International Journal of Automotive Technology, Vol. 23, No. 6, pp. 1509–1515 (2022)
DOI 10.1007/s12239–022–0131–x

pISSN 1229–9138/ eISSN 1976–3832

IMPROVEMENT OF NO_X AND CO REDUCTION PERFORMANCE AT LOW TEMPERATURE OF H_2-SCR CATALYST

Choong-kil Seo*

Department of Automotive & Mechanical Engineering, Howon University, Gunsan 54058, Korea

(Received 2 November 2021; Revised 26 January 2022; Accepted 5 April 2022)

ABSTRACT–The purpose of this study is to improve the simultaneous reduction of NOX and CO, harmful gases emitted from internal combustion engines, at low temperatures using a Pt/TiO_2 H_2-SCR catalyst. A better NOX/CO reduction performance was observed upon loading 2 wt% of the additive catalyst CeO_2 on the main catalyst Pt because the oxygen storage capacity improved. In the presence of CO, the water gas reaction was promoted, resulting in the NOX conversion rate by the 0.5Pt-2CeO_2/TiO_2 SCR catalyst of 42 % at 75 °C and 70 % at 100 °C; this was a 15 ~ 20 % higher NOX conversion as compared to without CO at low temperatures. The NOX reduction performance by the 0.5Pt-2CeO_2-2ZrO_2/TiO_2 SCR catalyst was the highest at temperatures below 100 °C. At an appropriate amount of the additive catalyst ZrO_2, the reaction rate improved because the acid point of the catalyst surface and the intensity of adsorption are adjusted. The optimum reduction temperature for NOX/CO reduction performance by the H2-SCR catalyst was 400 °C. Our results also indicate that the Pt species has a significant impact.

KEY WORDS : Catalyst, Nitrogen oxide, Selective catalytic reduction, Carbon monoxide, TiO_2

1. INTRODUCTION

Recently, in addition to the COVID-19 pandemic, air quality is rapidly deteriorating owing to the indiscriminate destruction of natural resources, acceleration of industrialization, and an increasing use of fossil fuels, thereby endangering human health. This is evident from the presence of fine dust and yellow dust in the atmosphere. Furthermore, problems associated with climate change and global environmental hazards continue to compound, warranting comprehensive measures for strengthening the system and limiting fossil fuel use, as well as rapid technological innovation. To realize global carbon neutrality, eco-friendly automobiles, such as electrical vehicles and full cell electrical vehicles, are being developed and commercialized. Recently, a technique for evaluating the environmental impact of automobiles is being developed based on the life-cycle assessment (LCA) criteria for all processes of the automobile industry, from car production to car scrapping. The European Union intend to establish LCA standards, with plans to apply Euro 7 emissions regulations (European Automobile Manufacturers' Association (ACEA), 2021). The Euro 7 emission regulations will be the last regulation for internal combustion engines. To achieve carbon neutrality, high-performance, low-cost, and eco-friendly vehicles and internal combustion vehicles with high thermal efficiency using alternative energy sources must be developed and assessed for their environmental impact by LCA.

Internal combustion engines still account for a large proportion of automobiles. They are responsible for emitting harmful substances, causing air pollution; as a result, air quality regulations are becoming stricter. Regulations on automobiles, construction machinery, ships, and household boilers have been tightened, and air quality is being managed by expanding the air management area nationwide in a manner suitable for local conditions. With the advent of the hydrogen economy in the future, technologies that generate and utilize hydrogen, the cleanest energy source, are in the spotlight with meaningful research ongoing. To date, selective catalytic reduction (SCR) catalysts (Sjövall *et al*., 2009; Seo and Lee, 2020; Lv *et al*., 2018; Zhu *et al*., 2019) have been commercialized as a powerful NO_X reduction after-treatment technology; NO_X is emitted from internal combustion engines. In addition, preliminary studies on H_2-SCR catalysts to reduce harmful NO_X have been conducted (Xue *et al*., 2018; Wang *et al*., 2019; Savva *et al*., 2021; Hu *et al*., 2020; Cao *et al*., 2020; Patel and Sharma, 2021; Xue *et al*., 2018). However, gases emitted from fossil fuels are mainly unburned and emit NO_X, CO and HC gases. This study is different because the H_2-SCR catalyst simultaneously reduces NO_X and CO gas at low temperature. Furthermore, our results show that this method has the potential to be commercialized for use in automobiles, ships, and household boilers under exhaust conditions below 150 °C.

**Corresponding author*. e-mail: ckseo@howon.ac.kr