PREFACE

Nanomaterials with varied structures and properties find application in all areas of materials science, including technological domain, are useful to mankind in innumerable ways. This research is emphasizes on the synthesis of materials that find application in energy and environment related applications.

This thesis contains 8 chapters where

*Chapter 1* deals with introduction to materials and brief review of literature of the work carried out in the concerned fields.

*Chapter 2* briefs the chemicals used in the research study, methodology adopted for syntheses and instrumentation employed to characterize the samples.

*Chapter 3* deals with the gel-combustion synthesis of ZnO nanoparticles (ZnO NPs) by cassava starch. The as-synthesised nanoparticles were explored as photocatalyst in the degradation of methylene blue (MB) under solar light illumination, hydrogen generation by water splitting under UV light and visible light illumination and antibacterial activity against gram-positive and negative bacteria. The reduction in the band gap to visible region on account of the fuel acting as a template and nucleating agent has been emphasised. ZnO NPs have been characterized by XRD, FTIR, PL spectroscopy, BET, SEM and TEM. The variations in catalytic dose, concentration of MB, pH, effect of stirring, kinetics of the reaction are elaborately discussed. The production of "green energy" (hydrogen) by photocatalytic water splitting led to the next step i.e. storage of energy (Li- ion battery) which has been taken up in the next chapter.

*Chapter 4* explains the gel-combustion synthesis of NiO nanoparticles by using two different fuel to oxidant ratio. Both the products are compared for their energy storage, microbial growth retardation, with respect to bacteria and fungus and MB degradation. The differed behaviour is highlighted and reasons for the same are cited. NiO NPs are characterized by XRD, Raman, UV-Vis spectroscopy, PL spectroscopy, SEM, TEM, DLS, Zeta potential, CV and Zeta sizer. The energy storage property of NiO NPs has been further directed to probe the other probable metal
oxides like hematite that are viable for battery applications. In addition, detection of chemical of physiological importance has also been attempted in the next chapter.

**Chapter 5** discusses the synthesis of hematite nanoparticles by cassava starch. The gel-combustion method adopted was done in two fuel to precursor proportions. The chapter also covers the comparison of electrochemical sensing of dopamine and battery performance of the two products. The changed behaviour of the two products are well accounted for, in this chapter. The nanoparticles are characterized by XRD, FTIR, Raman, UV-Vis spectroscopy, Zeta potential, Zetasizer, DLS, CV, SEM and TEM. The foregoing chapters emphasized on anodes of lithium ion battery which paved way to examine a cathode in the next chapter.

**Chapter 6** deals with synthesis of vanadia by gel-combustion technique using cassava starch. It deals with the charge-discharge profiles of vanadia as cathode against Li in LIB. The rate capability studies at different capacity (C) rates are also explained. The VNWCs are characterized by XRD, FTIR, UV-Vis spectroscopy, SEM and TEM. With the extensive use of lithium ion batteries, other preferred storage options are to be attempted to ease the load on the storage system. Hence aqueous batteries with metal hexacyanoferrate as electrodes using potassium ion has been explored in the next chapter.

**Chapter 7** explains the synthesis of CuHCF by co-precipitation technique. The partial reduction of iron(III) in hexacyanoferrate system to iron(II) by reducing agent (ascorbic acid) and their effect on the charge-discharge cycle has been thoroughly studied. The effect of variation in the concentration of ascorbic acid and the difference in battery behaviour has been high-lighted. The rate capability of the products have been compared and elucidated. The CuHCF nanoparticles were characterized by XRD, SEM and CV.

**Chapter 8** provides the summary of all the chapters aforementioned.