CH 533: NANO SCIENCE AND TECHNOLOGY (3-0-0: 3)

Introduction

Definition of a nanosystem, dimensionality and size dependent phenomena, surface to volume ratio, surface energy, surface defects and the properties at nanoscale.

Different Types of Nanomaterials

Classification based on dimensionality – 0D (quantum dots), 1D (wires), 2D (nanodisks), 3D (nanoparticles); carbon based nanomaterials (buckyballs, nanotubes, graphene); metal based nanomaterials (gold, silver) and metal oxides; nanocomposites.

Synthesis of Nanomaterials

Bottom-up approaches: Chemical precipitation and co-precipitation, sol-gel synthesis, microemulsions or reverse micelles techniques, solvothermal synthesis, thermolysis routes, microwave heating synthesis, sonochemical synthesis, photochemical synthesis, synthesis in supercritical fluids.

Top-down approach: Ball milling, photolithography, electron-beam lithography (EBL).

Introduction to Characterization of Nanomaterials

Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Field emission scanning electron microscopy (FESEM), High resolution transmission electron microscopy (HRTEM), Scanning tunneling microscope (STM), Atomic force microscope (AFM), Scanning probe microscopy (SPM), Photoelectron spectroscopy (PES), powder XRD for the study of nanomaterials, structures of nanomaterials by diffraction techniques, electroanalytical techniques, Raman scattering, miscellaneous techniques.

Applications of Nanomaterials

Applications in solar energy conversion and catalysis, Surface Enhanced Raman Scattering (SERS), nanoelectronics, topological insulator, nanomaterials for biological and environmental applications.

Text Books and References:

1. M. Wilson, K. Kannangara, G. Smith, M. Simmons and B. Raguse, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas Press India Pvt Ltd, New Delhi.
2. T. Pradeep, “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd.
3. C. N. R. Rao, A. Müller and A. K. Cheetham, “Nanomaterials Chemistry: Recent Developments and New Directions”, Wiley VCH.