CHAPTER 8

CONCLUSIONS AND SUGGESTED FUTURE WORKS

The solution evaporation method produced pure $LiNiVO_4$ when the precursor was sintered at 700 °C for 3 hours. The crystallite size calculated from Scherrer's equation is 97 nm. Cyclic voltammetry reveals that the material is not so stable since on the anodic many peaks were observed that may indicate material instabilityon successive cycles.

As a means to improve the cyling perfomance the cathode material $LiNiVO_4$ was prepared again following the same procedure, but the chitosan polymer solution was added during the final sttage of the preparation to confine the mixture in smaller volumes so that the required $LiNiVO_4$ product will be formed as smaller crystallites during the sintering process. Scherrer's equation used to calculate the cystallite size confirms the particle to be about 60 nm. Cyclic voltammetry shows that the sample produced was more stable and lesser peaks were noted at the anodic run. However, this was still not satisfactory.

To ensure better stability the $LiNiVO_4$ produced by chitosan modified solution evaporation method. Smaller crystallites were obtained and cyclic voltammery showed only one anodic peak for $LiNiVO_4$ coated 0.5 wt. % ZnO. $LiNiVO_4$ coated with 0.2 wt. % ZnO showed the presence of addition peaks but lesser compared with the uncoated sample.

Capacity retention and cycling efficiency are two main requirements of lithium ion batteries. Initial discharge capacity of 10.3 mAh g^{-1} was obtained from the cell fabricated with the $LiNiVO_4$ sample prepared by the solution evaporation method. Initial discharge capacity increased to 13.5 mAh g^{-1} using the chitosan modified solution evaporation method. The cell using coated $LiNiVO_4$ sample showed higher Initial discharge capacity

compared to the cell using uncoated cathode active material. The improvement is however not quite significant for the sample coated with 0.2 wt. % ZnO. However, the cells fabricated using 0.2 wt. % ZnO coated inverse spinel $LiNiVO_4$ retained 88 % of its initial discharge capacity at the end of 20^{th} cycle. The cell containing 0.5 wt. % ZnO coated $LiNiVO_4$ retained 82 % of its initial discharge capacity at the 20^{th} cycle. Cycling efficiency are 89.9 % and 98.3 % for the cell utilizing 0.2 wt. % ZnO and 0.5 wt. % ZnO coated cathode active material respectively. However the cell utilizing 1.0 wt. % ZnO coated sample showed poor capacity retention and cycling perfomance. Hence, 0.2 wt. % ZnO and 0.5 wt. % ZnO coated $LiNiVO_4$ when used in cell or battery perfomance exhibited enhancement or improvement in electrochemical perfomance.

Future works can be focused on other metal oxide coatings to improve the electrochemical perfomance. Polymer modified solution evaporation method can be improved by some other polymer candidates to study the effects on the crystallites and electrochemical studies.