CHAPTER I
INTRODUCTION

Flue gases, normally produced by coalbed gas, consist of mixtures of methane (CH_4), carbon dioxide (CO_2), nitrogen (N_2), and heavier hydrocarbons (>C2). CO_2 is considered to be crucial greenhouse gas that has a direct impact on the global atmosphere (Clarkson *et al.,* 1999). The emission of CO_2 has resulted in not only the increasing of the world temperature and weather disaster but also considered as hazardous matter to human health (Gruszkiewicz *et al.,* 2009)

To produce high–purity energy products, gas separation technique by membrane is the attractive approach because of its low capital investment, simplicity and ease of installation and operation, low maintenance requirements, low weight and space requirement, and good process flexibility (Sen *et al.,* 2007)

One of the most attractive techniques for gas separation technique is the mix matrix membranes (MMMs), consisting of two phase; one is the organic polymer and another phase is the inorganic particle which has the molecular sieve characteristics (Hashemifard *et al.,* 2011). However, when using MMMs; the interfacial interaction between two phases: molecular sieve and polymeric phase can have significant impacts on the separation performance (Chung *et al.,* 2007). Additionally, the CO_2-induced plasticization effect normally found in the separation systems involving polymer matrices can decrease the membrane selectivity (Reijerkerk *et al.,* 2011).

Therefore, inorganic membranes; e.g. zeolite, alumina, carbon; have been investigated to solve the problems associating with MMMs which will also improve the gas separation performance (Ismail *et al.,* 2001). Moreover, inorganic membranes have excellent thermal and chemical stability, well-defined stable pore structure than polymeric membranes. Furthermore, they are not suffered from the CO_2-induced plasticization effect (Kim *et al.,* 2004, Low *et al.,* 2011 and He *et al.,* 2010)

Among inorganic membranes, carbon membrane is prominently attractive since it can be prepared by pyrolysis of various polymer precursors such as polyimides (Hosseini *et al.*, 2009) polyacrylonitrile (Song *et al.*, 2009), poly(furfuryl alcohol) (Bird and Trimm, 1983), phenolic resin (Centeno *et al.*, 2004 and Wei *et al.*, 2007) and etc. As a result, the pore characteristics of carbon membrane can be tailored to fit the separation of many gas mixtures.

In this study, polybenzoxazine, which is a thermally polymerizable thermosetting resin that can be easily synthesized via a quasi-solventless method was selected as a precursor to prepare carbon membrane for a model flue gas separation. In addition, Ag+ ions that can form reversible π-bonded complex with double of CO2 were added in order to enhance the separation performance.