



INTRODUCTION

BASICS OF NANO CHEMISTRY

1. Nano-technology

- Nano-technology is a design fabrication, characterization and applications of materials at nano-level (1-100nm) and converting them into useful devices.

2. Nano-science

- Nano-science is the study of phenomena and manipulation of materials between molecular and nanometer size.

3. Nano-chemistry

- Nano-chemistry is the branch of nano-science, which deals the application of nanomaterials.
- It also includes the study of synthesis and characterization of Nanomaterials.

DISTINCTION BETWEEN NANOPARTICLES, MOLECULES AND BULK MATERIALS

1. The sizes of nanoparticles are less than 100 nm in diameter, molecules are the range of Pico meter, but bulk materials are large in micron size.
2. Molecule is a collection of atoms, nanoparticles are collection of few molecules that is less than 100 nm but materials contains thousands of molecules.
3. Surface area of nanoparticles is more than the bulk the bulk materials
4. Hardness of Nanomaterials is 5 times more than the bulk materials
5. Strength of Nanomaterials is 3-10 times higher than the bulk materials
6. Nanoparticles possess size depended properties, but bulk materials possess constant physical properties.
7. Corrosion resistant of Nanoparticle is more than the bulk material, hence localized corrosion in nano materials is stopped.
8. Behavior of bulk materials can be changed, but cannot enter inside the nanoparticles.
9. Nanoparticles due to its size, possess unexpected optical (visible) properties.

Examples:

- (i) Gold nanoparticle appear deep red to black color in solution compared to yellow color with gold.



- (ii) ZnO nanoparticles possess superior UV blocking property compared to bulk material.
- (iii) Absorption of solar radiation in photovoltaic cell containing nanoparticles are higher than the film (bulk materials).

- 10. Nanoparticles possess lower melting point than the bulk materials. Example: gold nanoparticles melt at lower temperature (300 °C) for the size of 2.5 nm, but gold slab melts at 1064°C.
- 11. Sintering of nanoparticles takes place at lower temperature in short time than the bulk materials.
- 12. Electrical properties, resistivity of nanoparticles are increased by 3 times.
- 13. Suspension of nanoparticles is possible, because nanoparticles possess high surface area, but bulk materials cannot.
- 14. The wear resistance of nanoparticles is 170 times higher than the bulk materials.

Differences between molecules, nanoparticles and bulk materials

S.No	Properties	Molecules	Nano Particles	Bulk materials
1.	Size of the particles	Size is much smaller	Size is larger than molecules but smaller than bulk materials.	Size is much larger than the molecules and nanoparticles.
2.	Magnitude of constituting particles.	Few Angstroms (A°) (10^{-10} m)	Angstrom to nano meter 10^{-10} m to 10^{-9} m	Microns to millimeter
3.	Number of constituting particles.	Two atoms for molecules.	2 to several thousands.	Infinite
4.	Electronic structure.	Confined.	Confined.	Continuous.
5.	Geometric structure	Well-defined structure and predictable.	Well-defined structure and predictable	Crystal structure decides.