CHAPTER I
INTRODUCTION

Nowadays the disposal of used automotive tires is major environmental and economical problems for most countries. It was estimated that 2.5×10^6 tons of used tires per year are generated in the European community, 2.5×10^6 in North America, and 1×10^6 in Japan (Berrueco *et al.,* 1999). The complex nature of tires also makes them difficult to recycle.

An interesting alternative to recycling waste tires is decomposing them to lower molecular weight products using tire pyrolysis. The products obtained from the process can be classified into 3 groups based on their phase: solid (47-63 wt% char), liquid (30-43 wt% water and oil) and gas (4.4 wt% light hydrocarbons, H_2, CO and CO_2 2.4-). The main gaseous components produced from tire pyrolysis are hydrogen (H_2), carbon monoxide (CO), carbon dioxide (CO_2), hydrogen sulphide (H_2S), and hydrocarbons: methane (CH_4), ethane (C_2H_4), ethene (C_2H_2), propane (C_3H_8), propene (C_3H_6), butane (C_4H_{10}), butene (C_4H_8), butadiene (C_4H_6), pentane (C_5H_{12}) and pentene (C_5H_{10}). In general, the products from pyrolysis are passed to a condenser to condense versatile liquid products that can be sold to the petrochemical industry while the pyrolysis gas containing light hydrocarbons is sent back to the bottom of furnace, and utilized as fuel.

Environmental pollution can, however, be created from the pyrolysis when the waste is not properly pre-treated. Hazardous emissions to the atmosphere is also a result from the improper disposal of exhaust gas from combustion of pyrolysis gas. One crucial problem of the process comes from the flue gas. Harzardous emissions (such as HC, SO_x, NO_x, CO and CO_2), generated from pyrolyzed gas combustion, can subsequently create environmental problems.

Gaseous products from tire pyrolysis is usually utilized as a fuel to produce thermal energy in the process. However, flue gas from combustion of pyrolysis gas creates an emission problem. Catalytic combustion techniques, therefore, become very interesting alternatives for treating the gaseous emissions entrained in the flue gas stream before exhausting to the environment.

Catalytic combustion, or catalytic total oxidation, is an effective method to reduce hydrocarbons and to treat gaseous emissions. Low temperature combustion operates in a temperature range of 300-500°C to eliminate traces of volatile organic chemicals (VOCs) in the air and residual hydrocarbons or other organic compounds in the chemical and petrochemical processed stream.

Noble metals are the most active species for performing the complete oxidation of hydrocarbons. It is known that the most active substances are platinum group metals including palladium (Pd), platinum (Pt), and rhodium (Rh) (Sadamori 1999). Zeolites are interesting oxidation catalysts. They can stabilize exchanged metals in the ionic state, thus providing high dispersion of the active component. Moreover, zeolites in acidic forms can also activate molecular oxygen, forming peroxide species. Thus, an increase in electron deficiency of the site gives rise to the species' ability to withdraw an electron from the hydrocarbon and oxidize it. Since the development of a large number of catalytic formulations is required in order to study all the factors that can affect catalytic activity, combinatorial catalysis and high throughput methodologies are more applicable nowadays.

Combinatorial heterogeneous catalysis is a methodology of solid state materials preparation, processing and testing for activities and selectivities of the catalysts (Senken, 2001), which is composed of (i) rapid library synthesis, (ii) high throughput testing, and (iii) large-scale information management.

The aim of this study is to investigate the oxidation activities of palladium (Pd)-based catalysts promoted with elements, such as Zr, Ti, and Sn in mono-, bi-, and tri-element systems by using a multi-flow reactor for high-throughput screening. ITQ-21 washcoated on a ceramic monolith was used as a catalyst support. The feed was simulated from that of the exhaust stream from combustion of tire pyrolysis gas. Moreover, characterization techniques, such as TPO, TEM, SEM and XRD were performed to examine the physico-chemical properties of the catalysts related to their oxidation activities.