

Nanotechnology

The term “Nano” comes from Latin word meaning Dwarf. And in scientific community it refers to 1nanometer.

1nm = one millionth of a mm

1nm = one billionth of a mm

The term “Nanotechnology” was used for the first time by **Richard Feynman** in 1959 in his article “There is plenty of room left at the bottom”.

The term “Nano science” was first defined by Japan scientist **Norio Taniguchi**.

Nano Science is a field of science which is concerned with study of atoms, molecules and objects whose size is on Nano meter scale.

Note: Materials behave differently at nano meter scale than when compared to when they behave at the normal scale.

For ex: Gold at macro scale is chemically inert but at nanoscale, it behaves as a catalyst.

The reason for this is the change in the fundamental property of matter due to the increased ratio of surface area to volume which leads to altering the physical, thermal and catalytic properties of matter.

Approaches to Nano Technology

- **Bottom-up**

Materials and devices are built from the molecular components which assemble themselves chemically by principles of molecular recognition.

Eg: Carbon nanotubes built using Graphene.

GRAPHENE: it is a substance composed of pure carbon where the length of carbon bonds is 0.142nm. The atoms in Graphene are arranged in a hexagonal pattern similar to honey comb structure.

The term Graphene was coined as a combination of graphite and the suffix “ene” by hans-peter Boehm.

Note: The **Nobel prize in Physics for 2010** was given to Andre Geim and Konstantin Novoselov for groundbreaking experiments regarding 2D material Graphene.

Graphene conducts electricity faster than silicon. It can also resist temperature Upto 150 degc. Hence it has become favoritly used in IC's and PC boards.

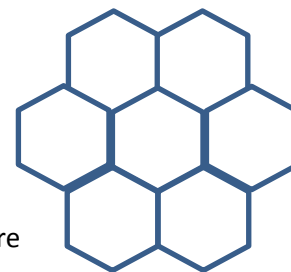


Fig: Atomic Structure of Graphene

- **Top-down**

As the name suggests, nano objects are constructed from larger entities.

Ex: Gold at macro scale is chemically inert. But at nano scale it acts as a catalyst.

Applications of Nanotechnology

1. **Nanoparticles**

These are tiny particles that have special properties that are used in some areas which has very high significance.

For eg: Nanoparticles of Titanium dioxide is used in some suntan lotions and cosmetics.

These tiny particles are transparent on skin and can absorb and reflect UV rays.

2. **Nano medicine**

It is the field of technology where Nano materials and devices are designed for medical purposes of

- Diagnosis
- Prevention of disease
- Treatment of injury
- Drug delivery

Bioavailability of drug

It is the science of ensuring the presence of drug molecules in the perfect place of the body with perfect amount of medicine where it will do most good.

Nano Pharmacology

It is the science which involves linking up of fabricated nanomaterials to biologically active compounds or molecules to be used as probes and drugs to identify and target abnormal cells.

Nanorobots

Medical nanorobots would circulate freely throughout the body when injected into the blood stream. These would carry drugs which will be selectively released on coming in contact with the abnormal cell.

3. **Military applications**

Bio-medical engineers are trying to develop nano-mechanical olfactory sensors (NOSE) to detect characteristic substances.

Smart dust may be deployed for stealthy monitoring of a hostile environment.

Potential hazards due to Nanotechnology

Critics of Nanotechnology point the potential toxicity to new class of nano substances that might alter balance both ecologically and for a person individually.

Scientists term this as **Nano Pollution**.

NanoPollution

It is the generic term given for all waste generated by nanodevices or during the nano-material manufacturing process.

Ex: Nanoparticles of Titanium dioxide that is used in sunscreen lotions and cosmetics can get into food chain and cause ageing of colon cells.

Cadmium selenide nanoparticles can cause cadmium poisoning.

Nanotechnology in India

Department of IT has started the **Nanotech development program**. A vision group under the leadership of CNR Rao was setup and entrusted with the task of formulating a **National Nanotechnology Policy**.

Government of India also has launched the Nanoscience and Technology initiative. A program that focuses on overall R&D in Nanotech field so that India can be a major Player in nanotech in years to come.

