CHAPTER I
INTRODUCTION

Because of going up of energy use, the polymer electrolyte membrane (PEM) fuel cells or known as proton exchange membrane fuel cell is attractive as an alternative energy. Since the PEMFC can operate at low temperatures, typically 80°C, thereby attention is paid to be used in the internal combustion engine of the vehicle manufacturers.

Nowadays, fuel cells have been studied as an alternative energy in the reasons of the several advantages which not only high efficiency but also environmental friendly and low operating temperature used in vehicles. From the latter reason, in low temperature of PEMFC, CO is preferentially adsorbed resulting in the rapid deterioration in fuel cell performance. Hence, it is necessary to remove CO in order to optimize concentration level lower than 100 ppm.

The practical method to remove CO is selective catalytic oxidation carried out by using a catalyst and oxygen (O_2) since it is an easy and economical technique. Therefore, the types of catalysts is the important step needed to be concerned. The ideal catalyst should give the high selectivity and activity for the oxidation of CO at low temperature; as the reaction follows: $2CO + O_2 \rightarrow CO_2$. However, the oxidation of H_2 can occur also which faster and easier than CO at high temperature as the reaction follows: $2H_2 + O_2 \rightarrow 2H_2O$. Therefore, a low temperature operating catalyst is a good catalyst or suitable for suppressing the H_2 oxidation.

The active metals that as demonstrative metals in this research are Pt and Au; however, these metals have various advantages and disadvantages in different ways. The advantages of Au over Pt are that it can catalyze the oxidative reaction of CO at lower temperature than Pt, high activity, high selectivity, stable price, and greater availability. The activity of gold is depended strongly on the particle size of gold and the optimal proportion of Au species, which is related to the nuture of supports and preparation method. Small Au particles are more active than large particles because of high surface area, high activity also, consequently, the preparation techniques should be considered. Besides, type of metal oxide support, the interaction between gold particles and supports, makes different activities also.

The preparation methods; impregnation, co-precipitation, deposition precipitation, and photodeposition, also affect to the properties of catalysts. Photodeposition is the latest method, used to modify the photo-catalytic properties, enhance the extent of gold deposition, decrease the heat treatment step by UV irradiation, and narrow down the gold particles size distribution—influenced by the pH value, irradiation time, concentration of precursor, and wavelength of the light source. The latest research have explored that under UV light irradiation with a wavelength less than 387 nm, the illuminated TiO_2 (anatase type; band gap energy, E_g = 3.2 eV) will generate photo-excited electrons and positive holes in aqueous medium. $AuCl^-_4$ ions adsorbed on the surface of TiO_2 particles can react with the photogenerated e^- to form Au^{3+}, Au^+, and Au^0. From these reasons, in this work photodeposition is used to gain the best catalyst and ZnO, which has the band gap energy of 3.2 eV, is used as a support. The influences of irradiation times, precipitant concentration, calcination, and storage conditions on the catalytic activities of the Au/ZnO catalysts are investigated. In addition, the effect of moisture, stability testing, and the color of all catalysts will be presented in this work.