CHAPTER 1
INTRODUCTION

In today's world, no one can deny that humans need a renewable energy revolution. This is due to the world's energy crises which is the diminishing of our energy resources, such as fossil fuel. And there is also another main problem which is increasingly banging at humanity's door, needing attentions, that is the emissions from fossil fuel usage. The emissions are mainly composed of the greenhouse gases which degrade the air quality all over the world and also play a significant role in global warming. During the last few years, humans finally feel the climate change and start to look at ways to turn around a disastrous trend of burning diminishing fossil fuels. Scientists have proposed the use of alternative energy which is renewable within a human lifetime, and can be produced safely and equitably for all time with minimal impact on the environment and future inhabitants. Examples of common alternative energies are solar energy, winds and tides power and hydrogen energy.

Hydrogen energy is seen as a meaningful choice for the future energy by virtue of the fact that it is renewable, does not develop the "greenhouse gas" CO_2 in combustion, releases big quantities of energy per unit weight in combustion, and is easily converted to electricity by fuel cells. In a fuel cell, hydrogen and oxygen are combined to produce electricity, heat, and water. Fuel cells operate best on pure hydrogen. Nonetheless, the steam reforming of alcohols and hydrocarbons produce hydrogen-rich gas containing a poisonous gas, carbon monoxide (CO). Moreover, only a trace amount (10 ppm) of CO is capable of deactivating Pt-based anode catalyst in Proton Exchange Membrane Fuel Cells (PEMFCs) at low temperature (~80–120°C).

Thus, to develop PEMFCs for general use it is essential to make efficient catalysts for preferential oxidation reaction (PROX) of CO that are able to operate at low temperature and high selectivity to remove CO from the reformed gas by oxidizing CO to CO_2, while at the same time being inactive to the undesired H_2 oxidation side reaction (Sanchez *et al.*, 1997). Hence, many scientists have started to do research on the catalyst used for CO oxidation. The effective catalysts for the PROX of CO generally are supported noble catalysts (Pt, Rh, Ru, Pd) (Rosso *et al.*, 2004).

Although Pt and Pd have been already used in automotive pollution control in chemical and petroleum industry for many years, but recent results suggest that this century may become golden age for gold-based catalysts. Metal oxides supported Au nanoparticles are highly active in removing CO by oxidation reaction (Yang *et al.*, 2010). From the research of Sanchez *et al.* (1997), the gold catalyst on manganese oxide support has been found to be resistive to both CO_2 and H_2O contained in the feedstream with a wide range of concentrations and also be able to operate at temperature lower than 127°C. Moreover, Au supported on transition metal oxides still be able to catalyze the CO oxidation reaction in a very low temperature (-70°C or 203 K) (Haruta *et al.*, 1993).

For the supports, generally metal oxides are used. Ceria is one of interesting choices of the support. As ceria is remarkably active in low temperature oxidation of CO and it can promote water gas shift reaction (Taha *et al.*, 1996). In addition, it is also active in transient oxygen storage or in other words, it has high oxygen storage capacity (Escamilla-Perea *et al.*, 2010), in which they can oxidized CO even in the absence of oxygen.

The aim of the present work is to study the catalytic activity of Au/La-CeO_x for PROX in the presence of H_2. The supported Au catalyst was prepared by deposition-precipitation technique. The catalytic activities are presented in terms of CO conversion and CO selectivity. The variables of this research are operating temperatures, support preparation procedures, drying procedures, calcation temperatures, percent gold loading, and effect of CO_2 and H_2O. All catalysts are characterized by X-ray diffraction (XRD), BET surface area, temperature-programmed reduction (TPR), UV-Vis Spectrophotometer, and Transmission Electron Microscopy (TEM).