2.2 PROPERTIES OF NANO MATERIALS:

size dependent properties:

Nanomaterials have the structural features in between of those of atoms and the bulk materials. The properties of materials with nanometer dimensions are significantly different from those of atoms and bulks materials. This is mainly due to the nanometer size of the materials which render them: (i) larger surface atoms; (ii) high surface energy; (iii) spatial confinement;

(iv) reduced imperfections, which do not exist in the corresponding bulk materials.

Due to their small dimensions, nanomaterials have extremely large surface area to volume ratio, resulting in more "surface" dependent material properties. The metallic nanoparticles can beused as very active catalysts. Chemical sensors from nanoparticles and nanowires enhanced the sensitivity and sensor selectivity.

Optical properties:

One of the most fascinating and useful aspects of nanomaterials is their optical properties. Applications based on optical properties of nanomaterials include optical detector, laser, sensor, imaging, phosphor, display, solar cell, photo catalysis, photo electrochemistry and biomedicine. The optical properties of nanomaterials depend on some parameters such as size, shape, surface characteristics, and other variables including doping and interaction with the surrounding environment or other nanostructures. In Cd Se semiconductor nanoparticles, a simple change in size alters the optical properties of the nanoparticles.

Electrical properties:

Electrical properties of nanoparticles discuss about fundamentals of electrical conductivity in nanotubes and Nano rods, etc. One interesting method

which can be used to demonstrate the steps in conductance is the mechanical thinning of a nanowire and measurement of the electrical current at a constant applied voltage. The important point here is that, with decreasing diameter of the wire, the number of electron wave modes contributing to the electrical conductivity is becoming increasingly smaller by well-defined quantized steps.

In electrically conducting carbon nanotubes, only one electron wave mode is observed which transport the electrical current. As the lengths and orientations of the carbon nanotubes aredifferent, they touch the surface of the mercury at different times, which provides two sets of information: (i) the influence of carbon nanotube length on the resistance; and (ii) the resistances of the different nanotubes. As the nanotubes have different lengths, then with increasing protrusion of the fiber bundle an increasing number of carbon nanotubes will touch the surface ofthe mercury droplet and contribute to the electrical current transport.

Magnetic properties:

Bulk gold and platinum are non-magnetic, but at the Nano size they are magnetic. Surfaceatoms are not only different from bulk atoms, but they can also be modified by interaction with other chemical species. This phenomenon opens the possibility to modify the physical properties of the nanoparticles by capping them with appropriate molecules. Actually, the non- ferromagnetic bulk materials exhibit ferromagnetic-like behavior when prepared in Nano range.

However, gold nanoparticles become ferromagnetic when they are capped with appropriatemolecules: the charge localized at the particle surface gives rise to ferromagnetic-like behavior.

Mechanical properties:

The mechanical properties such as hardness, toughness, elastic modulus, young's modulus etc., of nano materials are different from that of bulk

materials. In metals andalloys, the hardness and toughness are increased by reducing the size of the nano particles. In ceramics, ductility and super plasticity are increased on reducing grain size.Hardness increases 4 to 6 times as one goes from bulk Cu to nanocrystalline and it is 7to 8 times for Ni.