CHAPTER I
INTRODUCTION

As a consequence of global warming which comes from carbon dioxide (CO_2), a major greenhouse gas emitted by human activities, several ways to utilize CO_2 have been proposed. In this research, transformation of CO_2 to other species as a reactant in diethyl carbonate (DEC) synthesis will be focused. DEC is colorless transparent liquid under normal conditions and mildly toxic compound (Wang et al., 2007). Applications of DEC are numerous. For example, DEC can be used as an additive in gasoline for enhancing octane number (Pacheco and Marshell, 1997), a solvent, a chemical intermediate for polycarbonate (Briggs et al., 2009), an electrolyte in Li-ion battery, or an intermediate for pharmaceuticals.

There are several routes to produce DEC such as phosgene alcoholysis (using $COCl_2$ and ethanol (EtOH)), oxidative carbonylation (using EtOH, carbon monoxide (CO), and oxygen) (Pacheco and Marshell, 1997), urea alcoholysis (using urea and EtOH) (Wang et al., 2007), and transesterification (using EtOH and cyclic carbonates) (Qiu et al., 2010).

Using CO_2 as a reactant for synthesizing DEC is attractive. If dimethyl carbonate (DMC) synthesis was successfully synthesized from methanol and CO_2, DEC synthesis from EtOH and CO_2 was also investigated proposed.

Nevertheless, chemical thermodynamics, kinetics of the reaction, and deactivation of catalysts were found to affect the DMC yield dependent on operating conditions (Choi et al., 2002). As a result, such aspects should be properly considered for the synthesis of DEC. Moreover, supercritical condition of CO_2 was also concerned to be a potential way to improve the activity (Baiker, 1999).

The aim of this research topic was to synthesize DEC directly from ethanol and carbon dioxide under supercritical condition ($scCO_2$) over CeO_2-ZrO_2 catalysts prepared by co-precipitation. Various Ce/Zr molar ratios and calcination temperatures were investigated for optimizing the catalyst performance. In addition, the optimum CO_2-to-EtOH feed molar ratio along with varying $scCO_2$ initial conditions, including reaction temperature, were investigated for maximizing DEC production.