MM101

Chapter - Materials and Nano technology.

Q. Define technology:-

Technology is the application of scientific knowledge, engineering skills and practical experience to design, build and operate various machines, hardware (tangible) or softwares, systems (intangible) which makes our lives easier, more efficient and more productive.

Q. Define Nanotechnology.

Nanotechnology is the branch of technology that deals with dimensions less than 100 nm, especially the manipulation of individual atoms and molecules. Its the production, designing, characterization and applications of structure, devices and system etc by controlling their shape and sizes at a nm scale.

Q. In which other fields is Nanotechnology used?

The use of nantechnology is in the other fields such as

(i) Textile and clothing.
(ii) Information technology.
(iii) Healthcare and medicine.
(iv) Biotechnology and Agriculture.
(v) Environment and Energy.
(vi) Transportation and Aerospace.
(vii) Food and Nutrition Industry

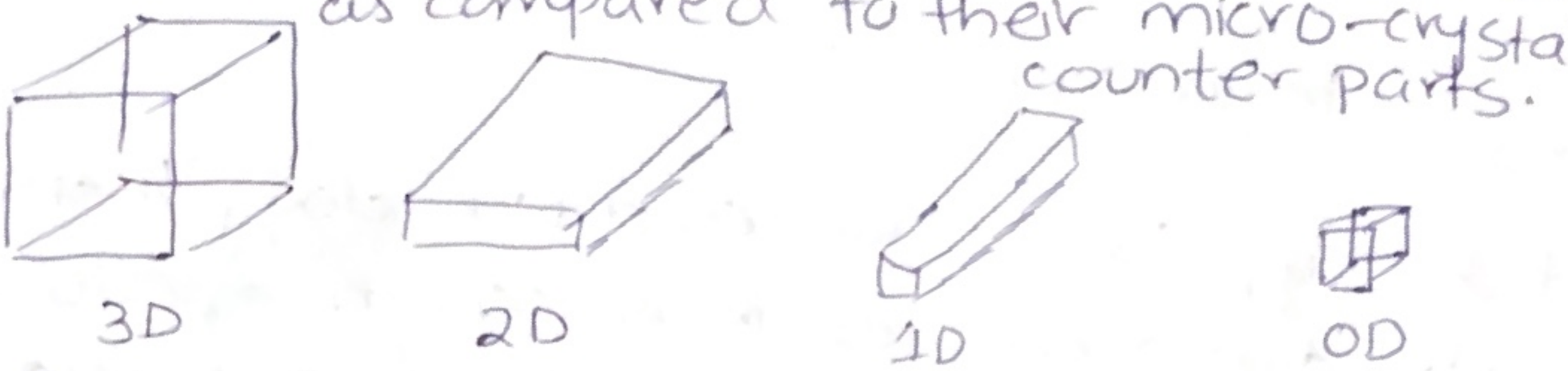
Some of the examples of nanotechcare given ahead in classification.

H-atom is 2.0nm.
Quantum dots are 80nm.

Q. Describe Nano-materials.

Nanometerials may be classified as those materials which have atleast-one dimension in nanometric scale/range.

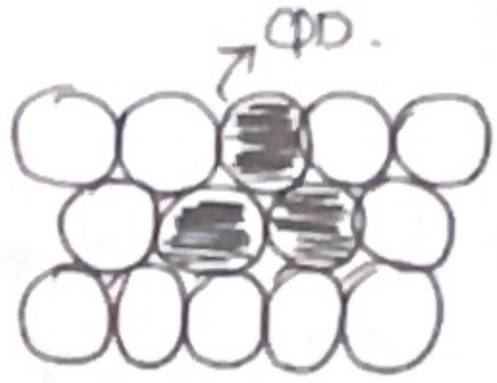
* Nano Crystalline malFials have a grain size of 1-100nm
* Nano material show distinct properties in their n-scale as compared to their micro-crystalline counter parts.



Q. Classify NaNoMaterials on the basis of dimensionality

0D	1D	2D	3D.
Nanospheres/ clusters	Nanotubes wires/rod	Thin films/ plates & layered structure	Bulk NMs, PlyCrystal
Examples	(i) Metal nano tube		
(i) quantum dots	(ii) Ceramic Crystal	(i) Graphene sheet	(i) Liposome
(ii) Fullerenes	(iii) Carbon/. metallic Nanotubes	(ii) C-coated nano plates	(ii) polycrystalline structure
(iii) Gold nanoparticle			(iii) Dendrimer

escribe Quantum dots.



Quantum dots are tiny man made nano-crystals with diametre in range of 2-10 nanometres (10-50 atoms). These nano-crystals exhibit unique optical, properties including the ability to transport and electronic es and emit light of various colors when exposed to UV-lights.

Q. Describe Carbon nanotubes (1D)

Carbon Nano tube is either a single walled or multiple walled structure made up from rolling a sheet of graphite (single → graphene) into a tube. They are strong, stiff and relatively ductile. They are used in

(i) flat screen displays
(ii) solarcells
(iii) capacitors
(iv) heat removal application

} because it also an excellent electric field emilter.

Q What makes technology at the nanoscale different from the technology at the macroscale?

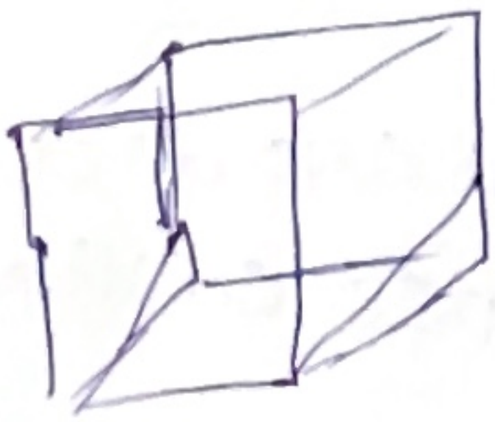
Q. How Volume to surface ratio of a bulk material is different from its nano-counterpart?

As object gets smaller in size they have much greater surface area to volume ratio. That is why materials at nanoscale have much greater surface area to volume ration than the bulk counterparts.

* The relative concentration of under-coordinated surface atoms is thus greater for nano-materials as compared to their bulk form.

Example.

A cube of 2cm has surface area of $24cm^2$ and a volume of $8cm^3$ (3:1) ↑



A cube of 10cm has surface area of $600\ cm^2$ and volume $1000cm^3$.

(0.6:1) ↓

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Q. How much surface area is increased when a cube of $1cm^3$ is broken down in cubes of $1nm^3$.

$1cm^3$ (cube) $\xrightarrow[int]{converted}$ $1nm^3$ (cubes)

The surface area increases by 10^{18} factor.

urface Area of a cube = 6x Area of a face of Cube.

Area of a cube face = LxL (side length square)

If L = 1cm for a cube of $1cm^3$.
and L = 1nm for a cube of $1cm^3$.

S.A of smaller cube = $(1nm)^2$
= $1m^2$

S.A of bigger cube = $(1cm)^2$
= $1cm^2$.

Q. How do the physical properties of materials at a nano-scale are changed?

Materials with structure at nanoscale have distinct optical thermal, electronic and mechanical properties.

- The quantum confinement effect changes the electronic structure of nanomaterials as they start to have discrete electronic states while bulk have continuous electronic states.

- Band structure of nanomaterials is changed and consequently they modulated optical and transport (ie thermal/electric) have properties.

How is the energy band gap in nanomaterials diff
from that of bulk materials.

As the size of the material is reduced in the nanome
scale the energy band gap starts to increase.
This increase is due to quantum confinement, where the
motion of the electrons and holes are/is restricted
to a very small volume, leading to discrete energy
levels rather continuous bands → increased threshold for excitement
cause → lower conductivity
→ reduced mobility of electric charge carriers.

Q. Describe how nanoparticles are used for coatings?

(i) stain proof clothing
(ii) self cleaning without
(iii) spill proof material

Q. Describe the use of nanoparticles in fabrics.

Nanohorizon company uses silver nano particle
as both a dye and to be used in polyester and
nylon.
This material is odour free and toxic to microbes.

Q. Describe the used of nanoparticles in food items.

Ti-dioxide in nanoparticle size is used or found
in 36% percent of food material chosen from
910 food products. → helps define food color
→ prevents UV degradation.

e of Nano particle in Cosmetics.

Sunscreen → TiO_2 / ZiO

Antiaging → Nanogold

Anti Bacterial product → Nano-silver.

Q. Define flurences.

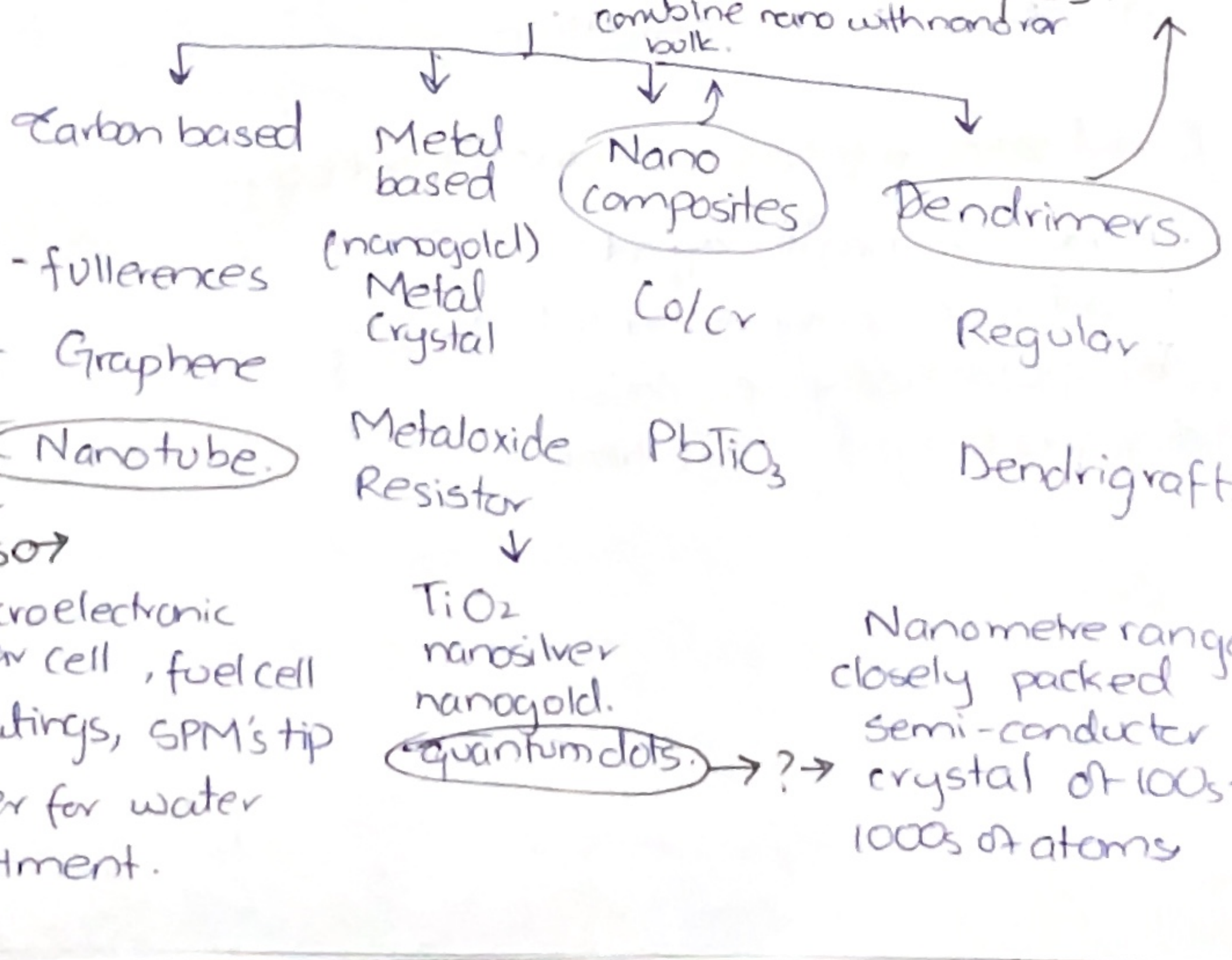
- consisl of 20-90 carbon atoms
- round hollow carbon cage structure
- electrically conductive and high strength.

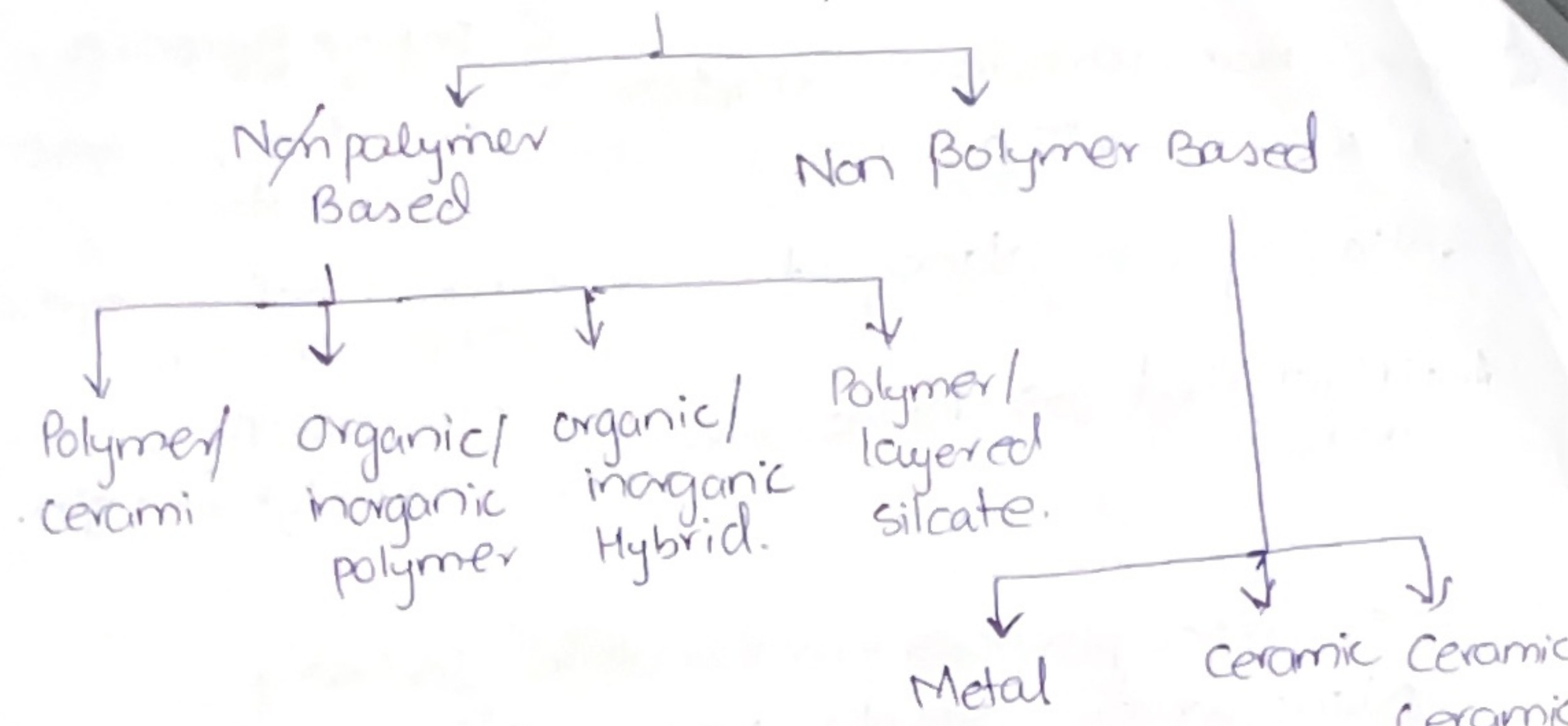
Q. Use of Nano particles in automobile Industry.

Nanosensor, self cleaning nano-films, Nano coating, Heat sheild, Nano material in fuel cells / battery, Nano additives in fuels.

narosized particle built from branched units it has numerous chain ends to be form funcls; used in as catalysts 3D caged one may deliver drugs

Q. Classification of Nano particles and examples.





Q. Why nanotechnology is being so concerned about?

(i) Enormous potential.
(ii) Huge gaps of knowledge.
(iii) Difficulty in detecting and removing.
(iv) Absence of regulation.

Q. Adverse affects of nano-technology.

(i) adverse health effects.
(ii) adverse environmental effects
(iii) potentially explosive.
(iv) prolonged life time.