CHAPTER I
INTRODUCTION

Natural gas is the cleanest source of fossil fuels, abundant in the nature and being more environmental safety compared to other fossil fuels. Therefore, many researches had been focused on reforming of natural gas to higher value-added chemicals. However, several researches were mainly focused on CH_4, whereas natural gas also contained ethane, propane and carbon dioxide. There were possibilities to convert all natural gas components to more valuable products.

The synthesis gas from natural gas reforming was an interesting way which can be further converted to various petrochemical products. There are three chemical methods of methane to synthesis gas which can be applied for natural gas reforming. There are steam reforming of methane (SRM), partial oxidation of methane (POM) and carbon dioxide reforming of methane (CDR). SRM is a high endothermic reaction which the reaction temperature is typically in a range of 425-550 °C. POM is an exothermic reaction, so the required energy is less than the first method. According to CO_2 in natural gas, CDR turns to be more attractive way that utilizes not only CH_4 but also CO_2. However, this reaction is also highly endothermic reaction (Pornmai *et al.*, 2012).

Beside conventional processes, non-thermal plasma has been investigated to produce synthesis gas from small molecules such as water, carbon dioxide, methane or from light hydrocarbons (Futamura *et al.*, 2004, Zou *et al.*, 2007, Wang *et al.*, 2011). In plasma reforming, reactant gases would be collided by generated electron for initiating chemical reactions. Plasma reforming overcomes limitation of the conventional techniques with a lower temperature operation (Holladay *et al.*, 2009). According to required high energy for methane reforming, plasma reforming would be possibly applied for natural gas reforming. However from collision in plasma reforming, multiple pathways cannot be avoided and lead to complex product distribution. Consequently, catalyst is an interesting way to improve the product selectivity.

The past decade, there were efforts to develop the catalysts with high activity for methane reforming. Nickel-based catalysts were found to be promising

catalytic performance. However, the carbon deposition and metal sintering occur due to the required high temperature in the reaction. The noble-metal based catalysts also showed a good performance and exhibited less carbon deposition. However because of their high price and limited availability (Liua *et al.*, 2010), the Ni catalysts might be the better choice. The combination of plasma and catalysts had been also investigated the effect of each another which can be divided into 2 types; in-plasma system and post or pre-plasma system. Many researches were suggested that in-plasma catalytic system enhanced both the performance of plasma and catalyst. The addition of the heterogeneous catalyst in plasma increased the product yields and gave lower the process temperature (Chen *et al.*, 2008).

The purpose of this work was to investigate the effects of reforming system for CO_2-containing natural gas under the plasma environment via corona discharge. The effect of Ni catalysts was also investigated for CO_2-containing natural gas reforming in order to compare to plasma alone.