CHAPTER I
INTRODUCTION

The partial oxidation of propylene increases attention of researchers, from both academia and industry. It can produce many by-products, some of them are acetaldehyde, acetone, acrolein, propioaldehyde, propylene glycol, and propylene oxide (PO).

The propylene oxide production is one of the most important industrial processes. It can be called epoxidation of propylene. Propylene oxide is an epoxide, which is used in organic synthesis. It easily undergoes ring-opening reaction to form bifuntional compounds. It can be used for producing resins, such as polyurethane and also some kind of surfactants and plasticizers. It is an important industrial intermediate, which has traditionally been produced by two-stage indirect processes, which are the hydroperoxide and chlorohydrin processes. In these two processes, environmentally hazardous chemicals such as chlorine or t-butylhydropeoxide are used as oxidants. The chlorohydrin process produced the stoichiometric amount of waste salts and chlorinated by-products. And the hydroperoxide process produced a co-product (styrene or t-butylalcohol) in the fixed amount. Much recent effort has been devoted to search for more environmentally friendly processes. The direct vapor-phase oxidation of propylene to propylene oxide, in the presence of oxygen and hydrogen, has long been considered desirable and is one of the important environmentally friendly reactions that still not solved by catalysis. Since direct oxidation is difficult to achieve, several approaches have been made to produce PO by oxidation over heterogeneous catalysts.

Silver-based catalysts are widely used for ethylene oxide production from ethylene and molecular oxygen. The process with ethylene is also very sensitive to support. Industrial catalysts are usually formulated on low surface area α-alumina over 80% selectivity. Most high-surface area supports give very low selectivity. Selectivity was achieved only when the area was reduced below 20 m^2/g by sintering. It is also well-known, however, that this catalysts and reaction conditions which are best suited for ethylene epoxidation do not give comparable results in the direct oxidation of propylene. It has been determined that this low selectivity is a result of the hydrogen atoms of the propylene oxide intermediated on the catalyst surface reacting with a neighbouring oxygen atom on the catalyst. The development of an isolated site catalyst, with atomic oxygen on the isolated sites, should overcome this problem and selective to epoxidation of propylene. This catalyst, however, has not yet been successfully prepared.

Gold had attracted little attention as catalyst because of its inert character and low melting point, which causes difficulties in depositing gold on supports with high dispersion. Highly disperse gold on titania catalysts are well known low-temperature CO oxidation catalysts, developed for use in spacecraft. The same type of catalysts can be used to epoxidize propylene 100 % selectively using a gas stream containing both hydrogen and oxygen. While many other metal catalysts produced only propane. Au/TiO_2 is a unique Au loading dependency, which allows the change in products between PO and propane.

The objectives of this work were divided into two parts. The first part was to investigate whether silver supported on alumina prepared by sol-gel method active for propylene epoxidation. The second part was to study the activity of partial oxidation of propylene over gold catalysts at various operating conditions.