CHAPTER 5

CONCLUSION

In this work, sample of $LiNi_{0.7}M_xM'_yM''_{0.3-(x+y)}O_2$, where M=Co, M'=Mn and M"=Al, were prepared. $LiNiO_2$ is known to give the highest specific capacity but it is not quite stable. Hence, cobalt has been added in order to maintain its high specific capacity and improve its stability. However, the need for higher energy providing materials for higher power consumption has lead to the insertion of moving elements into the existing materials. In this work, materials were prepared by sol-gel technique. The precursors were subjected to DSC. From the exothermic peak(s) in the DSC traces, it could be inferred from the materials begin to form in the temperature range between 268°C to 271°C.

Upon knowing the starting temperature of formation of the materials, the precursors were heated at 400°C, 800°C and 950°C. More peaks were observed in the XRD patterns when the precursors were heated at higher temperature. This imply that even when heated at 950°C, the required products may not have formed with the best crystalline structure. IR examination reveals that the hydroxy acetate peaks are still present even after the precursors have been heated at 950°C. However, the intensity of the hydroxy acetate peaks have reduced quite tremendously. EDAX analysis for samples heated at 950°C imply that the material S1 is $LiNi_{0.7}Co_{0.3}O_2$, S2 is $LiNi_{0.7}Co_{0.1}Mn_{0.2}O_2$, S3 is $LiNi_{0.7}Co_{0.2}Mn_{0.1}O_2$ and S4 is $LiNi_{0.7}Co_{0.1}Mn_{0.1}Al_{0.1}O_2$. Cyclic voltammetry shows that Li diffuses within the materials and undergo intercalation and de-intercalation as proven by the redox couple present in the voltammogram. From the batteries charge-

discharge cycle, lithium intercalation and de-intercalation is confirmed since the cell which has the configuration $LiNi_{0.7}M_xM'_yM''_{0.3-(x+y)}O_2$/electrolyte/C can be charged up to 3.2V implying that the lithium ion has rocked to the anode and intercalated in it and has rocked back to the cathode implying the occurrence of de-intercalation during discharge. However, the objective of this work is therefore satisfied because the materials produced show intercalation and de-intercalation properties and can be used to make batteries. Future studies can help to improve the performance and quality of the materials.

5.1 Suggestion for farther work.

It's suggested that the materials be heated at 800°C for a much longer time in order to allow the perfect crystalline growth within the materials. In order to determine the effect of cobalt, manganese and aluminium, it is useful to run the voltammetry experiment for as many cycle as possible until the voltammogram shifts from its original trace. If cobalt, manganese and aluminium improve the stability of $LiNiO_2$ structure, then it is expected that the cyclic voltammogram will give the same trace for greater cycle numbers.

It is also suggested some reverse engineering be carried out on the discharged cells such as subjecting the cathode to XRD in order to gain some ideas as to what has happened to the materials during cycling. This could provide information on the stability or instability of the cathode active materials.