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). 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 also very useful as non-toxic and water-soluble polymer. The primary end use of 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 processes using silver catalysts. Normally, silver catalysts supported on low-surface-area alpha-alumina (Ag/(LSA)α-Al_2O_3) provide high selectivity for 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 the selectivity for ethylene oxide (Iwakura, 1985; Bhasin, 1988; Jankowiak and Barteau, 2005).

Non-thermal plasma is one kind of electric gas discharge, of which electrons gain enough energy from an applied voltage to overcome the potential barrier of metal surface electrodes and directly transform to chemically excited or dissociated gaseous species by colliding with the gaseous components present in plasma zone. The non-thermal plasma is in general any plasma, which is not in thermodynamic equilibrium, 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 Boltzmann distribution (www.en.wikipedia.org). The generated excited or dissociated species typically exhibits much higher reactivity than the neutral species at the ground state condition. Moreover, the great advantage of non-thermal plasma is that the electrons in plasma condition have much higher energy than the neutral gas at relatively low temperature, near room temperature. The examples of chemical synthesis using the non-thermal plasma are oxidations of olefins and aromatics (Suhr *et al.*, 1988; and Patiño *et al.*, 1996; Chavadej *et al.*, 2008; Sreethawong *et al.*, 2008).

In this study, ethylene epoxidation under low-temperature cylindrical dielectric barrier discharge (DBD) system was mainly studied. Comparison of the effects of various operating parameters, including O_2/C_2H_4 molar ratio, applied voltage, input frequency, and feed flow rate, between the cylindrical DBD system and the parallel DBD system, where the latter was proved from the previous work to exhibit relatively good epoxidation performance even without the presence of catalyst when compared with a corona discharge system (Sreethawong *et al.*, 2008), on the activity of ethylene epoxidation was investigated.