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Subject: Chemistry

Class: Semester-6

Paper: DSE3T: Industrial Chemistry

Topic: Chemistry of Nano Materials

PART 1

Comments - Read the lesson in details and practice the flow chart.

Nanomaterial :⇒ The material of at least one dimension between 1 nm to 100nm are known as nanomaterial. Nano material are of metal, non metal, semi-conductor or oxides. Generally a lot of nanomaterials surrounded us that tiny particle of polluters, gases present in dust.

[Nano layer :- The nanol material of one dimension between 1 nm- 100 nm is known as nanolayer.]

Classification of Nanomaterials :

1. Zero dimensional
2. one dimensional
3. Two-dimensional
4. Three dimensional.

Zero dimensional : These are the materials having all the dimension within the nanoscale (no dimensions are largen than 100nm).

e.g - Quantum dots, Nanodots, Fullerenes.

2. One dimensional :. These are the materials having one dimension is outside the nanoscale. (one dimension are larger than 100 nm). e.g - Nanowire, nanotubes. Carbon NanoTubes.

3. Two- dimensional : These are the materials having two dimensional are outside the nano scale. (Two dimensions are larger than 100nm). This class exhibits plate like shapes and includes graphene, nanolayers

4. Three-dimensional : These are the materials that are not confined to the nanoscale in any dimension. (all three dimensions are larger than 100nm).

e.g - Graphite, bulk powder, bundles of nanowires.

Nanoparticles :- The nano material of three dimension range between 1 nm - 100 nm is known as Nanoparticles.

Quantum Dots - The semiconductor nano material between 1nm - 100nm is known as Quantum Dots.

Properties of Nano materials :-

1. Nanomaterial exhibit different color depending upon their size.

2. Nano material when irradiated with U.V light, emit visible light.

3. M.P of nano material is lower than M.P of bulk material.

4. Reactivity of nanoparticle is more than that of bulk material.

5. Nano materials of different sizes will have different electronic structures and different level separation

Application of Nanomaterial :

(a) In Aerospace and defence.

1. Light Weight vehicle
2. Nano drone
3. Jet engine application

(b) In Health care

1. Treatment of cancer, AIDS diseas
2. In drugs, Medicines
3. In diagonostics of diseases, abnormal condition etc.
4. In surgery

(c) In Electronics.

1. Graphene transistor
2. Microchips, nanowire
3. Memory and storage
4. Displays.

(d) In sports

1. Tennis racquets, balls
2. Swimsuit
3. Athletic shoes
4. Golf

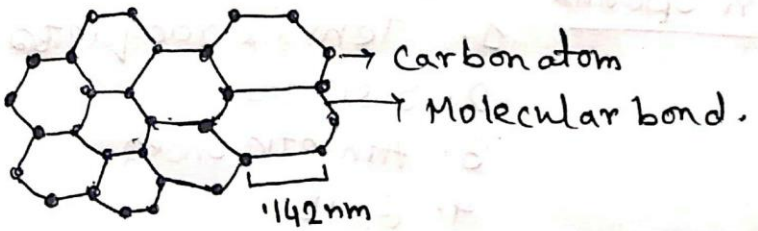
@In food:

1. Dietary supplements
2. Enhance flavor and color
3. Decrease microbial contamination in food.

Graphene :-

Graphene is discovered in 2003, It is an allotrope of carbon, single layer of graphite. It has honeycomb like structure and two dimensional carbon nanomaterial where all carbon atoms are sp^2 hybridized.

Graphene is not only one of the thinnest but also strongest materials. It conducts heat better than all other materials. It is a good conductor of electricity. It optically transparent, yet so dense that it is impermeable to gases- not even helium, can pass through it.



Properties of Graphene :-

(1.) Graphene is an inert material and does not readily react with other atoms (Even though all the graphene's atom are exposed to the environment).

(2.) However It has absorbing properties (i.e. it can absorb different atoms and molecules.

(3.) This can lead to changes in the electronic properties and may also be used to make sensors or other applications.

(4.) It is very very thin, flexible material so that it can be stretchable upto 20%.

(5.) It has highest surface area, 200 times strong than steel.

(6.) It is highly impermeable (even helium cannot go through it).

(7.) It conducts heat in all direction. It is an isotropic conductor.

(8) Graphene has high electrical current density (million times that of Cu) and intrinsic mobility (100 times that of Si).

Application of Graphene :-

1. Energy storage and solar cells :-

Porous carbon Nanomaterials are widely employed as electrodes for super capacitors and electrodes in commercial lithium Graphene-based Nanomaterials.

Graphene is useful for solar cells, super capacitors, Graphene batteries and catalysis for fuel cells.

2. Water filtration System :

For purification of water as it allows water to pass, but not other liquids and gases.

3. Medical Sensors and Drug Delivery:-

Several biomedical applications are being explored for graphene, including drug delivery, cancer therapy and as a sensor. However its toxicity profile must be investigated before clinical use.

4. Photovoltaic devices.:-

Due to their excellent electron-transport properties and extremely high carrier mobility, graphene can by used for low cost, flexible and highly efficient photovoltaic devices.

5. Composites.:-

It is the first-ever graphene-infused carbon fiber helmet. It also dispersers heat more efficiently, so it's cooler.