CHAPTER I

INTRODUCTION

Alumina (Al_2O_3) has been considered as one of the most promising advanced materials for variety of applications because of its distinctive chemical, mechanical and thermal properties. Alumina is widely used as ceramic, ceramic coating, catalyst, catalyst support, wear-resistance material, soft abrasive, medicinal material, filler, crucible, sagger and adsorbent. Many preparation methods have been developed to prepare alumina powder that possesses the required characteristics. Examples of these method are precipitation from solution [1], sol-gel synthesis [2], hydrothermal synthesis [3], microwave synthesis [4], emulsion evaporation [5] and solvothermal synthesis [6-13]. In such methods, the characteristics of alumina are taylor-made by controlling the crystal type, crystal size, particle shape, particle size distribution, degree of agglomeration and porosity of particles [14-17].

Transition aluminas are most widely used in industry because varieties of aluminas with such properties are commercially available. Alumina can exist in many metastable phases before transforming to the stable α-alumina (corundum form). There are six principal metastable phases of alumina designated by the Greek letters chi (χ), kappa (κ), eta (η), theta (θ), delta (δ), and gamma (γ), respectively. Many industrial solid catalysts are made up from active centers anchored on transition alumina supports. This is a consequence of the prominent characteristics such transition aluminas, such as like high porosity, surface area, good mechanical strength and thermal stability.

Recently, much attention has been devoted on the catalyst preparation. Currently, the chemical products are important for living. Therefore, the catalyst with the good properties is significant in the chemical process. As year passed, preparation procedures have been improved. One of the interesting processes is to investigate the method, which make alumina support stabilize under high temperature condition to raise its applications.

Most of the catalytic processes require only moderate temperature conditions. However, some catalytic reactions have been developed to take place of higher temperature, e.g., catalytic conversion of automotive emission gas, methane steam reforming, selective CO oxidation and CO oxidation. It has been found that activity of the alumina based catalysts usually remains at relatively high level, even after extended time at high temperature. Alumina support was one of the most active for the propene-SCR of NO and can be promoted by a wide range of metal oxides such as cobalt [18-20], platinum [21-24] and silver [25-28].

Certainly, no suitable catalyst is used to control the emission because each catalyst shows both advantage and disadvantage. Therefore, the procedures of research about new catalyst are divided into two parts: (1) to study and improve the conventional catalysts and (2) to develop and design the modern catalyst. This research was studied effects of various gamma and chi alumina phase composition supports to activity or selectivity of alumina catalyst.

The objective of this study is to investigate the effect of phase composition between gamma and chi alumina supports on oxygenative reaction.

The scopes of this research are:

1. Preparation of various ratios of gamma and chi phase of alumina (0-100%chi) by solvothermal techniques in butanol and toluene at 300 °C for 2 h.
2. Characterization of the catalyst sample using X- ray diffraction (XRD), N_2 physisorption, pulse CO chemisorption, and temperature programmed study.
3. Determination of the catalytic behavior in the selective catalytic reduction (SCR) of NO by propene under excess oxygen over an Ag/Al_2O_3 catalyst by various ratios of gamma and chi phase of alumina. Feed gas contained 1000 ppm NO, 1000 ppm C_3H_6, and 5 vol% O_2 at GSHV of 16000 h^{-1}. Carrier gas was helium. The reaction temperature was raised from ambient temperature to 600 °C stepwise.
4. Determination of the catalytic behavior in the CO oxidation over a Pt/Al_2O_3 catalyst by various ratios of gamma and chi phase of alumina.

Feed gas contained CO and excess O_2 in helium balance. The reaction temperature was raised from ambient temperature to 300 °C stepwise.

5. Determination of the catalytic behavior in the selective CO oxidation in excess H_2 over a Pt/Al_2O_3 catalyst by different alumina phase between gamma and chi alumina. Feed gas contained CO, O_2 and excess H_2 in helium balance. The reaction temperature was raised from ambient temperature to 300 °C stepwise.

This dissertation is arranged as follows:

Chapter II is concerned with literature reviews of alumina and alumina catalysts.

Chapter III explains the basic theory about alumina preparation and reaction study as SCR of NO_x by hydrocarbon, CO oxidation and selective CO oxidation.

Chapter IV shows experimental systems and procedures for the preparation of Ag/Al_2O_3 and Pt/Al_2O_3 catalyst by various ratios of gamma and chi phase of alumina supports.

Chapter V presents the experimental results and discussion

In the last chapter, the overall conclusions of this research and recommendations for the future work are given.