CHAPTER I
INTRODUCTION

Ethylene oxide is an important industrial chemical used as an intermediate in the production of various useful chemicals. It is a colorless flammable gas or refrigerated liquid with a faintly sweet odor and is the simplest molecule of an epoxide (www.en.wikipedia.org/wiki/Ethylene_oxide). The major use of ethylene oxide is in the production of ethylene glycol. Ethylene oxide itself can be polymerized to form polyethylene glycol or polyethylene oxide, which is very useful as non-toxic and water-soluble polymer. The primary end use for ethylene glycol is in the production of polyester polymers. Ethylene glycol is commonly known for its use as an automotive coolant and antifreeze. Ethylene oxide is also important in the manufacture of surfactants and detergents by a process called ethoxylation, sterilants for foodstuffs, solvents, antifreezes, adhesives, and sterilized medical supplies, such as bandages, sutures, and surgical implements (www.prlog.org).

Because ethylene oxide is a valuable chemical feedstock in many applications, the partial oxidation of ethylene to ethylene oxide, so-called ethylene epoxidation, has been of great interest in many global research works. The most widely used technique for ethylene epoxidation is catalytic process using silver catalyst. Normally, silver catalyst supported on low surface area alpha-alumina (Ag/(LSA)α-Al_2O_3) provides high selectivity to ethylene oxide (Matar *et al.*, 1989). Interestingly, the previous works reported that alkali and transition metals, such as Cs and Cu, could provide the improvement of selectivity to ethylene oxide (Iwakura, 1985; Bhasin, 1988; Jankowiak and Barteau, 2005).

Non-thermal plasma is one kind of electric gas discharges, of which electrons in electrodes gain enough energy from applied voltage to overcome the potential barrier of metal surface electrodes (Eliasson and Kogeischatz, 1991). Then, they are directly transformed to chemically excited or dissociated gaseous species by colliding with the gaseous components present in the plasma zone. The non-thermal plasma is in general any plasma that possesses non-equilibrium properties, either because the ion temperature is different from the electron temperature or because the velocity distribution of one of the species does not follow a Maxwell Boltzman distribution (www.en.wikipedia.org/wiki/Plasma). Typically, the generated excited or dissociated species have much higher reactivity than neutral species at the ground state. Moreover, the main characteristic of non-thermal plasma is that the electrons in plasma zone have a higher energy than neutral gas at relatively low temperature near room temperature. The examples of chemical synthesis using non-thermal plasmas are oxidations of olefin and aromatics, and so on (Suhr *et al.,* 1988; Patiño *et al.*, 1996; Tansuwan, 2007; Suwannabart, 2008; and Permsin, 2009).

The combination of catalysis and non-thermal plasma techniques tends to offer a number of advantages over the conventional catalytic process. One of them is low operational temperature close to room temperature at near or slightly higher than atmospheric pressure. This implies comparatively lower energy consumption used for activating catalysts. Moreover, the catalytic problems at high temperature operation, i.e., catalyst deactivation, catalyst regeneration, and catalyst replacement, could be eliminated. However, they often provide less selectivity to a desired product than the catalysis technique (Pietruszka *et al.*, 2004).

In previous work ethylene epoxidation was investigated by used parallel dielectric barrier discharge (DBD) together with Ag catalyst with particles supported. The results showed that Ag/SiO_2 supported catalyst provide a high number of ethylene oxide selectivity than Ag/Al_2O_3 supported catalyst (Suttikul *et al.*, 2011). For that cause catalyst were put inside the reactor– over barrier glass plate, and that the ethylene oxide selectivity still low. To enhance the efficiency of ethylene epoxidation and to improve the ethylene oxide selectivity, instead of used old technique, the Ag catalyst were coated on barrier glass plate– It have SiO_2 content approximately 75%

The objective of this work is to investigate a combined catalytic and parallel dielectric barrier discharge system for the epoxidation of ethylene by using silver catalyst supported on silica support (SiO_2). The effects of various operating parameters, including ethylene feed position, O_2/C_2H_4 molar ratio, applied voltage, input frequency, feed flow rate, and catalyst existence, on the activity of ethylene epoxidation will be examined.