CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

The outcomes of this study show the potential of hydrogen storage in hydrotalcite-derived mixed oxides. This chapter sums up the main findings of the research. Furthermore, recommendations for future work in this area are also presented here.

5.2. Conclusions of the Study

Among the conclusions of this study is the successful synthesis of (Ni)-Mg-Al HTlcs via the coprecipitation technique. Additionally, the XRD characterization and FTIR spectroscopy of the samples generally showed that (Ni-)Mg-Al phase was present in the samples and mixed oxides were formed upon calcination. It was also generally found that the BET specific surface areas of the HTlcs increased after calcination at moderate temperatures but when the calcination temperature was increased, the surface area of the HTlcs was found to decrease which may be caused by the crystallization of spinel-like phases and also sintering of the crystallites.

The TPR results for the Mg-Al HTlcs showed that only a small amount of hydrogen uptake owing to the low reducibility of the MgO. For Ni-Mg-Al HTlcs, the reducibility of the HTlcs increased as indicated by the lower reduction temperature of the material. The TPR results indicate that the addition of Ni into the HTlcs promotes the reduction of the resulting mixed oxides.

The TGA showed weight increase due to hydrogen adsorption. The adsorption capacity of the materials decreased as the holding temperature is increased and this agree with the exothermicity of the adsorption process. The initial hydrogen adsorption rate was not really influenced by the composition of the Mg-Al HTlcs. The increase in Ni contents of Ni-Mg-Al HTlcs slightly increases the average later rate of adsorption of the materials. From the results of the study it can be concluded that adsorption of hydrogen on hydrotalcite-derived mixed oxides is possible by including a suitable amount of highly reducible metals in the adsorbents. Additionally, the calcination of the adsorbent materials for mixed oxide formation conducted at moderate temperatures can produce materials with intact hydrotalcite-like structure and high specific surface area which is attractive for adsorption.

5.3. Recommendations

Future studies on the hydrogen adsorption using hydrotalcite-derived mixed oxides may use other approaches during the synthesis which may increase the hydrogen adsorption capacity of the materials. Among the recommendations that can be made include addition of other reducible metals such as Cu and Fe into the HTlcs in order to obtain a highly reducible mixed oxide that may favour hydrogen adsorption. Additionally, other synthesis technique may be used to obtain HTlcs with higher specific surface area such as using the sol-gel technique.

Besides that, other parameters that may be studied in the hydrogen adsorption step includes conducting a study of the adsorption isotherms of the system and studying the adsorption kinetics. Furthermore the adsorption of hydrogen on HTlcs may be conducted at lower temperatures which will be convenient for on-board storage applications. It is also recommended that the adsorption process is conducted using 100 percent hydrogen to imitate the actual adsorption scenario if the materials were to be commercially used as hydrogen storage adsorbent. Additionally, in order to investigate the reversibility of the hydrogen storage via hydrotalcite-derived mixed oxides the desorption of the system should also be done.