CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Pure carbon aerogel (CA) and enhanced carbon aerogel (CA-Mg) with specific surface areas (36.3241 - 101.4407 m^2/g) and probable pore sizes (3 – 11 nm) were synthesised successfully. Magnesium ions (Mg^{2+}) appeared to be the best metal ions as a crosslinking agent compared to other metal ions (Mn^{2+}, Ni^{2+}, Zn^{2+}) due to their stability and efficiency during the synthesis process. The carbonisation of CA was complete with the presence of Mg^{2+} because fewer peaks were observed in the FTIR spectra of CA-Mg such as the loss of the OH peak. The OH group disappears due to the oxidation of $MgCl_2$ to form MgO (periclase), as shown in the CA-Mg XRD pattern.

The hysteresis loops in the N_2 adsorption/desorption isotherm depict the presence of mesopores (2-50 nm), the required feature for CA-Mg to act as a hydrogen storage material. The specific surface area and pore size increased as the concentration of Mg^{2+} increased. Investigation of the morphology of the aerogels indicated that the structure of CA was well developed with Mg^{2+} enhancement, but at certain concentrations, the structure collapsed. 0.002 mol of Mg^{2+} was the optimum condition for synthesising CA-Mg with the best feature of CA as a hydrogen storage material.

Based on the TPD curve, the desorption behavior of pure CA and CA-Mg towards hydrogen was observed based, and CA-Mg with 0.002 mol of Mg^{2+} enhancement was the best option for hydrogen storage materials. It had the most

efficient way of desorbing hydrogen based on desorption peaks in the TPD curve. Therefore, we can conclude that such a direct and low-cost method for the synthesis of CA-Mg composites will have a bright future as hydrogen storage materials.

6.1 Suggestions and Recommendations

The findings have discovered new areas of research, that can be developed further. The following areas were identified as worthy of further investigation: -

a) The crosslinking reaction of carboxymethyl cellulose (CMC) is crucial for the enhancement of carbon aerogels (CA) and should be investigated further by using various crosslinking agents and forming a better feature of enhanced CA as hydrogen storage materials.

b) The synthesis of CA could be more efficient with enhancement because it can reduce the weight loss of CA during carbonisation, help in complete carbonisation and reduce the adsorption temperature of hydrogen toward CA.

c) The CA derived from CMC could be the best potential candidate for hydrogen storage materials, as CMC can be crosslinked with any metal ions and offer better surface features for hydrogen absorbability.