**NOx Trap and Removal Performance on Barium and Barium-Ceria Containing SCR Catalysts**

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**Highlights**

* Barium and barium-ceria containing V2O3-WO3/TiO2 SCR catalyst was synthesized.
* Baium-ceria containing catalyst has improved NOx storage performance than barium containing catalyst.
* NOx desorption occurs at SCR activation temperature range.
* No significant deactivation even after NOx desorption.

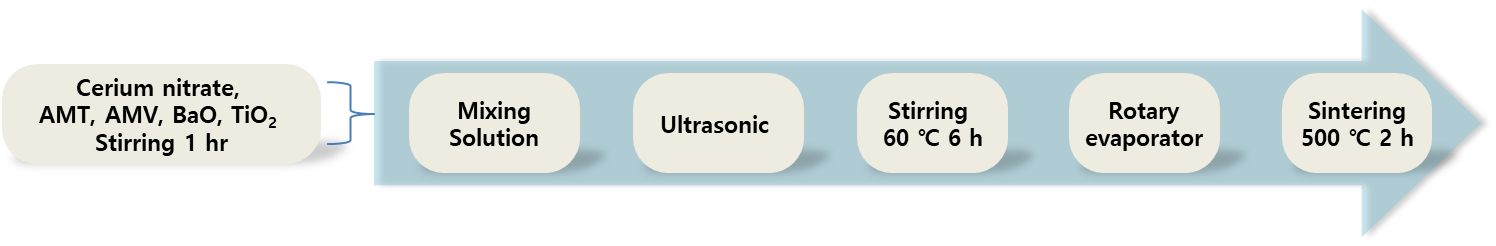
**1. Introduction**

Recently, the importance of reducing nitrogen oxides (NOx) has been emphasized because atmosphere regulations are enhanced [1,2]. Selective catalytic reduction (SCR) is a representative technology for converting harmful NOx into harmless water and nitrogen by reducing agents such as NH3 [2,3]. The optimum activation temperature of the V2O5-WO3/TiO2 SCR catalysts (VWTi catalysts) is a range of 300-400 °C, which requires a lot of energy and time to raise the temperature. However, it generated under low-temperature operating conditions, such as start-up and shut-down procedures of equipment, is a problem as it is not removed by catalyst and released into the atmosphere [4]. Therefore, NOx trap technology is required at low temperatures.

Barium is an alkali metal having the NOx storage properties. In the case of alkaline and alkaline earth metals such as K and Cs except Ba, the NOx occlusion ability increases but the catalytic activity decreases by increasing the basicity. However, Barium oxide converts NOx to nitrate (Ba(NO3)2) form and stores NOx. Currently, it is used as NOx Trap material of Lean NOx Trap (LNT) catalyst [4,5]. Ceria is a coagulating agent that supplies oxygen needed for reaction to the active material [6]. In this study, Barium and Barium/Ceria are impregnated into VWTi catalyst, and the adsorption / desorption behavior of the catalyst was confirmed.

**2. Methods**

TiO2, ‎Ce(NO3)3, and BaO are dispersed in ethanol with stirring. Ammonium metavanadate (AMV), and Ammonium metatungstate (AMT) are separately stirred for 1 hour in a solution of oxalic acid dissolved in ethanol. The solutions are treated with ultrasonic for 1 h after mixing each solution. Then, they are stirred for 6 hours at 60 °C. After the evaporation of ethanol at 60 °C using a rotary evaporator, the synthesized powder is sintered at 500 °C with a rate of 3 °C/min for 2 hours. Figure 1 shows the experimental flow chart scheme for the preparation of the NOx Trap functional catalyst.

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**Figure 1.** Experimental flow chart for preparation NOx trap functional catalyst

**3. Results and discussion**

The storage and desorption characteristics of Barium and Barium/Ceria doped VWTi catalyst are affected by reaction temperature, space velocity and catalyst content. Figure 2 shows the adsorption characteristics according to the composition of the catalyst at a space velocity of 36,000 h-1 and a temperature of 200°C. In the case of barium containing catalyst, barium increase the NOx adsorption property compared with the non-containing catalyst (VWTi catalyst). In addition, the barium-ceria containing catalyst showed better adsorption performance than barium containing catalyst.



**Figure 2.** NOx adsorption profile of V2O5-WO3/TiO2 (VWTi), BaO/VWTi, and BaO–CeO2/VWTi (SV : 36,000 h-1, O2 : 10 vol%, NOx : 500 ppm, N2 : Balance gas, 200 °C)

Desorption behavior was occurred at 300-350 °C, which is the catalytic activation temperature range. Furthermore, about 90% efficiency was measured in the denitration rate evaluation. It was confirmed that the activity did not decrease after desorption.

**4. Conclusions**

Due to the additional role of ceria, the adsorption property of barium-ceria containing catalyst was found to be higher than that of Barium containing catalyst. NOx desorption was observed at 300 - 350 °C, which is the catalyst activation temperature, and it was confirmed that there was no decrease in the activity of the SCR reaction.

**References**

1. L. Lietti, J. Svachula, P. Forzatti, G. Busca, G. Ramis, P. Bregani, Catalysis Today 17 (1993) 131–139.
2. X. Zhao, L. Huang, H. Li, H. Hu, X. Hu, L. Shi, D. Zhang, Appl. Catal. B Environ. 183 (2016) 269–281.
3. J.R. Strege, C.J. Zygarlicke, B.C. Folkedahl, D.P. McCollor, Fuel 87 (2008) 1341–1347.
4. Y. Li, Y. Li, Y. Wan, S. Zhan, Q. Guan, Y. Tian, RSC Adv. 6 (2016) 54926–54937.
5. C. Wang, L. Sun, Q. Cao, B. Hu, Z. Huang, X. Tang, Appl. Catal. B Environ. 101 (2011) 598–605.
6. X. Wang, L, Lv, Q. Zhang, Y. Zhang, J. Wang, M. Shen, Catal. Sci. Technol., 2013, 3, 200-207