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Assignment - 10.
Nano Technology.

Q1) Explain electrical properties of nanoparticles.

Ans 1) Nanoparticles have a very high surface area to volume ratio. This provides a tremendous driving force for diffusion, especially at elevated temperatures.

2) Nanoparticles are hard and impart their properties to the polymer (plastic). Nanoparticles have also been attached to textile fibers in order to create small and functional clothing.

3) In brief electrical properties of nanoparticles are:-

i) High current density.
ii) Variable electrical conductivity.
iii) High heat conductivity.
iv) Anisotropic thermal conductivity.
v) Super conductivity under certain conditions.
vi) Field emission properties.

Q2) What are the applications of nanomaterial? Explain any one application in brief.

Ans I] The applications of nanomaterial are in:-

① Medical.

② Electronics Industry

③ Space and defence.

④ Automobiles.

II Automobiles:-

i) Structural parts of the simple car should be strong, non deformable or rigid, in desirable shape and size.

ii) These are made of steel, some alloys, rubbers, plastics, etc. Nanotube composites have better mechanical strength than steel. Efforts are going on that synthesis of nanotubes can be replaced with steel.

iii) Nanoparticle spray painting can provide smooth, thin, attractive coating. Very powerful motors using shape memory alloys are made using nanoparticles of materials like Ni—Ti perform better and consume less power than other motors.

iv) By using nanoparticles clay better light weight less rubber consuming thinner tyres of cars are possible.

v) Use of efficient nanomaterial catalyst may convert harmful emission into less harmful gases. It helps in reduction of air pollution.

Q3) Explain optical properties of nanomaterial.

Ans The optical properties of nanomaterial are:-

a) Metallic nanoparticles :-

i) The glasses of the windows of old churches, palaces, houses are made by dissolving small amount of metal particles like gold, silver, cobalt, iron, nickel, etc. These windows are designed with beautiful tinted glasses.

ii) Depending upon the dissolved metal particles the colours like red, pink, blue, green etc can be adjusted with such transparent glasses. It is due to metal nanoparticles.

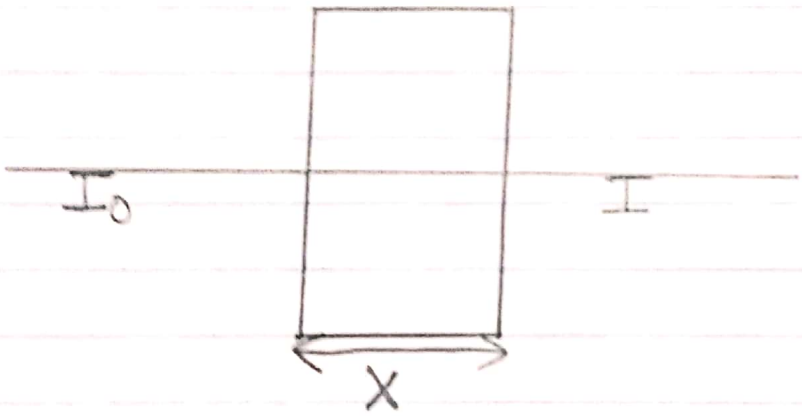
iii) The scientific study done by Michael Faraday in 1857 showed that gold metal nanoparticles produced intense red colour against yellow appearance of bulk gold metal.

iv) Nano zinc oxide particle have been found to have superior UV blocking properties compared to its bulk substitute. This is one of the reason why it is used in sunscreen

lotions.

v) It is necessary to consider mainly the dielectric constant of medium in which the particles float and the dielectric constant of the particles. In this theory interaction between the particles is neglected.

vi) A beam of electromagnetic radiation of intensity I_o and wavelength λ passes through a medium having dielectric constant Em.



b) Semiconductor nanoparticles :-

i) In semiconductor characteristic size below which size dependent properties of solid are defined is nothing but size of excitation.

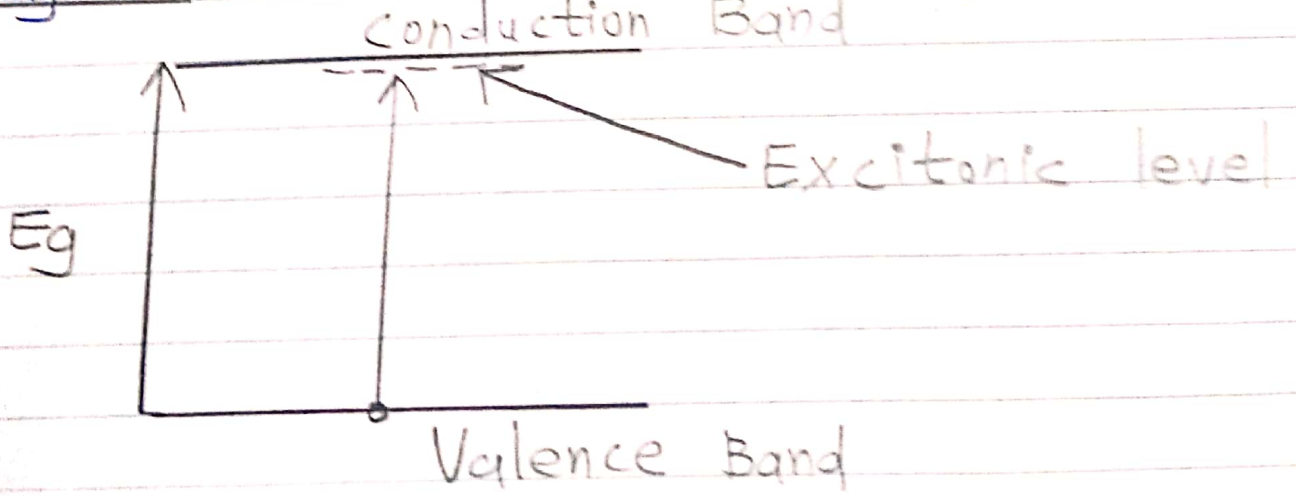
ii) The concept of excitation and its characteristic size is tool to understand semiconductor nanoparticles.

iii) The valence band and conduction band in semiconductor and in insulator are separated by finite energy gap.

iv) By gaining sufficient thermal excitation energy electron from valence band get excited to conduction band. Which results into creation of hole or vacancy in place of electron in valence band. Such formation of electron-hole pair is a quasi-particle is known as exciton.

v) An exciton can move in the crystal whose center of mass motion is quantized.

• a) Energy level diagram for a typical semiconductor along with the excitation energy level.



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b) Mott-Wannier exciton in typical lattice.