

CHAPTER I

INTRODUCTION

Catalytic partial oxidation using air or oxygen is widely used to produce numerous chemicals while complete catalytic oxidation has many uses for eliminating organic pollutants in gaseous streams. Work-done on the partial oxidation of propylene over noble metals has been summarized in several recent reviews.

Propylene oxide (PO) is an important industrial intermediate, such as antifreeze, polyethers, polyester fiber, surfactants, and others, which has traditionally been produced by the epoxidation of propylene with hydroperoxides or epichlorohydrin. In this process, environmental hazardous chemicals such as chlorine or t-butylhydroperoxide are used as oxidants and various by-products are produced stoichiometrically. Much recent effort has been devoted to search for more environmental friendly process, direct partial oxidation of propylene to PO is being investigated extensively.

Most of previous works, regarding to partial oxidation of ethylene, were done on the silver catalyst in various types with or without supports. Therefore, silver is unique in that it is the only metal to catalyze the epoxidation of ethylene to ethylene oxide. In addition, silver metal in powder form exhibits fairly low activity and selectivity towards this reaction whereas silver supported on α -alumina exhibits high activity and over 80% selectivity. Most high surface area supports gave very low selectivity. Selectivity was achieved only when the area was reduced to below 20 m²/g by sintering effect. The selectivity and activity of catalysts are depended on the method of catalyst preparation, type of support, metal loading, and promoter. Nevertheless, silver metal is not commonly used in high temperature reactions because of its thermal instability with respect to sintering.

The oxidation of propylene to PO is one of the most challenging subjects in catalyst. Propylene oxidation to PO is not analogous to ethylene oxide reaction on silver or any other known heterogeneous catalysts. Possibly, propylene is adsorbed in the form of an allyl that is readily oxidized to carbon dioxide and water. Gold has attracted little attention as a catalyst because of its inert character and low melting point, which causes difficulties in depositing gold on supports with high dispersion. Since gold was the least reactive metal, it has been regarded as poorly active as a heterogeneous catalyst. However, if gold is deposited on selected metal oxides as ultra fine particles, the results have shown that its chemistry can be dramatically changed. Highly dispersed gold catalysts are very active in many important reactions for chemical industry and environmental protection. Highly dispersed gold on titania catalysts were well known as low-temperature CO oxidation catalysts, developed for using in spacecrafts. The same type of catalyst can be used to epoxidize propylene with almost 100% selectivity to PO by using a gas stream containing both hydrogen and oxygen. While many other metal catalysts produced propane or carbon dioxide. Gold in the presence of water vapor or hydrogen and oxygen appears to have a very high activity as a partial oxidation catalyst. One theory is that it actually produces hydrogen peroxide from oxygen and hydrogen and then hydrogen peroxide attacks the olefin molecule and to produce the epoxide.

Gold catalysts can be prepared by various different methods such as coprecipitation, deposition-precipitation (DP), and sol-gel method. The objective of this work is to study the activity of direct vapor phase partial oxidation of propylene by gold catalysts, on different kind of supports which are zinc oxide, alumina, and titania. The catalysts studied have been characterized by atomic adsorption spectroscopy (AAS), X-ray diffraction (XRD), and surface area measurement (BET).