สำนักงานวิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this research, Li–Al–H, Li–B–H, and Li–Al–B–H systems were investigated with the addition of metal catalysts ($TiCl_3$, TiO_2, VCl_3, or $ZrCl_4$) for hydrogen storage. The results for the Li–Al–H systems show that $LiAlH_4$ decomposes in a two-step reaction. A small amount of a catalyst (1 mol%) can lower the temperature in the first and second steps of the hydrogen desorption and improve the amount of hydrogen released. $LiAlH_4$ in the presence of TiO_2 provides the highest amount of hydrogen desorption, 8.6 wt%, in the temperature range of 80–195°C. $LiAlH_4$ in the presence of VCl_3 starts to decompose at the lowest temperature of 52°C, which is lower than the undoped one by 93°C, with 8.5 wt% hydrogen released. For the Li–B–H systems, $LiBH_4$ desorbs a small amount of hydrogen around 0.1–1.0 wt% between 95 and 300°C and reaches 3.0 wt% hydrogen at 370°C. A small amount of a catalyst can improve the reversibility for at least three cycles. $LiBH_4$ with 1 mol% $TiCl_3$ provides the highest amount of hydrogen (3.5 wt%) in the temperature range of 65–355°C, while TiO_2–$LiBH_4$ releases the lowest amount of 2.1 wt% hydrogen between 75 and 360°C. In the case of the Li–Al–B–H systems, a 2:1 $LiAlH_4$:$LiBH_4$ molar ratio releases the highest amount of hydrogen at 6.6 wt% between 100 and 220°C. The $LiAlH_4$–$LiBH_4$ mixture in the presence of 1 mol% $TiCl_3$ starts to decompose at the lowest temperature of 40°C and provides the highest amount of hydrogen (6.4 wt%) among the doped samples. However, the hydrogen desorption capacities of all the doped mixtures are significantly lower than that of the undoped one. 3 and 5 mol% $TiCl_3$ were further added to the $LiAlH_4$–$LiBH_4$ mixture. It was found that the hydrogen desorption capacity decreases with the increase in the doping amount, 6.4, 5.6, and 2.7 wt% for 1, 3, and 5 mol% doping, respectively. No hydrogen absorption was observed for any of the Li–Al–H and Li–Al–B–H samples. The XRD patterns indicate Al and LiH in the Li–Al–H and Li–Al–B–H systems after

the desorption at 300°C. Moreover, LiCl is observed in the dehydrogenated $LiAlH_4$–$LiBH_4$ samples with the higher amount of the catalyst (3 or 5 mol% $TiCl_3$). The formation of LiCl might deteriorate the hydrogen desorption ability of the samples. That is why the hydrogen desorption capacity decreases with the increase in the doping amount. However, the X-ray diffraction technique cannot detect any peaks of the transition metal compound (Ti, V, or Zr) in the samples after the hydrogen desorption.

5.2 Recommendations

Since the desorption of the $LiAlH_4$–$LiBH_4$ mixture was performed from room temperature to 300°C, the role of $LiBH_4$ was not observed at all. The desorption at a higher temperature might be promising for bringing out the reversibility of $LiBH_4$. However, the desorption temperature should be lower than 400°C for a safety reason.