CHAPTER I
INTRODUCTION

Energy demand has increased rapidly, and the biggest source of energy used in the world is obtained from fossil fuels. Due to economical and environmental issues, the development of alternative renewable energy has been focused. One of the main researches is hydrogen energy, especially used in fuel cell technology.

Hydrogen is an interesting energy and an important fuel in the future for use as an energy carrier in electric vehicles and electric plants. However, the use of hydrogen for mobile applications is hindered by problems of storage, safety, and refueling. To overcome the problems, hydrogen can be produced on-board from various liquid fuels. Since methanol is easy to handle, has low cost, low boiling point (65 °C), no sulfur contamination, and no carbon-carbon bonds reducing the risk of coke formation, it is the best candidate for the fuel application. Furthermore, methanol can be catalytically converted into a H_2-rich gas at moderate temperatures (200–350 °C) by steam reforming.

Catalytic steam reforming of methanol has been wildly studied. Two main metal catalysts used in the reforming are copper-based catalysts and group VIII metals-based catalysts (Pd, Pt, and Ni) on various supports. CeO_2 is a great candidate for methanol catalysis applications. Doped ceria has been the subject of considerable interest, because addition of a dopant can increase the concentration of oxygen vacancies or improve the thermal stability of the parent oxide. For instance, gadolinium (Gd) is usually doped to ceria to enhance the ionic conductivity which can increase the catalytic activity, such as, CO oxidation.

Since preparation process of catalysts affects their properties, such as particle size, surface area, phase, and catalytic activities, synthesis method is, thus, an important factor. Ceria-based catalysts can be synthesized by many methods, such as ceramic method, precursor method, coprecipitation method, hydrothermal synthesis, spray pyrolysis technique, and impregnation method. However, these methods often require high reaction temperature and special equipment. Sol-gel technology is another alternative, offering low temperature operation, high purity of

product, various physical-form products, compositional homogeneity, and ultrafine product.

The purposes of this work are thus to synthesize via sol-gel route and investigate the catalytic properties of GDC (gadolinium-doped ceria) and metal loaded GDC for methanol steam reforming. Cu and Ni are chosen metal catalysts. The influences of reaction parameters, such as effect of metal content, reaction temperature, on the performance of the catalysts are studied in detail.