CHAPTER I
INTRODUCTION

Ethylene oxide (C_2H_4O, EO) is an important industrial chemical which is widely used as a key feedstock for the production of various useful chemicals. It is mainly used to produce ethylene glycol in which is used as a starting raw material to produce several valuable chemicals such as manufacture of surfactants and detergents, sterilants for foodstuffs, solvents, antifreezes, and adhesives leading to the high demand of ethylene oxide (Hassani *et al.*, 2009). For this reason, the partial oxidation of ethylene to ethylene oxide, so-called ethylene epoxidation has been great interest in many research works. (Lefort 1931)

EO is commercially produced by the partial oxidation of ethylene over Ag based catalysts supported on low surface α-Al_2O_3 (Yong *et al.*, 1991). However, the main disadvantage of this process is the yield of ethylene oxide is relatively low because of poorly dispersed Ag particles on this alumina support. A alkali and transition metal promoters, such as Cs, Cu, Re, and Au (Goncharova *et al.*, 1995; Rojluechai, 2006; Dellamorte *et al.*, 2007; Chongterdtoonskul *et al.*, 2013), or co-feed chlorine-containing moderators into gaseous reactants (Campbell *et al.*, 1984; Tan *et al.*, 1986) have been used to improve EO production performance. In addition, it is believed that ethylene in gas phase reacts with adsorbed oxygen on the silver surface to form EO (Twigg *et al.*, 1946)

However, there are several drawbacks of using conventional method, for example the high energy consumption and operating temperature, catalyst deactivation which lead to the regeneration and replacement of the deactivated catalyst and decrease the process efficiency. Therefore, finding a new method with using lower energy consumption is interesting.

Non-thermal plasma, such as dielectric barrier discharge (DBD), corona discharge, and glow discharge, is an alternative for the ethylene epoxidation reaction. Since the DBD plasma type is non-equilibrium plasma, the main characteristic is its high electron temperatures (10^4–10^5 K), whereas the bulk gas temperature remains as low as room temperature (Suhr *et al.*, 1988, Patiño *et al.*, 1996). It means that the energy consumption used for operating the reaction system is comparatively lower as

compared with conventional catalytic processes. There are many uses of the DBD for chemical synthesis, such as ozone production from molecular oxygen (Eliasson *et al.*, 1987), conversion methane to methanol (Zhou *et al.*, 1998), and partial oxidation ethylene to ethylene oxide (Sreethawong *et al.*, 2008). Moreover, the synergistic effect of plasma and catalytic becomes more interesting, for example epoxidation of ethylene over alumina and silica Ag supported catalyst (Suttikul *et al.*, 2011), partial oxidation of methane over sol-gel Fe/Hf/YSZ catalyst in DBD. (Indarto *et al.*, 2006), and gaseous benzene removal under multistage corona discharge. (Chavadej *et al.*, 2007).

In this work, ethylene epoxidation under in a low-temperature parallel dielectric barrier discharge (DBD) reactor with two rough glass plates as dielectric barrier is investigated. The effects of various operating parameters, including applied voltage, input frequency, and total feed flow rate on the ethylene epoxidation activity under parallel DBD systems with a upper glass plate coated with Ag 0.1 wt% was examined for maximum ethylene oxide production performance. After that the effects of calcination temperature as well as the effects of oxygen source types (oxygen and nitrous oxide) were also studied.