CHAPTER I

INTRODUCTION

At present, air pollution control is a very interesting and serious problem, because of the number of exhaust gases emitted by motive power, especially automobiles. The components of automotive emissions are:

1. Suspended particulate Matter.
2. Carbon monoxide, CO.
3. Nitric Oxide, NO_x
4. Unburnt hydrocarbon, HC.

The three major pollutants (CO, NO, and HC) have severe effects on health, environment and global warming. The US emissions standard remove 90 percent of these pollutants from car exhausts. Accordingly the, committee for the environment of Thailand has the policy of limiting the content of CO from gasoline automobile not more than six percent on Bosch's measurement system. And US Federal Emission limits have shown a control limit of the major three pollutants as in figure 1.1 (Coombes,1992).

Currently, there are a number of ways to control and eliminate these pollutants, such as improved working machines of vehicle, controlled combustion unit and treatment of emission gases. Nowadays, automobiles always use treatment technology to control exhausted gases before discharge

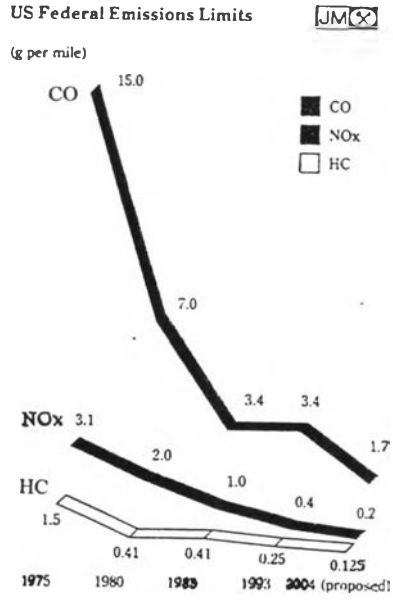

Figure 1.1 Shows the US Federal Emission Limits. (Coombes, 1992)

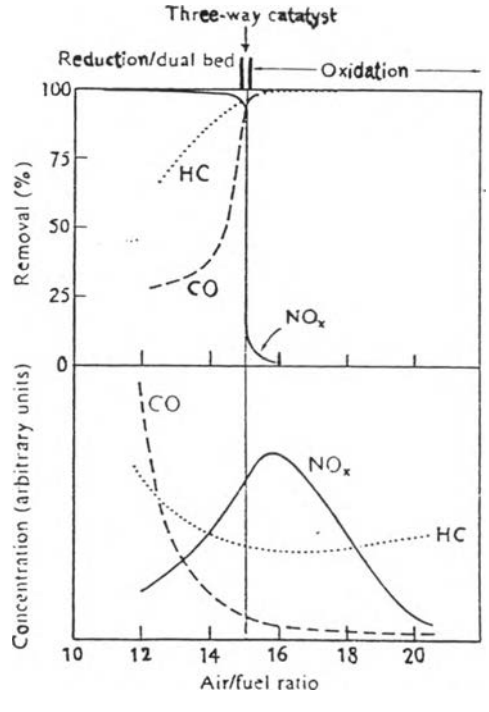

Figure 1.2 Conversion Efficiencies of Three-way Catalyst and Pollutants content. (Toyota motor Corp.,1991)

in to the atmosphere. The treatment technology is a catalytic converter or a three-way catalyst equipped with a muffler.

It is called a "three-way catalyst" because it converts all three major gas pollutants simultaneously. And it has to operate at an accurate air/fuel ratio by keeping the ratio between air/fuel ratio near stoichiometric point at 14.7 in order to achieve high efficiency. (Coombes,1992). Figure 1.2 shows the efficiency of eliminating the three pollutants at various ratios of air to fuel.

The three-way catalyst system will strip oxygen of NO_x to oxidize CO and HC. Both reactions are shown in equation 1 and 2, respectively. And NO_x is reduced by CO and HC as shown in equation 3 and 4.

OXIDATION REACTION (Toyota,1991)

$$2CO + O_2 \longrightarrow 2CO_2 \qquad (1)$$

$$HC + O_2 \longrightarrow H_2O + CO_2 \qquad (2)$$

REDUCTION REACTION

$$NO_x + CO \longrightarrow xCO_2 + 1/2\ N_2 \qquad (3)$$

$$NO_x + HC \longrightarrow H_2O + x\,CO_2 + 1/2\ N_2 \qquad (4)$$

Another essential requirement for a three-way catalyst equipped for a gasoline engine is the activity for selective reduction of nitric oxide in the presence of a small excess of oxygen, as slightly oxidizing condition

frequently occurs in the engine for oxidation of carbon monoxide and hydrocarbon.

For these constraints of a three-way catalyst system, noble metals such as rhodium have been used for reduction of NO_x and combined with platinum for simultaneous oxidation of CO and HC. However, these noble metals for these applications have been expensive and are a scarce resource and have other disadvantages. (Kummer, 1980., Egelhoff, 1982) For this reason, the focus of this research desired to minimize the need for rhodium and platinum, thus, substituted (noble metals) for base metal.

Hence, the scope of this research would be as follows:

1. The objective of this study
    1.1 To prepare the modified three-way catalyst by base metal substituting for rhodium and platinum to control CO,HC and NO.
    1.2 To test performance of the prepared modified three-way catalyst on the redox reaction.
    1.3 Comparison activity with the conventional three-way catalyst.
2. Advantage
    2.1 To reduce the production cost of a conventional three-way catalyst .
    2.2 To apply to gas purification.
3. The scope of this study
    3.1 Preparing of modified three-way catalyst by
        - using the various base metal salts.
        - varying the percent of base metals.

- varying the condition of calcination catalysts.

3.2 Testing the activity of modified three-way catalyst by simulating exhaust gases under two conditions:

3.2.1 At stiochiometric condition.(air/fuel = 1.0)

3.2.2 Lean and rich condition for variable air/fuel ratio for different operating conditions of the engine.

3.3 The characterization of a modified three-way catalyst by

3.3.1 Measurement of active sites of catalyst by chemisorption of carbon monoxide on active phase.

3.3.2 Measurement of total surface area of this catalyst by BET surface method.

3.3.3 Study of the strength adsorption of oxygen on catalyst's surface by temperature program reduction with hydrogen.