CHAPTER 2

SUMMARY OF THE WORK

In the subsequent chapters preparation of mainly silver nanoparticles (last chapter includes the preparation of gold nanoparticle) in different media and in the presence of different stabilizers, the characterization of these nanoscale systems by different techniques, and the chemical reactivity of the particles have been described.

In chapter 3 preparation of two types of hydrosols of silver will be discussed. Three typical surfactants namely, CTAB, SDS and TX-100 have been used to protect the particles against any sort of coagulation, precipitation etc. These surfactants have been found to leave a control on the particle size also. These particles have been characterized by UV-visible spectrophotometry,TEM and XRD studies. All the hydrosols prepared were yellow in color and was having a sharp plasmon band characteristic of metallic silver. Surfactant concentrations were optimized. TEM studies showed largest particle size for SDS-stabilized system, then CTAB-stabilized one, and smallest size particle was found for in TX-100 medium. Powder XRD and electron diffraction studies of dry products of hydrosol showed small crystallites of fcc Ag.

Chapter 4 is devoted to a comparative investigation of silver sols in different aqueous and non-aqueous media. For this purpose silver sol was prepared in organic solvent systems. Organosol was prepared by the phase transfer of hydrosol under two appropriate conditions. Again, silver particles were also generated in the restricted environment of reverse micelles. These organic solvents have been removed to obtain dry products of the stabilized particles. These dry products can be handled like normal chemical compounds and can be redispersed in suitable solvents. The dry residues of the organosol and reverse micellized sol exhibited similar behavior. IR study showed the involvement of surfactants in the phase transfer. Solubility test of these dry products and other informations shed light on the mechanism of phase transfer of the hydrosol into organic solvent and the orientation of surfactant molecules around the metal particles. Next three chapters deal with the chemical responses of the surfactant-stabilized nanoparticles. Chapter 5 discusses the effect of varying sized particles on a number of chemically active molecules. Actually, nanoparticles of silver in aqueous medium showed catalytic behavior in the reduction of some dyes. Smaller particles were found to show better catalytic effect. Another important observation was the marked catalytic effect at certain stage of growth of the particles. However, the stabilizers also affected the rate of reduction depending on their charge and concentration.

Chapters 6 and 7 manifest the actual chemical reactivity of the particles. Under certain conditions of surfactants and $NaBH_4$, silver nanoparticles have been reversibly formed from its ions in aqueous solution and can be dissolved in situ into its ions. This cycle can be repeated several times in the presence of air (O_2) as long as excess $NaBH_4$ is present. A number of other metals and reducing agents have been tried. But it was uniquely associated with silver and borohydride. In this reversibility surfactants CTAB and SDS played an important role. The phenomenon was not observed in TX-100 medium. Common complexing agents for silver ion, viz., NH_3, CN^-, etc. cannot play the role of surfactants. The study was accompanied by UV-visible, TEM and fluorescence measurements. An interesting reversible fluorescence quenching and enhancement of a fluorescence probe were observed with the reversible formation and dissolution of the particle, respectively. This was the subject matter of Chapter 6.

A judicious selection of nucleophile systems for the dissolution of silver and gold nanoparticles is the focus of Chapter 7. These reagent systems were observed to be strong enough to dissolve the inert bulk metals like gold, silver and copper spontaneously even at room temperature (25° C).