



## CHAPTER I

### INTRODUCTION

During the 1980s, membranes for gas separation became commercial processed on a large scale. This led to intensify both academic and industrial interests. Membranes for gas separation have many advantages: low energy consumption, low operation cost, small unit size, easy of operation, and environmentally friendly, when compared with conventional technologies such as cryogenic distillation, absorption, and pressure swing adsorption. Therefore, gas separation by the membrane process has acquired great significance in the industrial scenario in terms of economic considerations (Chung *et al.*, 2007).

Mixed matrix membranes (MMMs) have a great potential to separate gas more efficiently. Polymeric membranes are cheap and easy to fabricate, but the productivity-selectivity trade-off suggested by Robeson (1991) is a main problem of polymer materials. In contrast to the polymeric membranes, inorganic membranes have a high separation performance. However, inorganic membranes are expensive and difficult to prepare without defects. So-called MMMs combine the cost effectiveness and ease of fabrication of polymer membranes with the enhanced separation performance of inorganic structures.

Typically, MMMs consist of a dispersed molecular sieving phase in a continuous polymer matrix. The most common dispersed phase material is zeolite molecular sieves that have attractive separation properties for a desired gas separation. Although the feasibility of the mixed matrix concept has been developed for gas separations, there are several challenges that should be solved before applying this technology to large scale gas separation plants. The most important challenge is how to select the ideal polymer/sieve combination to separate the desired components (Chaffin *et al.*, 2007).

In our research group, most studies related MMMs have been primarily focused on optimizing separation performance of given gas pairs by employing various types of adsorbents introduced into different types of polymers. However, the objective of this work was to systematically study the effects of zeolite embedded in the polymer matrix on CO<sub>2</sub>/CH<sub>4</sub> selectivities. Eight different zeolites (NaX, NaY, sili-

calite, beta zeolite, NaA, AgA, CaA, and H-mordenite) are selected as adsorptive fillers by considering their hydrophilic/hydrophobic nature and framework structure effective pore dimension, and effective pore size.