CHAPTER I
INTRODUCTION

Alternative power sources for transport are an increasingly urgent need as demand grows for reduced emissions from combustion engines. There are enormous technological advances in other areas. It is, however, still necessary to burn fuel to power vehicles. The inefficiencies of heat engines mean that most of the energy from precious carbon-based resources is wasted and the products of combustion are major atmospheric pollutants. The problem could be resolved partially by legislation against combustion engines. While several approaches may work, a better idea is to develop other methods of transport power that are less polluting. Electric power from fuel cells is probably the best contender.

However, CO impurities contained in reformed gas, which is the feed for fuel cell, are known to poison the platinum anodes of the commonly used Polymer Electrolyte Fuel Cell (PEFC) or Proton Exchange Membrane (PEM) fuel cells. Several approaches are being discussed to solve the CO problem and selective CO oxidation is the most likely option to solve this problem because of its simplicity and low cost.

The main objectives of this study are as follows. First, a sol-gel procedure is used to synthesize the transition metal catalysts supported on metal oxides for selective CO oxidation. Then, the conventional preparative methods, such as impregnation and co-precipitation are compared with the synthesized sol-gel catalysts and then their properties are characterized and tested under standard reaction conditions. Second, the effect of reaction parameters on the activity and CO_2 selectivity of the catalysts are also investigated.

This dissertation is organized as follows: Chapter I is introduction into the subject. In chapter II, a general literature survey on transition metal supported mixed oxide catalysts, selective CO oxidation, and fuel cell background is given. In chapter III, a review of the preparation techniques is given. Then, the sol-gel chemistry and its controlling parameters are discussed. This is followed by a discussion of the experimental set-up used to collect data. After that, characterization techniques used in this study are explained in detail. Chapter IV gives the results of Pt/CeO_2 and

$Pt/CeO_2.Al_2O_3$ catalysts on the catalytic activity. In chapter V, the Pt/CeO_2 and Au/CeO_2 catalysts prepared by using impregnation, co-precipitation and sol-gel techniques are discussed. The activity of platinum metal and gold metal and the reaction conditions are examined and the activity results obtained are interpreted with the characterization techniques. The effect of catalyst preparation method and reaction conditions on the catalytic activities and selectivities are compared. Then, a comparative study of Pt/CeO_2, and Au/CeO_2 catalysts is presented. In chapter VI, the activities of platinum metal and gold metal supported on ceria for water gas shift reaction are compared with studies reported in the literature and their activities are explained using the results obtained from characterization techniques. In addition, the results of activities of platinum metal and gold metal supported on $CeO_2.Al_2O_3$ for water gas shift reaction which is a precursor reaction to selective CO oxidation are presented. Finally, overall conclusions and recommendations are discussed in chapter VII.