CHAPTER I
INTRODUCTION

Global warming is primarily due to the rapid increase concentration of greenhouse gas like carbon dioxide (CO_2) in the atmosphere. With its impact on environmental problems, CO_2 is considered as the most important greenhouse gas for the global climate change (Xu *et al*., 2002; Plaza *et al.,* 2008). CO_2 is produced from flue gas, separated from synthesis gas, fossil/biomass gasification gas, and reformate, or captured from atmospheric air. CO_2 in the gas product reduces significantly the energy content of the gas and decreases the efficiency in the transportation, storage, and any application of the product hydrogen (Xu *et al*., 2002; Siriwardane, 2006).

Capture and sequestration of CO_2 has been recognized as one of the alternatives to reduce CO_2 emission (Plaza *et al.,* 2007; Xu *et al.,* 2005; Hiyoshi *et al.*, 2005). There are several techniques, such as liquid solvent absorption, cryogenic techniques, membrane separation, solid sorbent adsorption, pressure (and/or temperature) swing adsorption, and vacuum (and/or temperature) swing adsorption available for the CO_2 separation and CO_2 recovery emitted by power plants (Kazama *et al.,* 2002; Pevida *et al.,* 2008; Dong *et al.,* 1999; Xu *et al.,* 2002; Plaza *et al* 2010).

The most widely used processes in CO_2 capture plants are amine-based processes and wet scrubbing systems (Tontiwachwuthikul *et al.,* 1991). However, there are associated with many problems. For example, the large amount of heated water leads to the use of a lot of energy in these systems (Arenillas *et al.*, 2005). In addition, amine degradation by oxidation leads to corrosion of process equipment (Gray *et al.,* 2004). The cost of CO_2 sequestration process is considered because it accounts for tentatively three-fourths of the total energy cost for CO_2 separation. Therefore, the development of cost-effective techniques for CO_2 separation is essential (Plaza *et al.*, 2009).

Adsorption is recognized as one of the alternatives because of the low energy consumption, cost-effective, and the wide range of operating temperatures and pressures (Drage *et al.,* 2007). However, the achievement of this approach depends on the regeneration and adsorbent life with high CO_2 selectivity, adsorption capacity, and adsorption/desorption kinetics for CO_2 (Plaza *et al.*, 2009).

Pichaichanlert (2010) investigated the use of activated carbon and activated carbon modified with monoisopropanolamine (MIPA), n-methyethanolamine (NMEA), piperazine and K_2CO_3 for CO_2 adsorption. XRD, BET, and TGA characterizations were used to confirm the formation of amine and K_2CO_3 on the activated carbon. The activated carbon modified with different types of amine especially piperazine and MIPA showed improvement in the CO_2 adsorption at moderate temperatures over the unmodified activated carbon. The results of K_2CO_3 loading on the activated carbon showed high adsorption capacities at 30 °C but its effectiveness decreased with the increase in the temperature.

A high-capacity and high-selective CO_2 adsorbents based on a modified AC with polyethyleneimine (PEI) was reported (Xu *et al.*, 2002). Polyethyleneimine (PEI) is a good polymer with its affinity toward gas molecules, especially CO_2 molecule because there are many nitrogen atoms in the molecule to react with CO_2 (Aroua *et al.*, 2008). The high molecular weight of branched PEI (M_w=600,000-1,000,000) was selected because of its very low volatility.

As a part of our continuing effort in the development of the surface modification on activated carbon to increase CO_2 adsorption capacity at high temperatures, effects of using polyethyleneimine (PEI) as a modification agent were investigated.