

CHAPTER I

INTRODUCTION



Nowadays, people realize that the control of pollution of air, water and soil cannot be solved separately. The still increasing use of fossil combustibles is expected to continue for decades; so will the connected NO_x emission unless the industrialized countries strengthen their efforts to control these emission to acceptable limits. With increasingly strict standards for the emission of NO_x in the stack gases from stationary sources and automotive exhausts, it is becoming more and more evident that combustion modification will not give sufficient reduction. Some form of post-combustion NO_x removal will be necessary if emission standards are tightened.

Ambient air quality standards were set and stringent emission regulations were enforced since the early 1970S in the USA [1] and Japan [2]. At that time local or nation-wide improvement of standards was regarded as the best countermeasure to treat pollution problems. In the 1980S, however analysis technology and monitoring system improved greatly [3], leading to increased public awareness of a variety of local and global environmental problems [4,5]. The "environmental crisis " announced in the 1970S has returned more forcefully today. Increasing concerns about air quality and the environment have led to tougher standards in many countries throughout world in the control of exhaust emission on mobile and stationary engines, and even more stringent regulations are expected to be introduced in the near future [6]. Oxides of nitrogen play a major role in the photochemical reactions in the troposphere and the stratosphere [7-9]. NO is slowly converted into NO_2 through photochemical oxidation. NO is rapidly oxidized by atmospheric oxidants such as ozone. NO_2 itself is a precursor for nitric (nitrous) acid [10], which contributes substantially to so-called acid rain. NO is able to reach all parts of the respiratory

system because of its low solubility in water. It diffuses through the Alveolar-cells (epithelium) and the adjacent capillary vessels of the lungs and damages the Alveolar-structures and their function throughout the lungs. At present, two practical methods have been developed for reduction of NO_x in exhaust gases. As the countermeasure for the removal of the NO_x from stationary sources, i.e., power ammonia has been used as a reduction reagent to advance the de- NO_x reaction on supported catalysts like vanadia on titania. On the other hand, to purify the exhaust gases from gasoline-engine vehicles, the emission control systems have been developed using the so-called three-way conversion catalysts [11]. The pollutants in diesel exhaust gases are nitrogen oxides [12-15]. Combustion occurs on the lean side in a diesel engine, oxygen contents in exhaust gases are high [16-17]. The selective catalytic reduction of NO_x with NH_3 are limited due to difficulties in installing them onto vehicles, and satisfactory measures have not yet been taken to reduce these pollutants.

Microporous materials include a wide range of crystalline and amorphous solids such as metallosilicates, zeolites, and microporous metal oxides [18]. Novel microporous materials may have a potential to create a new field in scientific and practical way. Their ion-exchange, molecular sieving, and catalytic properties make them more attractive [19]. Metal containing microporous crystals are of great interest as a number of promising catalytic performances have been revealed [20]. Those materials are expected to have two functions: molecular sieves and metal oxides. Most recently, some studies on the NO decomposition in the presence of excess oxygen and a low concentration of hydrocarbons were reported using microporous crystalline metallosilicates such as H-ZSM-5 [21], Cu-ZSM-5 [22], Cu-incorporated zeolites [23], and some metallosilicates [24]. Held and co-workers [25-26] and M. Iwamoto and co-workers [27-28] were the first who reported that the catalytic activity of Cu-ZSM-5 could be greatly enhanced with the presence of small amounts of hydrocarbon in an excess oxygen.

1.1 The Objectives of This Study

1.1.1 To study the method of preparation of ion-exchanged zeolite and metallosilicate catalysts.

1.1.2 To study the characterization of ion-exchanged zeolite and metallosilicate catalysts.

1.1.3 To study the decomposition of nitric oxide over prepared catalysts in the presence of excess oxygen with low concentration of propane.

1.1.4 To compare of catalytic activities of prepared catalysts.

1.2 The Scope of This Study

1.2.1 Studying the preparation of metallosilicates by rapid crystallization method.

As the source of metals, are chloride for Al, nitrates for Fe, and Cu. The charged metal contents expressed as atomic ratio of Si/metal is 50. H-ZSM-5(H-Al-silicate), H-Fe-silicate, H-Cu-silicate, Cu/H-ZSM-5, Cu/H-Fe-silicate, Pt/H-ZSM-5, Pt/H-Fe-silicate, and Pt/H-Cu-silicate were prepared by using ion exchange method.

Activity of prepared catalysts was tested by using selective reduction of NO under the presence of excess oxygen with low concentration of propane.

The prepared catalysts were tested by X-Ray Diffraction Pattern, BET Surface Area Measurements, Scanning Electron-Microscope, NH₃-Temperature Program Desorption, and Chemical Analysis(AA and ICPS).

1.2.2 Studying the preparation of copper ion-exchange on Na-ZSM-5, H-ZSM-5, and NH₄-ZSM-5 catalysts.

Copper (0.5 %(metal/catalyst)) was added to ion-exchange and the percentage of copper on the prepared catalysts was measured.

Effects of pH, time, and temperature on copper ion-exchanged ZSM-5 were studied.

Effect of copper content on the catalytic activity for selective reduction of nitric oxide under the presence of excess oxygen with low concentration of propane was observed.

Finally, effect of oxygen concentration on the catalytic activity for selective reaction of nitric oxide was studied.