CHAPTER I
INTRODUCTION

The world's economy dramatically grows in the recent century that was driven by two important parts: industry and transportation. Over 90% of the energy used for industry and transportation is derived from petroleum which is the main factor causing serious global problem. Due to the continuous depletion of the world's non-renewable petroleum reserves, increasing of environment concerns and the price volatility of petroleum, there are many efforts to develop the fuels from alternative sources, including renewable resources such as vegetable oils, animal fats or even waste cooking oils.

Biodiesel chemically referred to as a fatty acid methyl ester (FAME) is a fuel derived from fats and oils via transesterification process using methanol (alcohol) at ambient pressure in the presence of hydroxide or, more effectively, alkoxide catalyst. It has recently been considered as the best candidate for a diesel fuel substitution. The main advantage of using biodiesel is that it is biodegradable and produces less harmful gas emissions such as sulfur dioxide (SO_2) (Helwani *et al.*, 2009). It also reduces net carbon dioxide emissions when compared with petrodiesel fuel. Although biodiesel is considered as a potential sustainable alternative fuel, there are several properties that limit its uses. Biodiesel has low heating value and low oxygen stability. It can also cause the increasing of nitrogen oxide (NO_x) emission and the corrosion problem in the engine. Moreover, more than 95% of biodiesel production feedstock comes from edible oils that may cause some problems such as the competition with the edible oil market, which increases both the cost of edible oils and biodiesel (Dennis *et al.*, 2010). Therefore, renewable diesel, green biodiesel or hydrogenated biodiesel has been studied and gained attention in recent years.

Hydrogenated biodiesel obtained from the deoxygenation process of vegetable oils or animal fats at elevated temperature and pressure in the presence of a heterogeneous catalyst consists mainly of long-chain alkanes. It can substitute directly for or blend with petrodiesel without modification of vehicle engines or fueling infrastructure. Hydrogenated biodiesel not only reduces the limitations of biodiesel uses, but also possesses many advantages over biodiesel including higher cetane number that provide better vehicle performance, lower cloud point, and lower NO_x and greenhouse gas emission. It can also be produced domestically from a variety of feedstocks.

In the previous work, Pd supported titanium dioxide (TiO_2) catalyst was considered as a promising catalyst on the deoxygenation of beef fat for the production of hydrogenated biodiesel because it showed the higher catalytic performance compared with other Pd-supported catalysts (Pd/Al_2O_3, $Pd/F\text{-}Al_2O_3$, Pd/SiO_2, Pd/TiO_2, Pd/C, and Pd/KL).

The main purpose of the present work is to study the effect of catalyst preparation methods over the Pd/TiO_2 catalyst on the deoxygenation of beef fats for the production of hydrogenated biodiesel. TiO_2 synthesized via a combined sol-gel process with surfactant-assisted templating method was selected for comparative studied as a support with the commercial P-25 TiO_2 (Sreethawong *et al.*, Sukulkhamaruethai *et al.*, 2004). For metal loading method, photochemical deposition (PCD) and incipient wetness impregnation (IWI) were chosen (Zhang *et al.*, 2004). Moreover, Pd/TiO_2 catalyst synthesized via a combined single-step sol-gel process with surfactant-assisted templating method (SATM) was conducted to compare with above catalysts (Sreethawong *et al.*, 2005).