CHAPTER I
INTRODUCTION

Every day the consumption of energy from fossil fuels is increasing while fossil fuels are limited, and causes global warming and environmental pollution (Houghton, 2004). In the last few years, requirements for reducing these problems are important for the sustainable development of society. Renewable energies, such as bio-energy, geothermal energy, wind energy, etc., have been looked at as replacements for petroleum energy. Moreover, these kinds of energy have long-term use and no CO_2 emissions. Fuel cells, utilizing renewable energies, have been considered for a long time because they are non-polluting (CO_x-free) and use hydrogen as a fuel source (Adamson, 2004).

Hydrogen is of interest as a fuel source because it has high potential to be an energy carrier and it can be converted to electricity by reacting with oxygen, giving water as a product. Because it is a very small molecule and flammable, storing hydrogen is a problem. The characteristics of the storage should be (1) high capacity, (2) easy reversibility, (3) safe operating conditions, and (4) reasonable cost. There are several approaches for hydrogen storage: compression, liquefaction, and solid adsorption/absorption. The first two techniques are not practical in transportation because they either require high pressure or cryogenic conditions (Zhou, 2004). Hydrogen, however, can be stored via adsorption or absorption in solid-state materials, which can be divided into two major categories: one is carbon (i.e. activated carbons, carbon nanotubes, CNTs, and graphite) and the other is metal (i.e. transition metals and alloys). This study is focused on metal hydrides.

The advantages of metal hydrides are very high volumetric hydrogen density at moderate pressure and lowest operating energy compared to those of compressed hydrogen and liquid hydrogen (Heung, 2003). The target of hydrogen capacity specified by the U.S. Department of Energy, DOE, for fuel cell vehicles is that it should be 6.5 wt% or 3.1 kg H_2 for 500 km filled-up (Deluchi, 1992). Even though the metal hydrides have high hydrogen capacity, some of them are not reversible, such as $LiBH_4$. However, a new complex based on Li-N-H and Li-Al-N-H systems has been studied because of its high hydrogen capacity and reversibility.

In this study, Li-N-H and Li-Al-N-H systems were selected as base materials for hydrogen storage. For the first part, it was focused on the mixture of lithium amide, $LiNH_2$, and lithium hydride, LiH. After that, a small amount of catalysts, such as Ni, Fe, and TiO_2 (1 mol%) and the mixing processes were studied for their effects on the hydrogen storage capacity, kinetics, reversibility and stability of hydrogen desorption/absorption. For the second part, the mixture of $LiNH_2$ and lithium aluminium hydrides, $LiAlH_4$, was studied for its potential as a hydrogen storage material.