Preface

Nanotechnology has been viewed as the ‘little big science’ and the impetus for the next industrial revolution. Nanocrystalline oxide materials lead to major discoveries in solid state physics/chemistry and they constitute the most fascinating class of materials exhibiting a variety of structures and properties. They play a pivoted role in many areas of modern technology. The electronic and magnetic properties exhibited by these oxides are noteworthy.

Assembling nanoparticles to form nanostructures is a complex process. Nanocrystals of oxide materials like ferrite, vanadate, tungstate and phosphate have unusual magnetic, optical and electronic properties, which often differ from their bulk counterparts. Preparation and processing of these nanostructured oxides has been the subject of extensive research. Recently there are many developments in the preparation and use of nanoparticulate oxide materials, more specifically isolated nanoparticles of simple and compound oxides. However, these synthetic methods have many disadvantages and only a very few can be considered as “user- friendly”. Most of these methods need expensive equipments, harsh reaction conditions and are time-consuming. So it is very important to develop some other facile methods for the preparation of oxide nanomaterials using simple equipments and with a fast production rate. Currently much attention is devoted to, low cost and eco-friendly methods, thus reducing consumption of energy, space and reagents and minimizing the generation of waste. These features are in agreement with the modern tendency towards a ‘‘Green Chemistry’’. In this context, we have attempted the soft chemical routes for the synthesis of ferrite, vanadate, tungstate and phosphate nanocrystals. We have adopted these

synthetic routes since these methods are eco-friendly, energy saving and highly reproducible. These ternary oxide materials are selected for the present study because of their inherent stability after synthesis and due to their potential applications in the fields of magnetism, catalysis and luminescence.

This thesis is divided into seven chapters. A detailed literature survey on nanomaterials with special stress on the general methods of synthesis, properties and applications is presented in the first chapter. The various characterization methods and material studies adopted in this thesis are also described. The second chapter is a specific review on oxide materials like ferrite, vanadate, tungstate and phosphates which are the materials under study in this work.

The synthesis of copper ferrite and cobalt ferrite nanoparticles by sol-gel method is described in the third chapter. The methods used for the characterization, and the studies on the dielectric and magnetic properties of the synthesized ferrites are discussed in this chapter.

The soft chemical synthesis of monoclinic α-silver vanadate nanorods and monoclinic bismuth vanadate nanobars by room temperature aqueous process without using any template is explained in the fourth chapter. A comparative study of the visible light photo catalytic activity of the synthesized nano phased vanadates on the degradation of methylene blue is also investigated. A possible growth mechanism of one dimensional nanostructures is also discussed.

In the fifth chapter, the morphology tuning and mechanistic study of tungstate nanomaterials like, snowflake-like tetragonal and bamboo leaf-like monoclinic lead tungstate nanocrystals, rod-like and fibre-like silver tungstate nanocrystals, cactus and aloe vera leaf-like barium tungstate nanocrystals by

room temperature precipitation method are explained. This chapter also describes methods used for the characterization, and the optical studies of the synthesized tungstate nanocrystals.

The synthesis of nanosized zinc orthophosphate and cobalt orthophosphate by colloidal aqueous precipitation and their characterization are described in the sixth chapter. The quantitative phase analysis and the luminescence property of zinc orthophosphate when it is doped with Mn^{2+} are also investigated. The study of the effect of temperature on the molar magnetic susceptibility, the effect of temperature and frequency on the dielectric constant and ac electrical conductivity of nanocrystalline cobalt orthophosphate are also discussed. The summary of the work is presented in the seventh chapter.

The results of the work have been presented in various national and international conferences in and abroad and published in part in reputed journals.

Note: The references in each chapter are listed at the end of the chapter itself for convenience. This sometimes implies listing of the same reference repeatedly in different chapters. However, such an arrangement helps immediate reference and facilitates information retrieval. Therefore this arrangement was effected in the thesis.