PREFACE

Materials whose sizes fall in the nanometer regime (1 to 100 nm), are called nanomaterials and the technology dealing with those materials are called nanotechnology. Nanostructured materials are appearing profusely in the area of science because of their fascinating character and properties. Nanoparticles may be broadly classified into three different categories: metallic nanoparticles & their compounds, semiconductor nanoparticles and nanoparticles of compounds organic in origin. As the size and shape governs the special properties of nanostructured materials we have focused our attention to achieve control over size and shape of metallic nanoparticles. To prepare metallic nanoparticles we have extensively used photoactivation technique, seed mediated synthesis, wet chemical techniques and compared the result with the published results. We have investigated and developed methods to obtain small particles of Cu, Ag, Au, Ni, Pd, Pt, Fe_3O_4 etc. and different alloyed and core-shell type bimetallics combining two of them. Amongst them we have given emphasis onto the size controlled synthesis of coinage metal nanoparticles or core-shell type bimetallic structure keeping the Ag or Au onto the shell because of their rich plasmon absorption band and their useful application for surface enhanced Raman scattering (SERS) studies.

Synopsis

Chapter-I This chapter describes the brief introduction on coinage metal & magnetic nanoparticles, micelles and SERS activities. Finally, a discussion on the previous work on nanoparticles is described that has been reported from our laboratory.

Chapter-II In this chapter synthesis of gold nanoparticles in TX-100 micelles through UV-photoactivation technique is elaborated. The capping & template activity of micelles, effect of temperature, kinetics studies on the formation of particles are elaborated in detail. The particles are characterized by UV-visible absorption spectra, TEM images, EDX studies.

Chapter-III This chapter reports the development of 'core-shell' bimetallics through seed mediated route using photochemical approach. These particles are also characterized by UV-visible absorption spectra, TEM images and EDX studies.

Chapter-IV This chapter presents in one hand wet chemical approach for the synthesis of alloyed spherical and rod shaped bimetallic nanoparticles composed of nickel & palladium (Ni-Pd) and nickel & platinum (Ni-Pt), on the other hand it discusses the synthesis of Fe_3O_4 nanoparticles in micelle and coating the same by gold or silver by sugar reduction method. The temperature dependent magnetic property, TEM, SEM, EDX, XRD studies reveal the superparamagnetic behavior, size distribution, percentage composition and the crystallinity of the alloyed and 'core-shell' structures.

Chapter-V Finally, in this chapter the synthesis of Au_{core}-Ag_{shell} type bimetallic nanoparticles by wet chemical route is described. Then experiment on 'single molecule SERS' in solution is elaborated successfully, exploiting the Au_{core}-Ag_{shell} type bimetallic nanoparticles. The newly modeled bimetallic system establishes a relationship between the local electromagnetic (EM) field effect and chemical effect (CE) on the enhancement of SERS spectra, which provides further insight into enhancement mechanism of SERS.