## Abstract

Design of nanostructures with controlled size and shape using low temperature solution based routes has been a major area of research in the field of nanoscience and nanotechnology. Among all, the oxide nanoparticles form the major category of material being used commercially. One of the important methodologies used to synthesize nanosized particles is by using microemulsion where emulsifying agents or surfactants are used as aggregates to control the size and shape of tiny aqueous droplets. These droplets can be effectively used to synthesize inorganic materials having nanodimensions. The size and shape of the product nanoparticles may be controlled through a proper choice of parameters which are involved in the formation of surfactant aggregates.

Chapter 1 discusses the background of the thesis with an introduction to nanomaterials followed by the characterization, methods and properties which have been studied in the subsequent chapters.

Chapter 2 discusses the microemulsion method for the synthesis of anisotropic nanostructures of alkaline - earth metal oxalates with the aid of a cationic surfactant, CTAB. We discuss the synthesis of magnesium oxalate dihydrate, calcium oxalate dihydrate and the mixed metal oxalate of the two. Nanoparticles of magnesium oxide were used as a catalyst for Claisen Schmidt condensation. Chalcone formation was found to increase with time as observed using gas chromatography-mass spectrometry (GC-MS).

In chapter 3, the role of the dicarboxylate ligand in controlling the aspect ratio of these anisotropic mesostructures and the oxidation state of the transition metal ion in the formation of anisotropic structures has been investigated. The requirement of + 2 oxidation state of the metal ion for the formation of anisotropic structures has also been discussed. We observe formation of spherical particles for the + 3 oxidation state of metal ion.

In chapter 4 we discuss the synthesis of mesoporous silica using surfactant assemblies. A control over the pore size, particle morphology and surface area has been achieved using both microemulsion and hydrothermal method. We have systematically studied the effect of different types of stabilizers like PEG and surfactants of different types like the cationic, cetyl trimethyl ammonium bromide (CTAB) to anionic sodium lauryl sulfate (SLS) on the porosity of the mesoporous silica samples. With the combined effect of the hydrothermal conditions on the CTAB templated synthesis, uniform spherical particles with pores as large as 22 nm and surface area of ~ 1100 $m^2/g$ have been obtained. On changing the surfactant from cationic to non-ionic, the morphology of the particles changed from fibres to uniform spherical particles. The role of the surfactant in guiding the morphology has been discussed.

In chapter 5 we discuss some of the applications associated with the mesoporous silica particles. We have used the anisotropic silica nanostructures for DNA encapsulation studies and observed a loading capacity of ~ 8 µg.

In chapter VI, nanoparticles of perovskite based manganese oxides have been synthesized using microemulsion method. The $RE^{3+}_{(1-x)}A^{2+}_{x}MnO_3$-type manganites where R.E. = Pr, Nd and A= Sr have been synthesized, characterized and studied for its magnetic properties.