

CHAPTER I

INTRODUCTION

Biodiesel or fatty acid methyl ester (FAME) is known to be an alternative for petroleum-based diesel. Advantages of biodiesel are: renewability, biodegradability, higher flash point, higher cetane number, reduction of exhaust emissions, miscibility with petroleum-based diesel, and its ability to be produced domestically. Biodiesel produced from vegetable oil that contains higher unsaturated fatty acid composition exhibits lower oxidative stability. In contrast, the higher the saturated fatty acid composition, the worse cold flow properties become. Therefore, partial hydrogenation of polyunsaturated FAMEs to monounsaturated ones is a promising solution to these problems. Moreover, noble metal catalysts such as Pd seem to be the most promising. Supported Pd catalysts have been widely employed as catalysts for hydrogenation reaction. Materials usually used as a catalyst support are: carbon, silica, alumina, and zeolite. Due to the difference in nature and structure of each support, the type of support is believed to affect catalytic activity and selectivity of the catalyst. Moreover, the same support with different pore size also affects the rate and selectivity of the reaction.

Since the 1990s, resorcinol-formaldehyde organic gels have received considerable attention as carbon precursors due to their unique properties, such as high surface areas and controlled porous structures. Starting from the first report by Pekala (Pekala *et al.*, 1989), research has been focused on achieving and controlling the degree of meso/macroporosity of these carbon materials and on modifying the synthesis procedures. From the reaction engineering point of view, when working either in the liquid- or gas-phase, the use of non-microporous materials is considered highly desirable in order to avoid internal mass-transfer limitations. Three different types of carbon gels can be obtained depending on the solvent drying method : aerogels (drying under supercritical CO₂), xerogels (drying at ambient temperature and pressure conditions) and cryogels (freeze drying). Depending on the pH and the dilution ratio of the starting resorcinol formaldehyde precursor solution, these materials can present widely different textures. Carbon xerogels have been used as catalyst supports in fuel cells, using metals like Pt, Pd, and Ru in fine chemical applications.

Polybenzoxazine (PBZ) provides high thermal stability, high flame retardant, low shrinkage upon polymerization, no by-products or volatile generation, excellent dimensional stability, and rich molecular design flexibility. In addition, the supercritical drying process is not necessary due to high crosslink density of polybenzoxazine (Ishida *et al.*, 1996) Porous carbon obtained via ambient drying method is called carbon xerogel. Polybenzoxazine is a great candidate as a polymer precursor to produce carbon xerogel to be used as a material support.

In this study, carbon xerogels derived from polybenzoxazine with BET surface area of 327 m²/g and pore size 25 nm were produced by modifying a previously described ambient-pressure drying method and explored as Pd catalyst support for partial hydrogenation process. The carbon xerogel supported Pd (Pd/CX) were characterized by electron microscopy (SEM, TEM). Pd/CX samples were studied in comparison with commercially obtained samples of Pd catalyst support on activated carbon and silica (SiO₂).