CHAPTER 1

INTRODUCTION

1.1 Background

Inverse spinels such as $LiNiVO_4$ are among the cathode materials being studied all over the world. Other vanadates include $LiCuVO_4$, $LiCoVO_4$, $LiZnVO_4$ and $LiCdVO_4$ (Kazakopoulos and Kalogirou, 2008; Fey *et al*., 1999). However much attention has been given to inverse spinel $LiNiVO_4$. The material serves as cathode material in lithium ion battery technology. However the main problem of this type of cathode material is capacity fading which leads to poor electrochemical performance. This problem can be improved by coating and substitution as reported by other researchers (Tong *et al*., 2006; Ha *et al.*, 2006; Suresh *et al*., 2005; Liu *et al*., 2002). However such improvements are still not satisfactory.

This current work focused on the capacity retention by applying coating on $LiNiVO_4$ synthesized from chitosan modified solution evaporation method. $LiNiVO_4$ has been coated with Al_2O_3 (Fey *et al*., 2006). Polymer has not been used in the synthesis of $LiNiVO_4$.

1.2 Objectives of the work

The target of this work can be summarized as following;

(a) To prepare $LiNiVO_4$ using solution evaporation method and the chitosan modified solution evaporation method.

(b) To apply ZnO coating on $LiNiVO_4$ prepared by the chitosan modified solution evaporation method.

(c) To test the electrochemical performance of the prepared $LiNiVO_4$ material.

1.3 Scope of the thesis

Chapter 2 introduces some of cathode materials in the world of lithium ion batteries. Methods to improve properties of cathode materials are included in this chapter. Some types of cathode materials have been discussed in this chapter to give quick and simple introduction to the world of lithium ion batteries and cathode materials. Recent advances on cathode materials towards successful achievement in the performance of lithium ion batteries have been included. Substitution of metal ions and coating of metal oxides on cathode materials have been found to be effective but not satisfactory solutions for some of the major and minor problems faced by the cathode materials.

Chapter 3 presents the experimental procedures for the preparation and characterization of inverse spinel $LiNiVO_4$. The structural and electrochemical characterization is explained here. The theory behind the X-ray diffraction, scanning electron microscope, transmission electron microscope and cyclic voltammetric are dealt briefly in this chapter. At the same time, this chapter gives introduction on equipments used in this work.

Sample prepared by solution evaporation method were characterized and results presented in Chapter 4. X-ray diffraction (XRD), scanning electron microscope (SEM), transmission electron microscope (TEM) and cyclic voltammetric and charge-discharge characteristics are some of the characterization techniques undertaken. The results

obtained here are analysed in this chapter. This will provide understanding of the structural and electrochemical properties of the product.

Chapter 5 used the same characterization to give information from samples prepared by chitosan modified solution evaporation method. This chapter clearly explains the difference between product by solution evaporation method and chitosan modified solution evaporation method. The structural and electrochemical performance also included here.

Results on the investigation of ZnO coated samples are reported in Chapter 6. Characterization methods on $LiNiVO_4$ with different weight ratios of coating amount together with the results are presented in this chapter. Results cover the structural and electrochemical aspects of the coated samples.

The results reported in Chapter 4 to 6 are discussed in Chapter 7. Better understanding of the results from the current work is drawn here. The specialty of the solution evaporation method and chitosan modified solution evaporation method and coating of the inverse spinel $LiNiVO_4$ are documented in this chapter. Chapter 8 concludes this work and raises some ideas for future work.