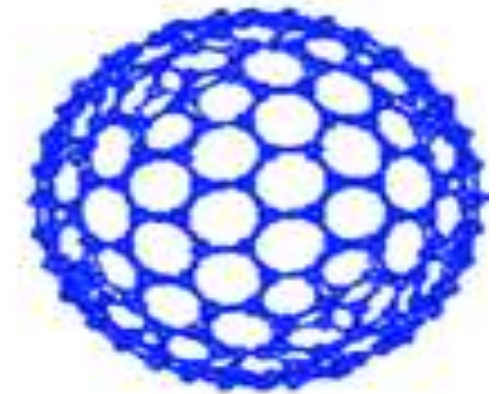


Nanotube

0D



**Spheres
Clusters**



Fullerene



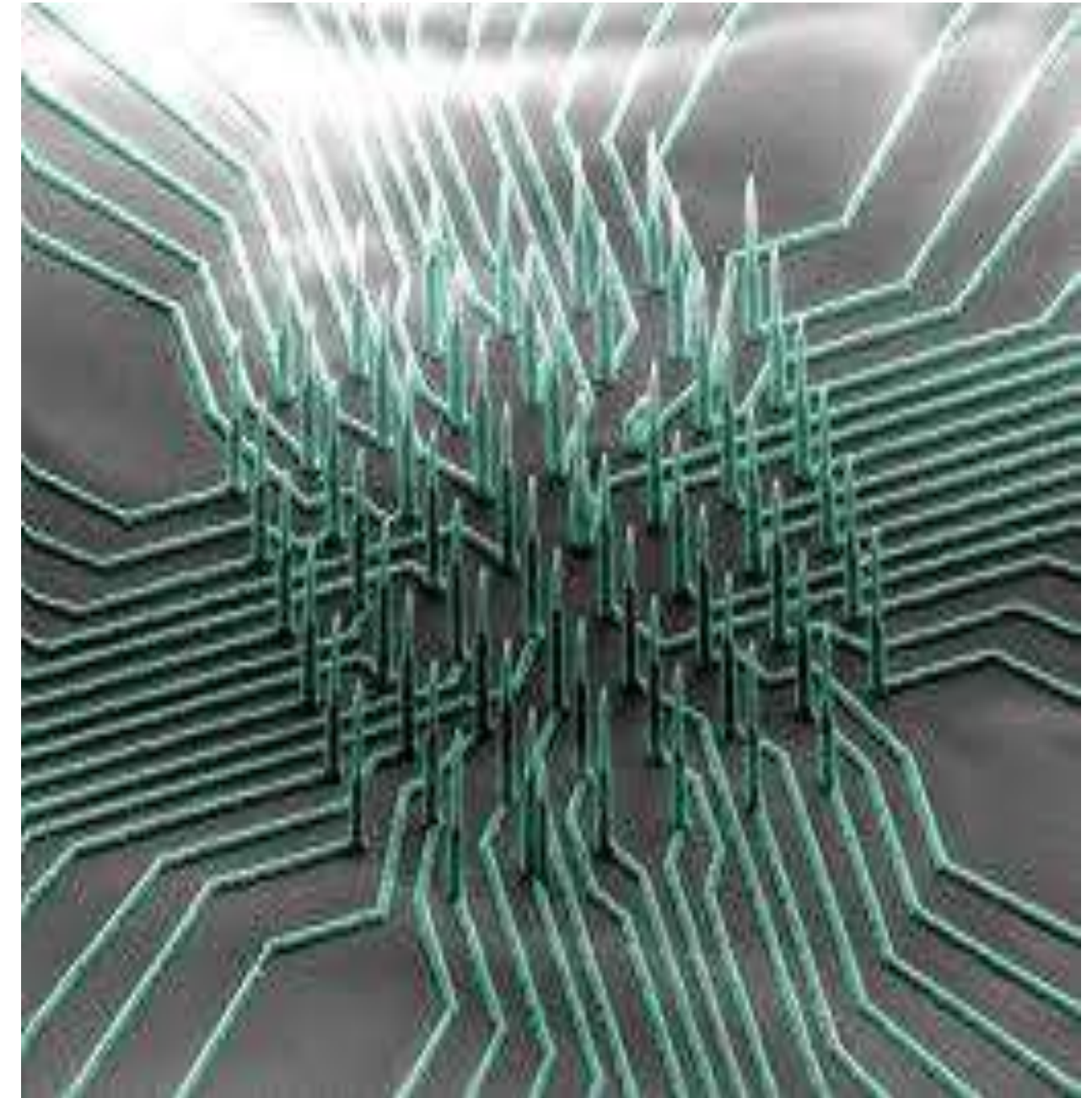
NANOWIRE



- They are one dimensional material.
- They have the dimensions in the **order of nm**.
- Nano wire is a material having an aspect ratio, ie length to width ratio greater than 20, Nano wires are also known as **quantum wires**.

Example:

- Nanowires of metals (Ag,Pt,Ni), Nano wires of Semiconductors(Si,GaN), Nano wires of Insulators(SiO_2 , TiO_2) and Molecular Nano wires(DNA)





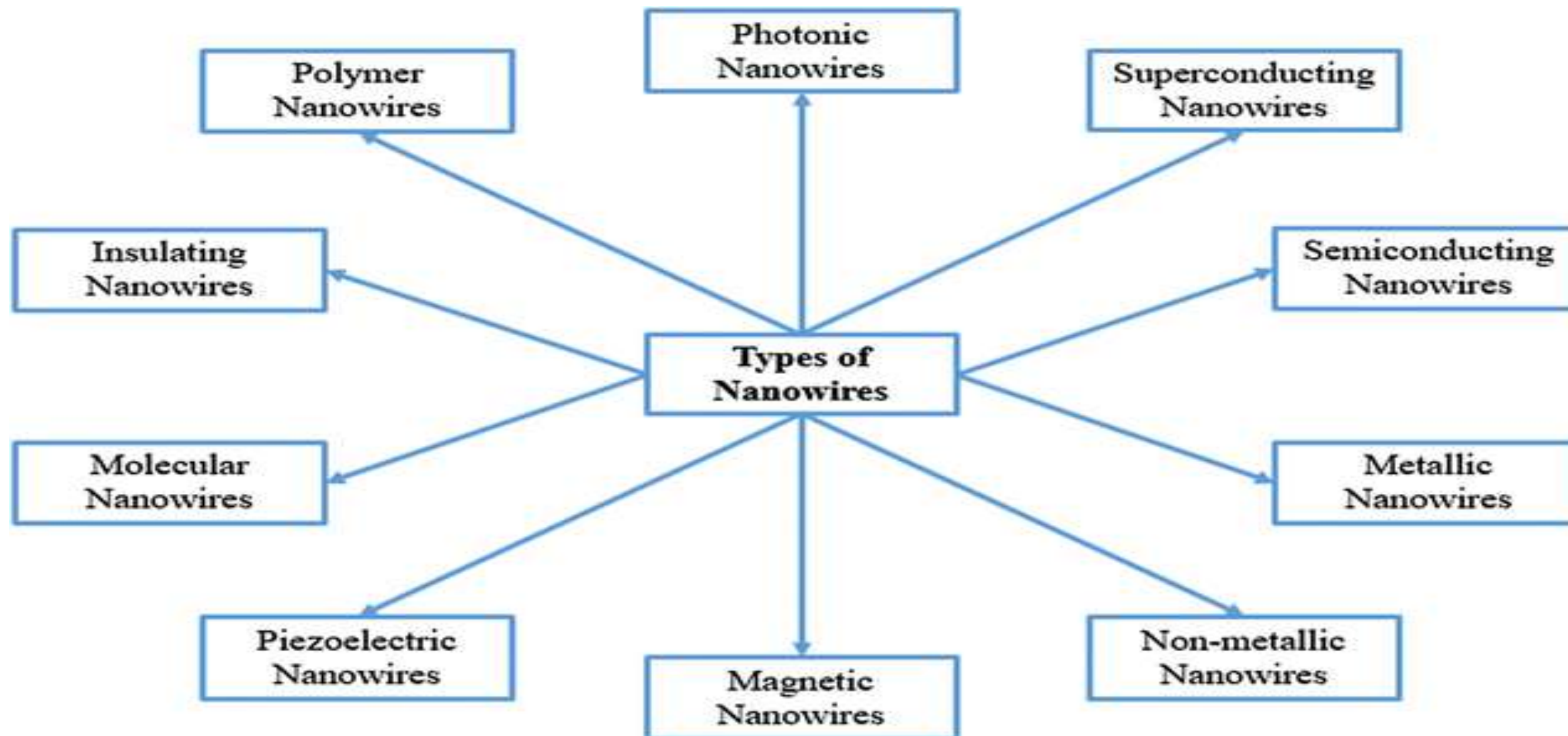
CHARACTERISTICS OF NANOWIRE

- Conductivity of Nano wires is less than that of the corresponding bulk materials.
- It exhibits distinct optical, thermal, chemical and electrical properties due to its larger surface area.
- Silicon nano wires show strong photo luminescence characteristics.
- It can be **synthesized by**
- **Solution phase**
- **Template assisted phase**





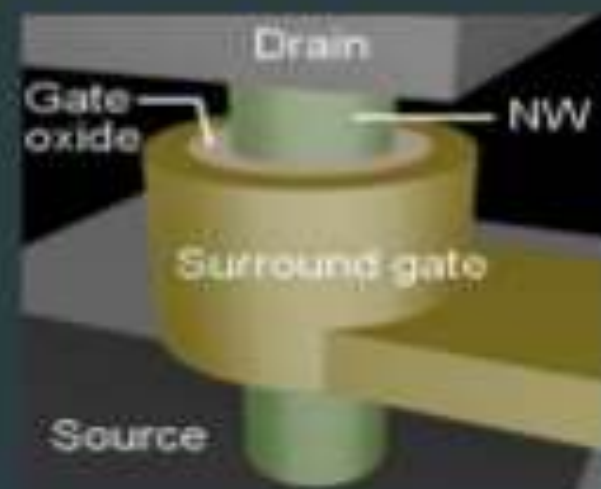
TYPES OF NANOWIRES



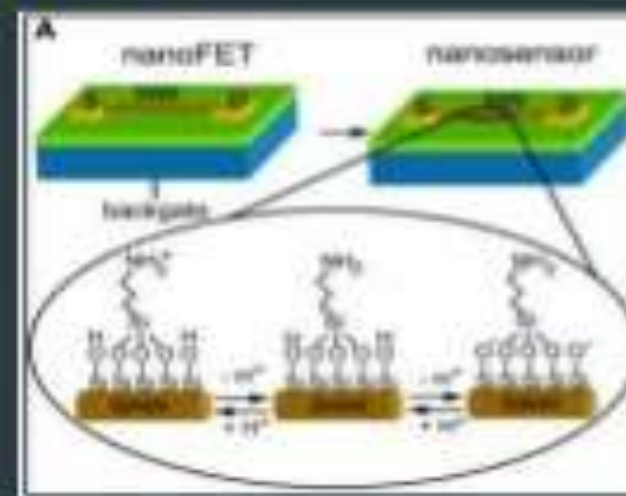


APPLICATIONS OF NANOWIRES

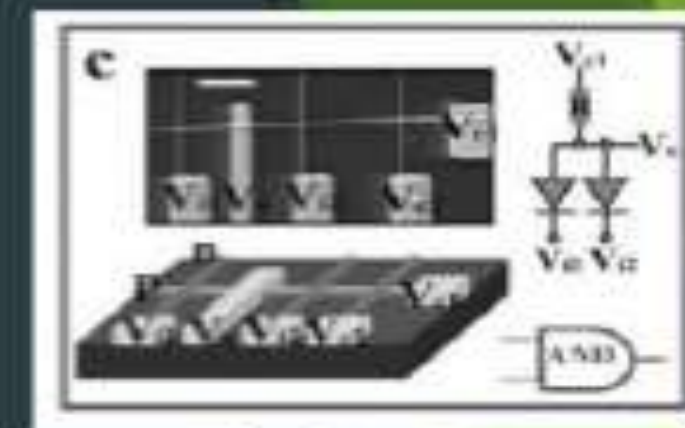
Nanowires : Applications



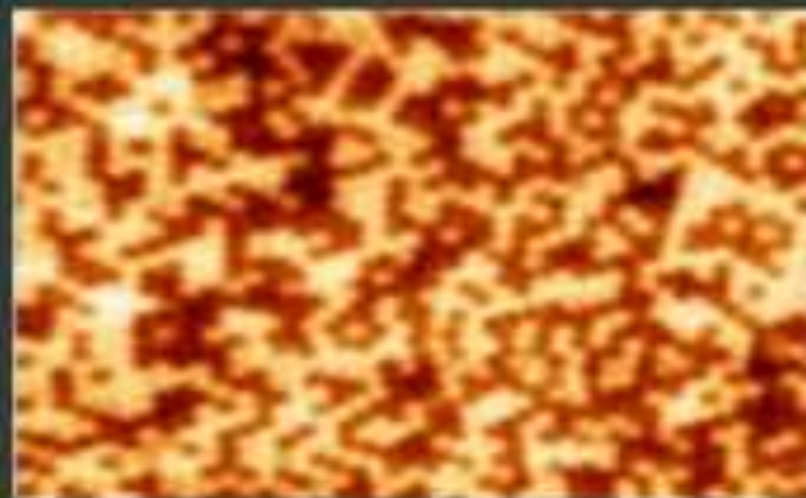
Field Effect Transistors



Chemical, biological sensors



Logic gates



Magnetic devices

Nanogenerators



Nanowire Batteries

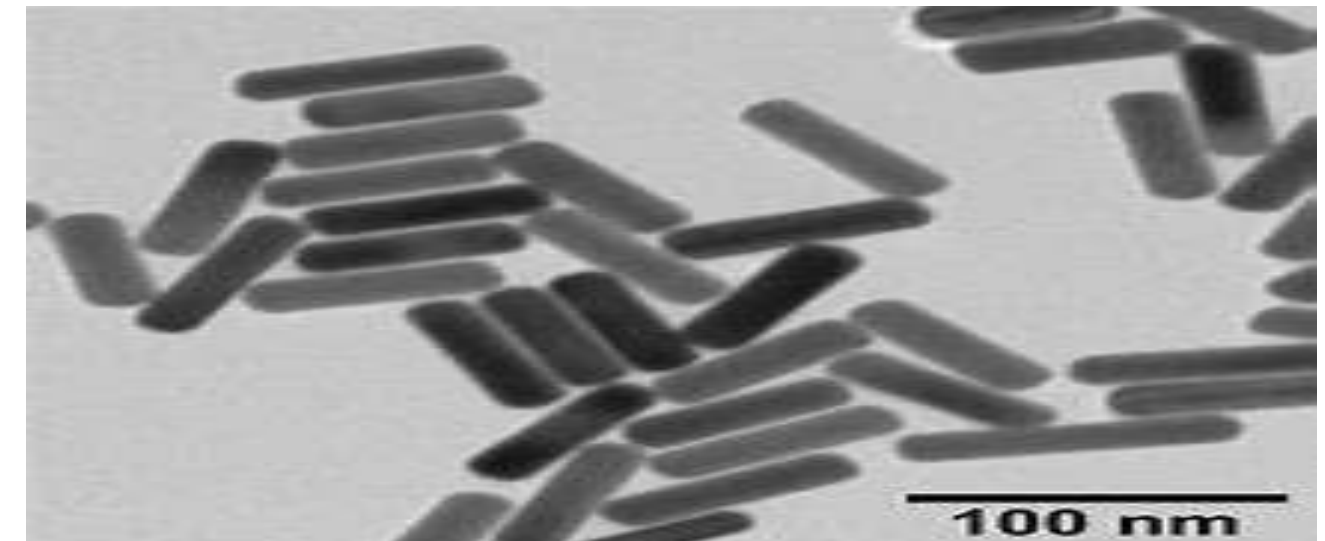
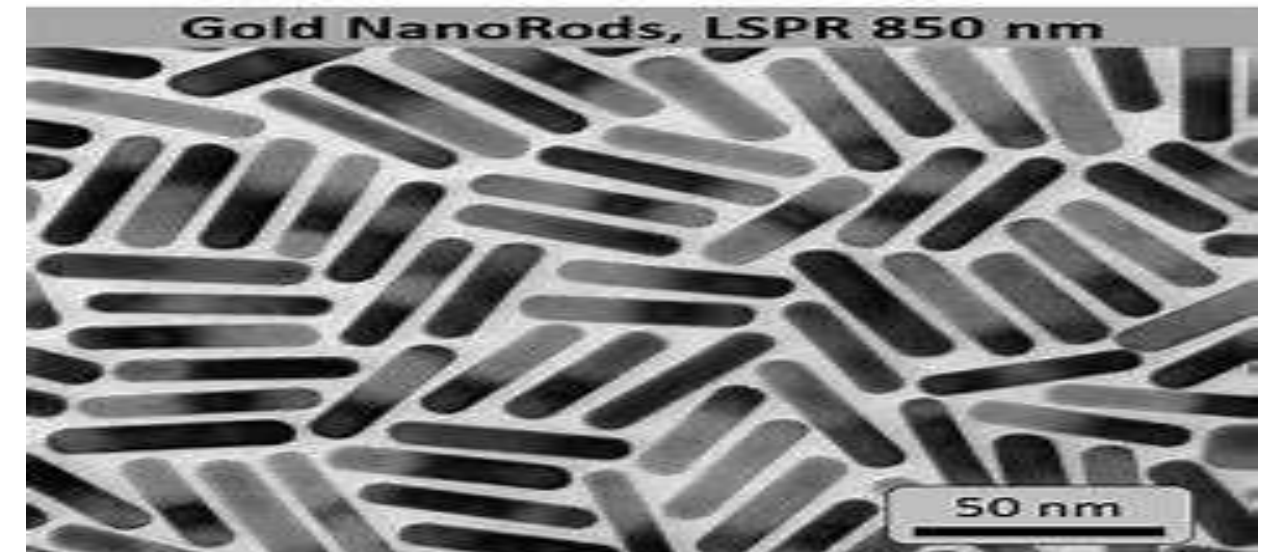




NANORODS

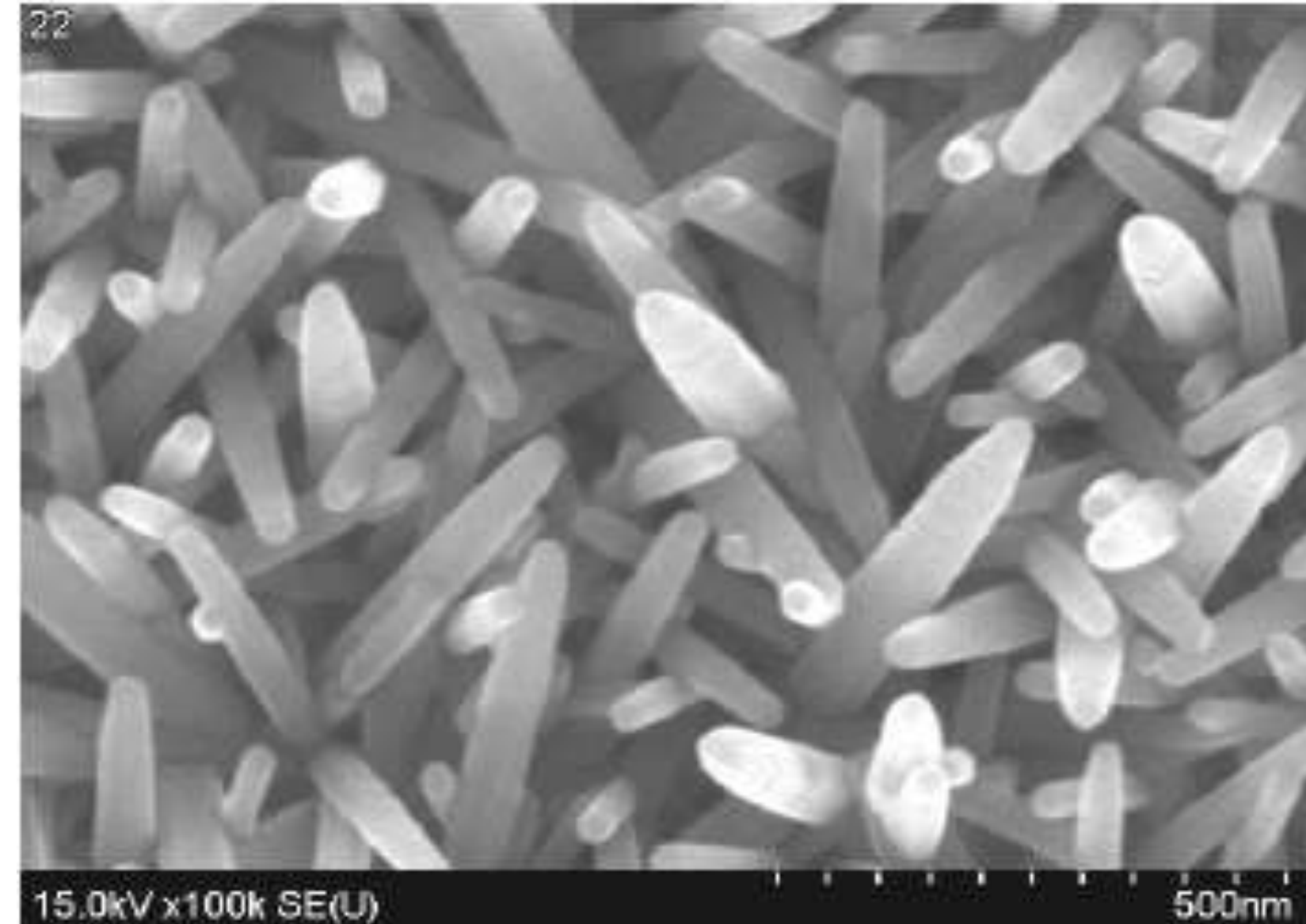


- Nano rod is a material having an aspect ratio, in the range 1 to 20 with short dimension of the material being 10-100nm . They may be synthesized from metals or semiconducting materials.
- Nanorods are produced by direct chemical synthesis.



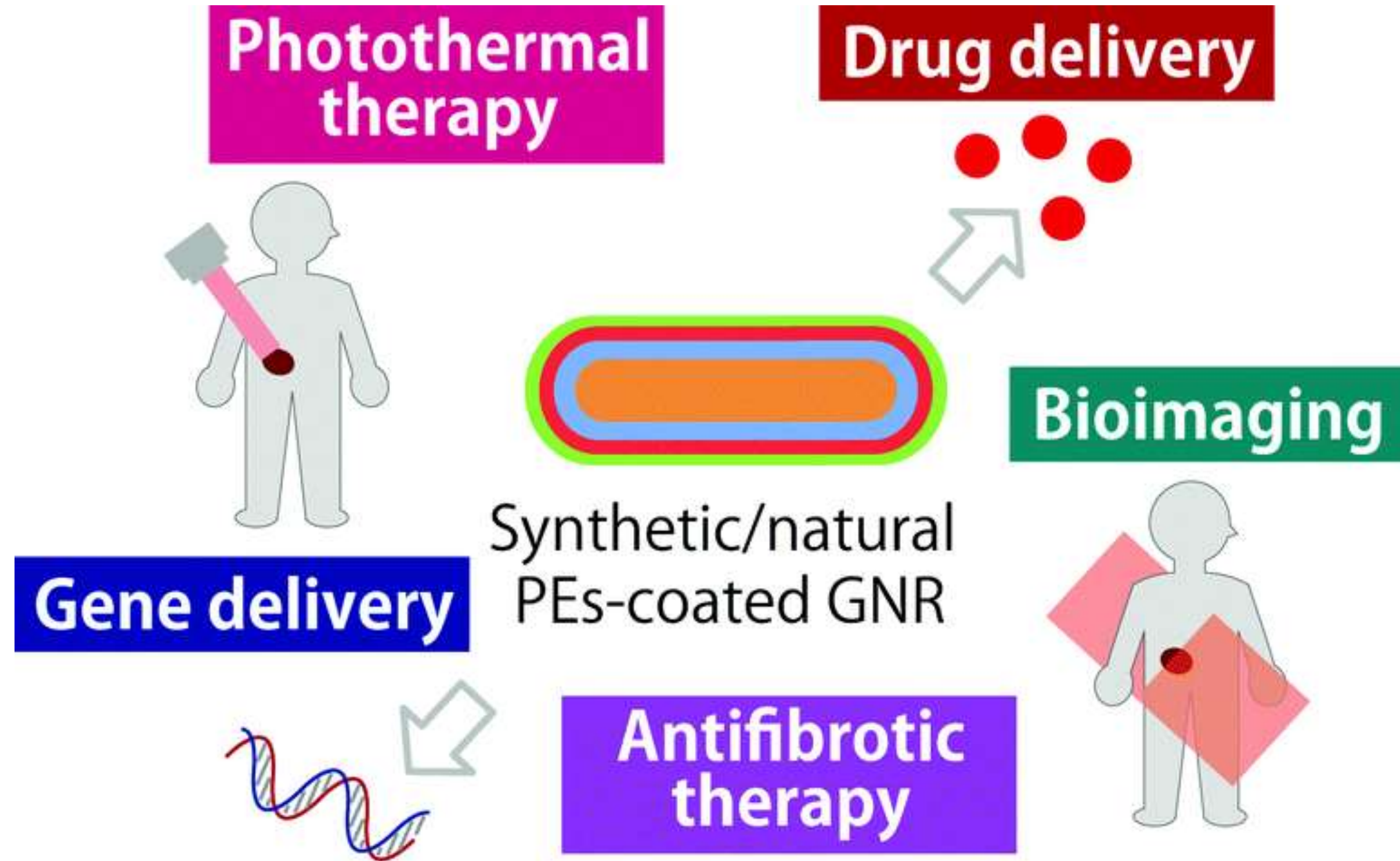


- They are 1 D materials
- They exhibit good optical and electrical properties
- Quantum confined





APPLICATIONS OF NANORODS

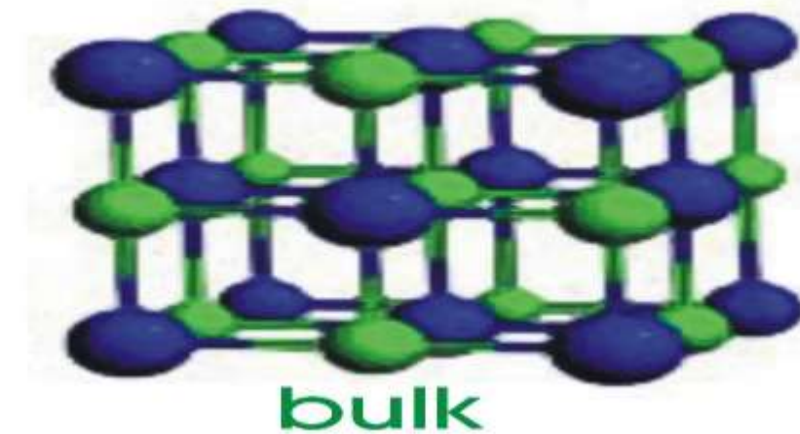




NANO CLUSTERS



- Nano clusters constitute an intermediate state of matter between molecules and bulk materials.
- These are fine aggregates of atoms or molecules. They are bound by forces, which may be metallic, covalent, ionic, hydrogen bond and van der Waals force in character.
- the size of nano cluster is sub-nano meter to 10nm in diameter
- Nanoclusters are particles that range in size from a few atoms to several thousand atoms.
- Their high fraction of surface atoms give them properties different from bulk material properties.
- They are able to detect copper and mercury ions in an aqueous solution based on fluorescence quenching.

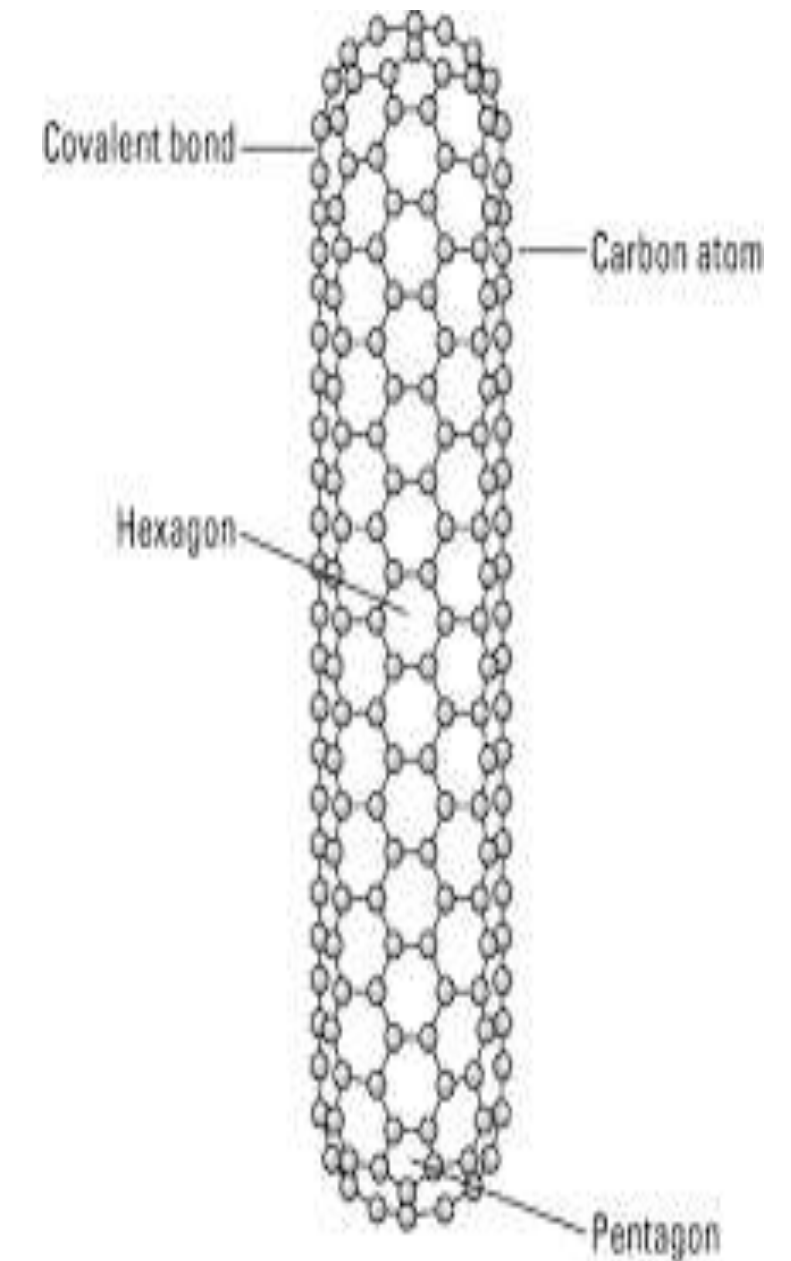




NANO TUBES



- ' Nano tubes are one of the wide spread studied and used materials, consists of tiny cylinders of carbon and other materials like boron nitride.
- ' Nanotubes are cylindrical structures with diameters of $\sim 1-100\text{nm}$
- ' Studies of carbon nano tubes are quite extensive
- ' Carbon nanotubes are tubular forms of carbon that can be predicted as graphene sheets rolled into cylindrical form.
- ' These nanotubes have diameters of few nanometers and their lengths are up to several micrometers.
- ' Each nanotube is made up of a hexagonal network of covalently bonded carbon atoms.





NANO TUBES



Carbon nanotubes are of two types :

1. Single wall carbon nanotube (SWNT) Multiple wall carbon nanotube (MWNT)

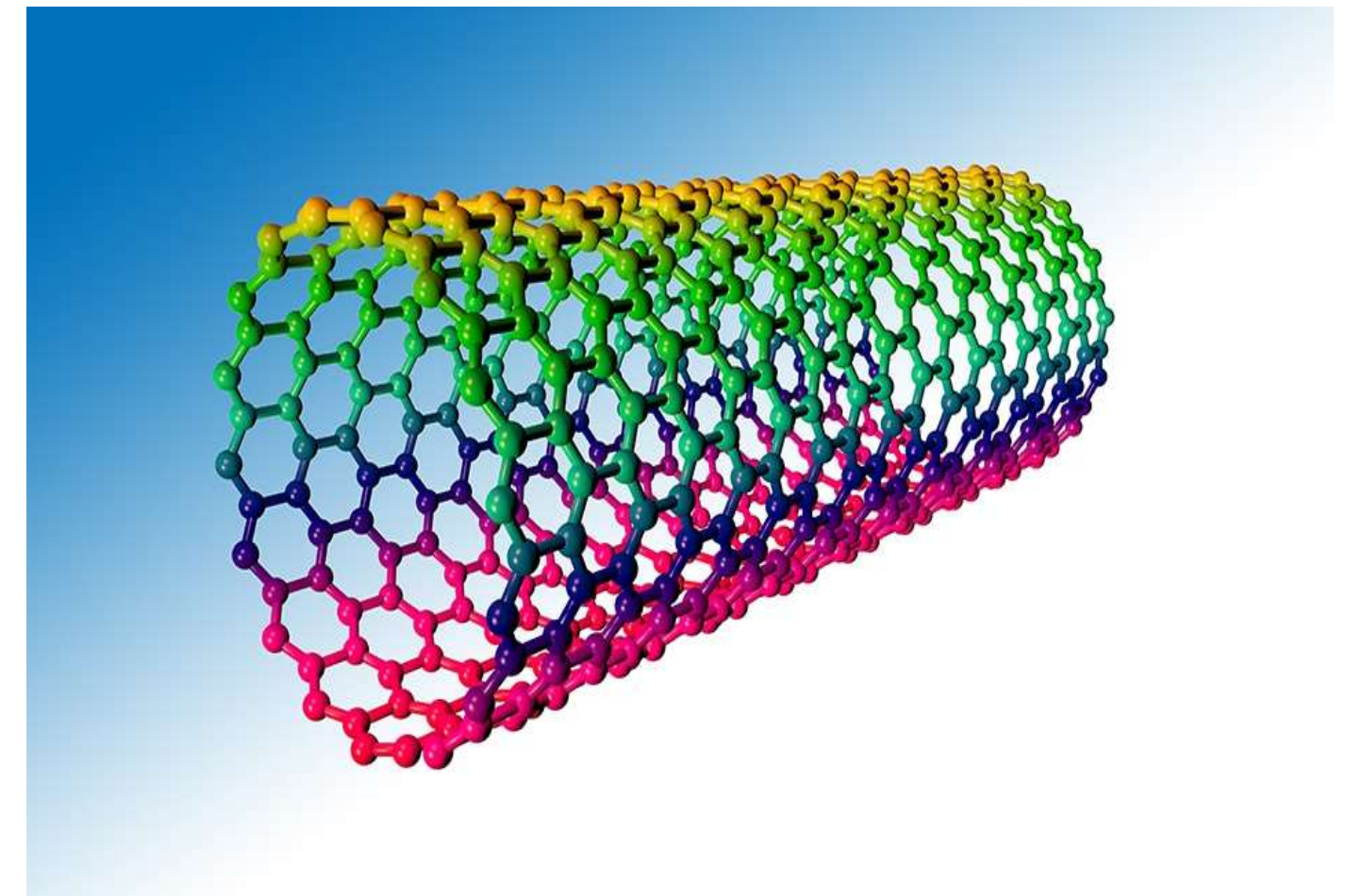
' **Single wall nanotube (SWNT)** consist of one cylinder.

It is made of single graphene sheet rolled up into cylinder closed by two caps (semi fullerenes).

The SWNTs have diameter in the range of 0.5 -2.0 nm. The length is in the range of 50-150 μm length.

The SWNTs are microporous and the specific surface area is in the range of 1300 m^2/g (outer surface).

SWCNTs are commonly arranged in bundles. SWNTs have less topological defects and have better mechanical and electro physical properties.

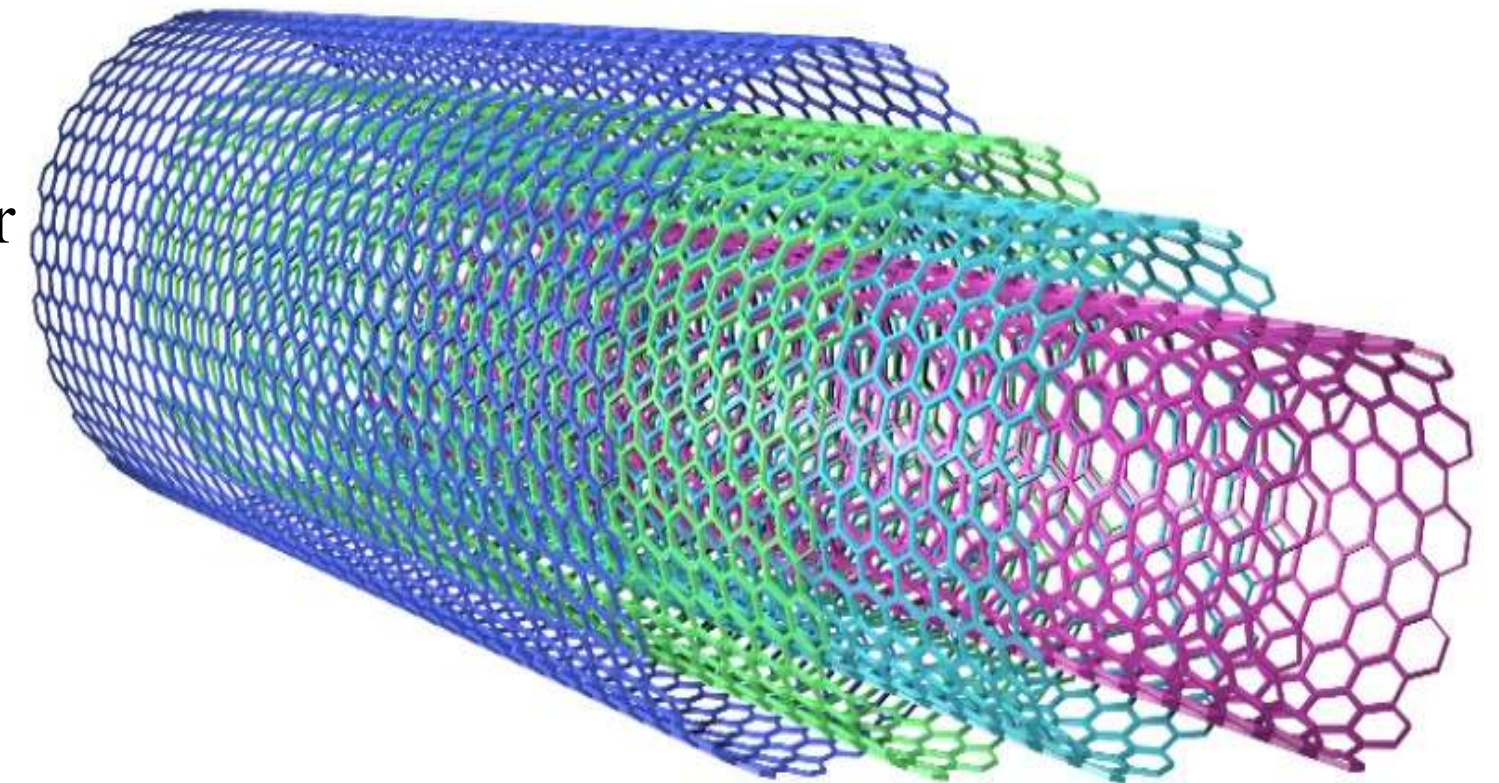


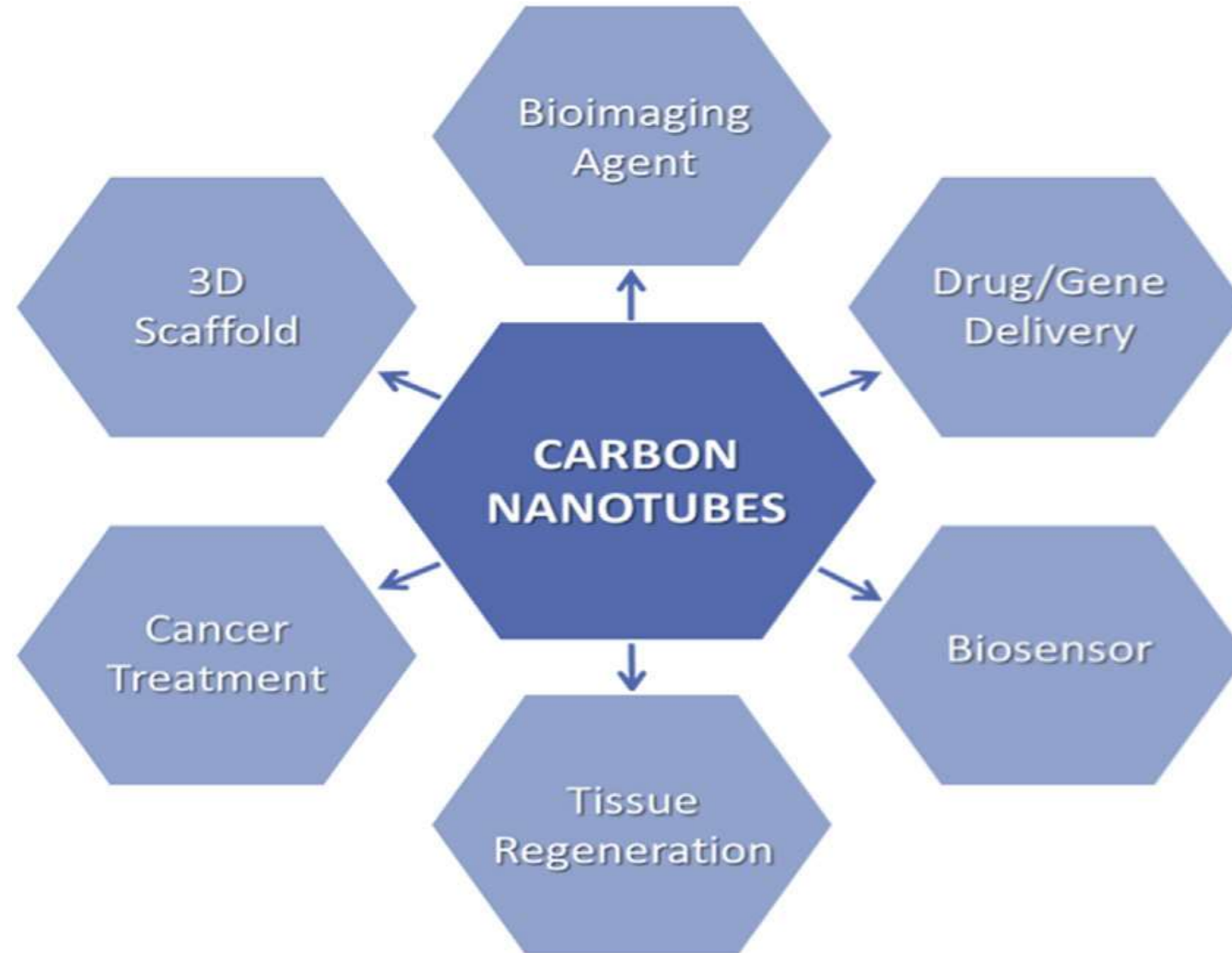


NANO TUBES



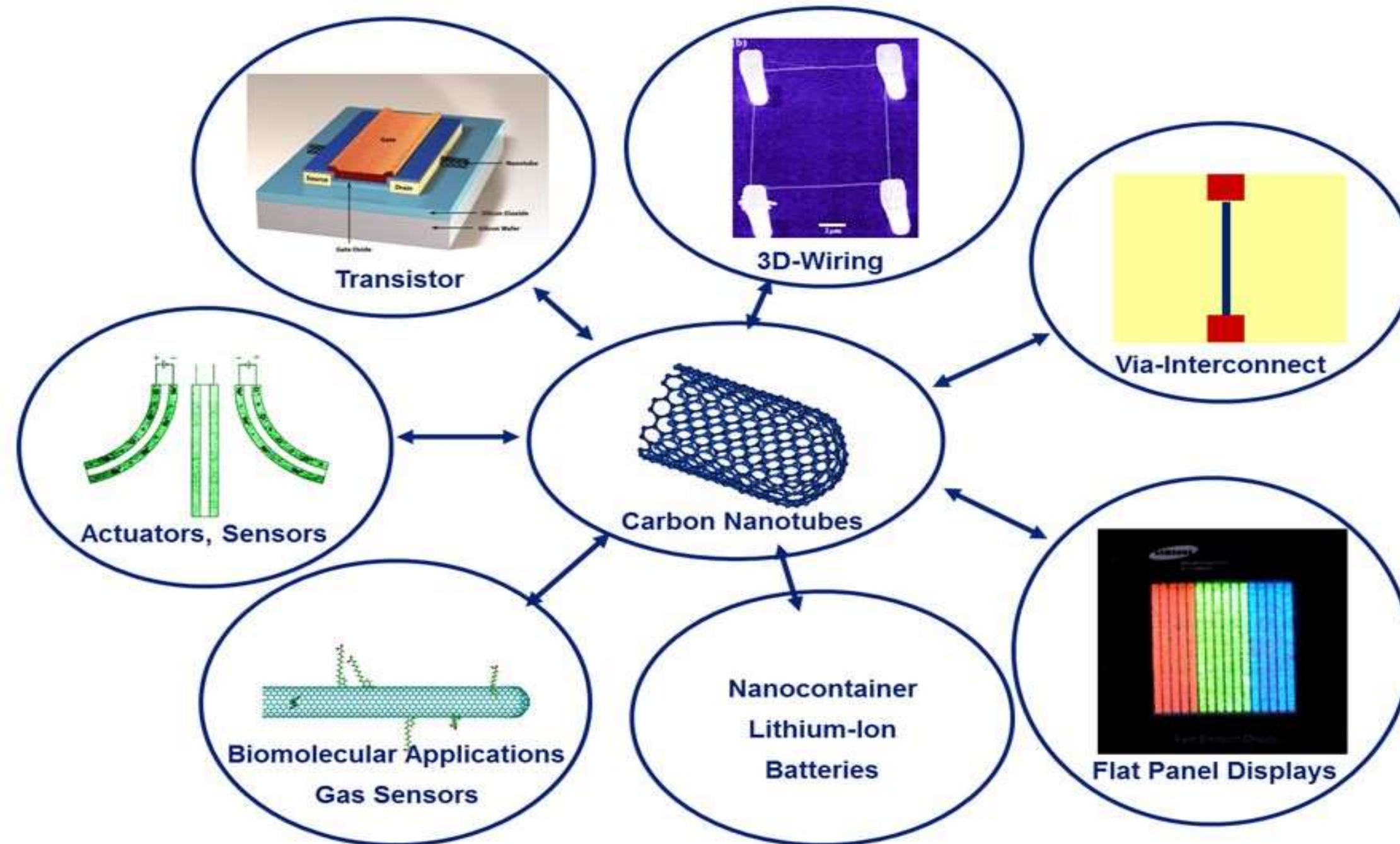
- **Multiwall (MWNT) nano tubes** consist of many nested concentric SWNTs cylinders with increasing successive radii.
- The concentric walls are spaced regularly at 0.34 nm similar to inter graphene distance.
- MWNTs have outer diameter in range of 2 – 100 nm depending on number of coaxial tubes present.
- MWNTs are usually mesoporous in nature and specific area depends on the number of walls.
- The length of MWNTs can range from few to hundreds μm .
- The advantage of MWNT over SWNT is that the multi-shell structures of MWNTs are stiffer than single wall hence stability is higher.







Electronic Applications of Carbon Nanotubes



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SUMMARY



REFERENCES

1. Dr. V. Veeraiyan, "Engineering Chemistry-II" VRB Pub. Co. Ltd, Chennai. 2016..
2. Wiley, "Engineering Chemistry", John Wiley & Sons. Inc, USA.
3. P.C. Jain & Monicka Jain, "Engineering Chemistry", Dhanapat Rai Publishing Company Pvt. Ltd. 2017.

THANK YOU