



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Nano-technology and Nano-scale effects

LECTURE NO: 13



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

13.1 DEFINATION

- The word “**nano**” comes from a Greek word that means “**Dwarf**”
- $1\text{nm}=10^{-9}\text{m}$
- **Nanotechnology** is a process that builds controls and restructures that are the size of atoms and molecules.
- **Nano-particle** is defined as the small object that acts as a whole unit in terms of transport and properties.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

13.2 Concept

- The idea of nanotechnology was for the first time introduced in 1959 by the physicist **Richard Feynman**.
- The term nanotechnology was first used in 1974 by **Norio Taniguchi**
- Nano-particles are having the following properties
 - They are highly mobile in free state
 - They have enormous surface areas
 - They may exhibit the quantum effects



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

13.3 APPROACHES

- Nano-technology is based on two main approaches
- **Bottom up approach:** Materials and devices are built from molecular components and which assemble themselves chemically by molecular recognition
- **Top down approach:** Nano objects are constructed from large entities without atomic level control



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

13.4 Nano scale effects

- Two principal factors cause the properties of nano-material to differ significantly from other materials
- Increased relative surface area
- Quantum effects



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

13.5 Increase relative surface area:

- Nano-scale materials have far larger surface areas than similar masses of larger area
- As surface area per mass of material increases, greater amount of material can come into contact with surrounding materials, thus affecting reactivity.



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

13.6 CONTD....

Size of the cube	Number of cubes	Collective surface area
1m	1	6 m ²
0.1m	1000	60 m ²
0.01m	10 ⁶	600 m ²
0.001m	10 ⁹	6000 m ²
0.0 ⁻⁹ m=1nm	10 ²⁷	6x10 ⁻⁹ m ²



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

13.7 Quantum size effect

- **Quantum size effect** = Electronic properties of solids are altered with reduction in particle size
- When particle sizes of solid matter in visible scale are compared to what can be seen in a regular optical micro-scope, there is a little difference in the properties of the particle.
- Materials reduced to nano-scale can show different properties compared to that they exhibit in macro-scale enabling unique application.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

13.8 CONTD...

- **Example:**
- -Opaque substances become transparent (copper)
- -Stable materials turn combustible (aluminium)
- -Solids turn into liquids at room temperature (gold)
- -Insulators become conductors (silicon)



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

THANK YOU