



CHAPTER I INTRODUCTION

Nowadays, polymer electrolyte membrane fuel cells or Proton Exchange Membrane Fuel Cells (PEMFCs) have been significantly applied to stationary and mobile applications due to its exclusive properties e.g. high power density and light weight.

However, steam reforming of alcohols and hydrocarbon produce hydrogen-rich gas containing some impurity such as carbon monoxide (CO), a toxic gas, is able to deteriorate Pt-catalyzed anode in PEMFC at low temperature (~80—120°C). In order to obtain the optimum performance of PEMFC, the concentration of CO in reformed gas required to remain lower than 10 ppm for fuel cell operation. Thus, the preferential oxidation (PROX) of CO in low temperature is one of practical and economical methods to solve CO problem (Kordesch *et al.*, 1996; Rosa *et al.*, 1997; GotzH *et al.*, 1998).

This method, catalyst and oxygen (O₂) are applied for removing the CO. However, there are two competitive reactions of there as follows:



From equations (1.1) and (1.2), they are shown that O₂ oxidize in both CO and H₂, which convert to CO₂ and H₂O, respectively. On the other hand, the rate of H₂ oxidation is higher than that of CO at high temperature. Therefore, a low temperature operating catalyst is required for suppressing the H₂ oxidation. Furthermore, the challenge is to achieve the selective catalyst promoting CO oxidation rather than H₂ oxidation.

In this reaction, the active metals as demonstrative metals are platinum (Pt) and gold (Au). The limitation of Pt-based catalyst is a high costly, which not suitable for fuel cell application. Therefore, the Au-based catalyst is focused. Moreover, there are many advantages such as catalytic activity at low temperatures in several oxidation reactions when compare with the other metals from platinum group, high active

and selectivity for CO oxidation than for H₂ oxidation (Haruta M and Daté M., 2001).

As well known, the activity of gold-based catalyst depends on the type of support, particle size of gold, and preparation technique, etc. Different reducible metal oxide or supports will occur to different interactions between gold particles and supports and consequently makes different activities. In general, small Au particles are dispersed on reducible metal oxide or support more than large particles. Consequently, it has high surface area and activity. There are many types of the preparation techniques of gold-based catalyst such as impregnation, co-precipitation (CP), deposition precipitation (DP), and photo-deposition, which has been reported that they were used to prepare the nano Au particles.

Although the CO oxidation on Au/MnO_x and Au/FeO_x in the presence of hydrogen has been studied with the simulated reformed gas (Luengaruemichai *et al.*, 2005), these previous studies did not study on the mixed support of Au/FeO_x-MnO_x. Thus, the purpose of this thesis is to develop the new catalyst (Au/FeO_x-MnO_x) prepared by deposition precipitation technique for PROX of CO in the presence of H₂ rich gas for fuel cell application. In order to understand the relationship between the catalyst properties and its activity and selectivity, several different characterization methods are used.

Finally, the fuel processor system—consists of three major units in series e.g. evaporators, methanol steam reformer reactor, and PROX of CO reactor— was intended for investigation the catalytic behavior in the real reformat condition.