CHAPTER I

INTRODUCTION

In general, a catalyst usually consists of three components; (i) a catalytic phase, (ii) a promoter, and (iii) a support or carrier. As known, the catalytic properties apparently depend upon the components as mentioned above. The catalytic phase can be metal, metal oxide, metal carbide and etc. The active form of the catalytic phase definitely depends on the specific reaction within the catalyst is applied. It is known that the performance of catalysts could be improved using a promoter such as noble metals. However, besides the consideration only in a catalytic phase and a promoter, it should be noted that a support could play a crucial role, especially as a dispersing medium for the catalytic phase. Hence, the nature of support can affect the catalytic properties based on the fact that the dispersion and interaction between a support and a catalytic phase can be altered with different supports.

It was reported that many inorganic supports such as SiO_2 (A. Martinez *et al.*, 2003; J. Panpranot *et al.*, 2002; S.L. Sun *et al.*, 2002), Al_2O_3 (B. Jongsomjit *et al.*, 2001; B. Jongsomjit *et al.*, 2002; B. Jongsomjit *et al.*, 2003; G. Jacobs *et al.*, 2002; T. Das *et al.*, 2003), TiO_2 (B. Jongsomjit *et al.*, 2004; B. Jongsomjit *et al.*, 2005; G. Jacobs *et al.*, 2002; J.L. Li *et al.*, 2000; J.L. Li *et al.*, 2002), ZrO_2 (J. Panpranot *et al.*, 2005), and zeolites (X.H. Li *et al.*, 2003) have been extensively studied for many years. In particular, the use of mixed oxide support was also mentioned (B. Jongsomjit *et al.*, 2005) as one of the promising ways to obtain a suitable support due to its synergetic effect arising from the mixing property. In the recent year, a significant development in nanoscience and nanotechnology has been tremendous. Therefore, many inorganic nanoscale materials have brought much attention to the research in this field (J. Panpranot *et al.*, 2006). However, only few studies have been done on using a nanoscale material as a support for a catalytic phase. In addition, it would be of great benefits to compare differences in characteristics between the catalytic phase dispersed on the nanoscale support and the traditional micronscale support. This will lead to a significant development in a catalyst design.

In the present study, the properties of cobalt (Co) catalysts dispersed on various mixed nano-SiO_2-ZrO_2 supports for carbon monoxide (CO) hydrogenation reaction were investigated and compared with those on the traditional mixed micron-SiO_2-ZrO_2 supports. The study was scoped as follows:

1. Preparation of mixed SiO_2-ZrO_2 supports by mechanical mixing.

2. Preparation of mixed SiO_2-ZrO_2 supports supported Co catalyst (20 wt% Co) using the incipient wetness impregnation method.

3. Characterization of the catalyst samples using X-ray diffraction (XRD), temperature programmed reduction (TPR), hydrogen chemisorption, scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX), and transmission electron spectroscopy (TEM).

4. Reaction study of the catalyst samples in carbon monoxide (CO) hydrogenation at 220°C and 1 atm and a H_2/CO ratio of 10.