CHAPTER I
INTRODUCTION

Epoxides are valuable chemical intermediates used in the petroleum and chemical industry. They are compounds containing three membered cyclic ethers which are known to be much more reactive than the typical acyclic ethers, due to their bond angle strain. Epoxides are used in a variety of applications, especially the polymerization production of epoxy resins (epoxies). They are well known due to their mechanical and electrical properties, structural stability, temperature resistance, chemical resistance, and adhesion to other materials. The epoxides, such as ethylene oxide and propylene oxide, are used to make polyurethane, polyester resins, polyether polyols, flame retardants, surfactant, etc. In this research, we focus on cyclohexene oxide which is an important intermediate for the production of plasticizers, rubbers, pharmaceuticals, dyes, etc.

Many kinds of oxidizing agents, e.g. hydrogen peroxide (H_2O_2), tert-butyl hydroperoxide (TBHP), peracid, etc., have been used in the epoxidation of cyclohexene. In many cases, H_2O_2 is preferentially selected because it is easy to handle and possess relatively high active oxygen content. In addition, H_2O_2 is inexpensive, safe, clean, and environmentally friendly (Sreethawong *et al.*, 2005). The main problem in the production of cyclohexene oxide is the formation of undesired products, which are produced by side reactions, such as 2-cyclohexene-1-ol, 2-cyclohexene-1-one, trans-1,2-cyclohexanediol, and others. Therefore, it is a challenge to improve the catalyst to have better yield towards cyclohexene oxide, the main product.

A lot of research has been done for cyclohexene epoxidation by using TiO_2-containing catalysts. CeO_2 was also proven to be a good support for Fe, used for cyclohexene epoxidation (Reddy *et al.*, 2010); RuO_2 on TiO_2 support also exhibited high yield (Woragamon *et al.*, 2009).

The aim of this research is to do a study on cyclohexene epoxidation via mesoporous-assembled Ru/Ce/TiO_2 mixed oxide catalysts. The purpose of the research is to study the possibility of incorporating Ru into the Ce/TiO_2 mixed oxide catalysts and optimizing the reaction conditions. The catalysts will be synthesized by

a single-step sol-gel method with the aid of a structure-directing surfactant. The catalyst will be characterized by several techniques, such as surface area analysis (BET), thermogravimetric-differential thermal analysis (TG-DTA), and X-ray diffraction analysis (XRD) and temperature programmed reduction analysis (TPR). The catalyst activity will be tested by the cyclohexene epoxidation reaction. The effects of various reaction parameters, such as cyclohexene content and catalyst content, on the catalytic performance will also be studied.