CHAPTER I
INTRODUCTION

Ethylbenzene (EB) is a key intermediate in the manufacture of styrene which is one of the most important industrial monomer. The EB production in 2010 is estimated to be about 34 million metric tons (Odedairo *et al.*, 2010). The commercial processes for benzene alkylation that produce the EB have conventionally been catalyzed by metal halide, usually called Friedel-Craft catalysts. The use of catalysts has many problems such as handling, safety, waste disposal and corrosion. Recently, several commercial processes have been developed by using solid acid catalysts, especially zeolite. Among the zeolite catalysts, ZSM-5 zeolite may be the best catalyst for the alkylation of benzene with ethylene because of its special structure and its surface acidity (Li *et al.*, 2009). The alkylation of benzene in a fixed-bed reactor in the vapor phase using a ZSM-5 based catalyst is the famous Mobil-Badger process.

The competing technologies for EB production based on zeolite catalysts mainly include Mobil-Badger, Mobil-Badger EBMax, Lummus-UOP and CDtech processes in the petrochemical industry. So that using commercial HZSM-5 zeolites is one of the interesting options that we are looking forward to studying.

Even though many researches (Sun *et al.*, 2009) have been studied on the use of these conventional commercial HZSM-5 zeolites, they found that the use of conventional commercial HZSM-5 zeolites is limited due to their rapid deactivation. Among the zeolite catalysts, HZSM-5 zeolites seem to be the most active catalyst for the alkylation of benzene with ethylene because of its special structure and acidity. However, the direct use of ethanol as an alkylating agent with benzene for this reaction has gained more attention due to green chemistry aspects. Moreover, a long stable catalyst life was also observed when alcohol was used as an alkylating agent. It was reported that the morphology of HZSM-5 catalysts affected the selectivity to EB for benzene alkylation with ethanol (Gao *et al.*, 2010).

Our previous study demonstrated that a commercial HZSM-5 catalyst with a SiO_2/Al_2O_3 ratio of 195 gave somewhat high selectivity to EB. In this research, the aim is to investigate the effect of morphology of synthesized HZSM-5 on the

selectivity to EB. The HZSM-5 catalysts were synthesized at a desired SiO_2/Al_2O_3 ratio with variation of hydrothermal condition. The catalytic activity was tested using a fixed bed reactor reaction at different reaction conditions; temperature and benzene to ethanol ratios.