



## INTRODUCTION

The (nano) in the word nano chemistry means a billionth ( $1 \times 10^{-9}$  m). Atoms are very small and the diameter of a single atom can vary from 0.1 to 0.5 nm. It deals with various structures of matter having dimensions in the order of a billionth of meter.

## BASICS OF NANOCHEMISTRY

### Nanoparticles

Nanoparticles are the particles, the size of which ranges from 1-100 nm. Generally they are obtained as colloids. The colloidal particles have a tendency to remain single crystal and hence are called as nanocrystals. Nanocrystals possess electronic, magnetic and optical properties. Since the nanoparticles exhibit an electronic behavior, governed by the quantum physics, they are also called as quantumdots.

### Nanoscience

Nanoscience is the study of phenomena and manipulation of materials between molecular and nano meter size.

### Nanochemistry

Nano Chemistry is the branch of Nano Science, which deals with the chemical applications of nano materials. It also includes the study of synthesis and characterization of Nano materials

### Nanotechnology

Nanotechnology is defined as the design, production, characterization, and applications of materials at a nano scale level (1-100nm) and converting them into useful devices.

## DISTINCTION BETWEEN NANO PARTICLES, MOLECULES AND BULK MATERIALS

- The size of nano particles are less than 100 nm in diameter, molecules are in the range of picometers, but bulk materials are larger in micron size.
- Molecule is a collection of atoms, nano particles are collection of few molecules that is less than 100 nm but bulk materials contains thousands of molecules.
- Surface area of nano particles is more than the bulk materials.
- Hardness of the nano materials are 5 times more than the bulk materials



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- Strength of nano materials is 3 - 10 times higher than the bulk materials
- Nano particles possesses size dependent properties, but bulk materials possess constant physical properties.
- Corrosion resistance and wear resistance is more than the bulk materials
- Behavior of bulk materials can be changed, but cannot enter inside the nano particles.
- Nano particles, due to its size, possess unexpected optical (visible) properties.

## Examples

- Gold nano particles appear deep red to black colour in solution compared to yellow colour with Gold.
- ZnO nano particles possess superior UV blocking property compared to bulk material.
- Absorption of solar radiation in photovoltaic cell containing nano particles are higher than the film (bulk material).
- Nano particles possesses lower melting point than the bulk materials. Gold nanoparticles melt at lower temperature ( $300^{\circ}\text{C}$ ) for 2.5 nm, but Gold slab melts at  $1064^{\circ}\text{C}$ .
- Sintering of nano particles takes place at lower temperature and in short time than the bulk materials.
- Electrical properties, resistivity of nano particles are increased by 3 times.
- Suspension of nano particles is possible, because nano particles possess high surface area, but bulk materials cannot.