CHAPTER I
INTRODUCTION

As the expanding of energy demand dealing with the increasing of crude oil prices, hydrogen as an abundant element is focused as the primary energy carrier in the field of renewable energy since it can be produced from agricultural wastes; moreover, it is defined as a clean burning fuel without CO_2 emission for the greenhouse effect. Recently, hydrogen is widely used to produce electricity in automobile applications by passing through the efficient and innovative technique known as PEM fuel cells.

For using hydrogen in fuel cell applications, it is associated with many disadvantages dealing with safety problem, handling with cost of storage, requirement of new infrastructure; especially, its purity, and so on. To overcome these problems, the production of hydrogen based on high energy liquid fuel reforming process such as gasoline or methanol is recommended as the suitable pathway for achieving the high purity of hydrogen as the main product during the operation.

Among the hydrocarbon sources, methanol is considered as one of the best candidates because of it properties such as high hydrogen/carbon ratio, ease to synthesis from many kind of feedstocks (biomass, coal, and natural gas), and the absence of carbon-carbon bonds, which efficiently prevents the risk of coke formation. Interestingly, hydrogen converted from methanol is not worsening the fuel cell performance because of its having no sulfur to contaminant. Conventionally, three possible processes can be used to convert methanol to hydrogen via thermal processes, such as steam reforming of methanol (SRM), partial oxidation of methanol (POM), and oxidative steam reforming of methanol (OSRM).

Therefore, ORSM is chosen as the promising way to obtain the high hydrogen production via an energy savingby combining the advantages of SRM and POM together.

$$CH_3OH\,(g) + 1/2aO_2\,(g) + (1\text{-}a)H_2O\,(g) \rightarrow (3\text{-}a)H_2\,(g) + CO_2\,(g)$$

where $0<a<1$ and $\Delta H^{\circ}_R = 49.5\text{-}241.8a\ kJmol^{-1}$ (25 °C).

Among the catalysts studied in ORSM, copper (Cu-) based catalysts exhibit high catalytic performance during reaction. Nevertheless, CO (>100ppm) could be possibly formed as the by-products, the poisoning gas for PEM fuel cell. On the other hand, it has been reported that gold (Au) based catalysts are responsible for the high catalytic activity in the low temperature CO oxidation and WGS. Therefore, the bimetallic catalysts of Au and Cu are expected to improve the activity in OSRM with combining the benefits of both metallic catalysts.

The purpose of this research is to investigate the oxidative methanol reforming reaction over Au-CuO/CeO_2. The catalysts were prepared by co-precipitation technique and characterized by X-Ray Diffraction (XRD), Transmission Electron Microscope (TEM), BET surface area measurement, Temperature–Programmed Reduction (TPR), Temperature–Programmed Oxidation (TPO), Fourier Transform Infrared Spectroscopy (FT-IR, and UV-visible Spectroscopy techniques. The influences of the main parameters; steam/methanol molar ratio, O_2/methanol molar ratio, Au/Cu (wt/wt) ratio, catalyst pretreatment, and calcination temperature as a function of reaction temperature, were studied in details.