News Release

NIPPON SHOKUBAI

June 10th, 2021

Nippon Shokubai Receives the Technology Award from the Catalyst Manufacturers Association, Japan

-Identified an exhaust-gas detoxification mechanism of De-NOx catalyst-

NIPPON SHOKUBAI CO., LTD. (Headquarters: Osaka, Japan, President: Yujiro Goto, hereinafter "Nippon Shokubai") has received the Technology Award 2021 from the Catalyst Manufacturers Association, Japan for our research on "the development of highly active and resistant De-NOx catalyst and the identification of its performance enhancement mechanism."

The association presents the Technology Award to creative inventions or improvements that have made significant contributions in the catalyst industry, or to catalyst-related technical papers recognized for their academic value. We have received this award after our paper on practical catalyst research was published in prestigious academic journals in the catalyst research field "ChemCatChem, " "Applied Catalysis A: General, " as well as "Industrial & Engineering Chemistry Research" and the significance of its academic achievement was recognized.

The main subject of the research V2O5/TiO2-SiO2-MoO3, or V/TSM catalyst, is a product developed by fully utilizing our catalyst technologies and has been used in many applications as a De-NOx catalyst for detoxifying nitrogen oxides contained in exhaust gas from power plants or waste incineration facilities. While at power plants catalysts are used at a gas temperature between 300 and 400°C to achieve higher treatment performance, at waste incineration facilities, due to the heat resistance of the fabric filter for dust collector, exhaust gas is generally cooled to about 150°C then reheated back to below 200°C at the inlet of the catalyst in order to improve the treatment performance.

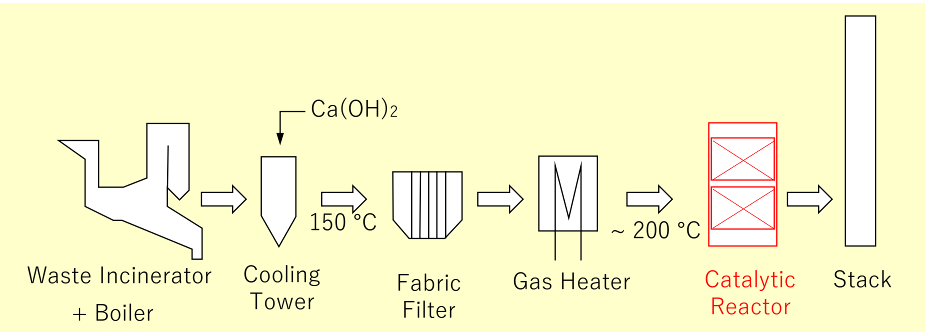

Figure 1 Example of exhaust gas treatment process at waste incineration facilities

V/TSM catalyst exhibits sufficient performance even at low temperature below 200°C which is a difficult temperature range for conventional catalysts to work. Also, while catalyst is deactivated in such low temperature by sulfur oxides[*1] contained in exhaust gas, V/TSM catalyst is far more resistant against the deactivation compared to conventional catalysts. Using V/TSM catalyst not only decreases the required volume of catalyst and catalyst replacement frequency, but also lowers energy consumption required for re-heating the exhaust gas which is expected to suppress CO_2 emission.

To identify the mechanism for demonstrating this high-level activity and resistance, we have analyzed the catalyst in cooperation with Professor Tsunehiro Tanaka in the Graduate School of Engineering at Kyoto University. Analyzing XAFS (X-ray Absorption Fine Structure) data collected at SPring-8, the large synchrotron radiation facility of RIKEN, and utilizing our analytical technologies including X-ray diffraction and infrared absorption spectrometry, we have studied the structure and the deactivation mechanism of the catalyst in detail and from the results have successfully obtained the following insights:

- In addition to ammonium bisulfate[*2], a typical substance to cause the catalyst deactivation, ammonium thiosulfate[*3] is also produced at a low temperature of below 200°C.
- V/TSM catalyst has an excellent De-NOx activity due to its increased oxidation-reduction ability which is achieved from interactions between TiO2-SiO2-MoO3 solid solution[*4] and active species of vanadium oxide. V/TSM catalyst can also suppress deactivation caused by sulfur oxides owing to the catalyst's excellent ability to decompose ammonium bisulfate and ammonium thiosulfate.

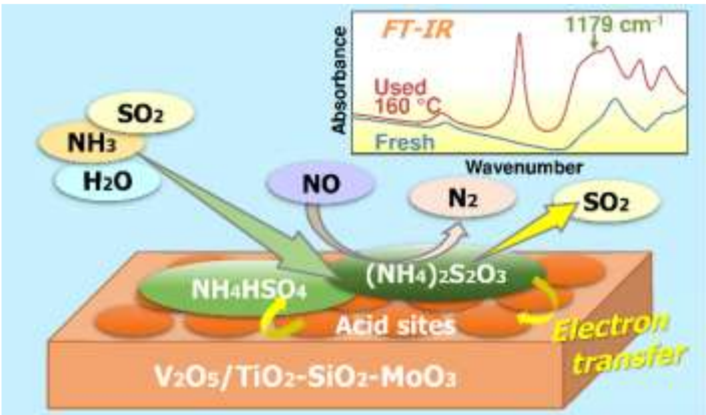

Figure 2 Decomposition model of ammonium sulfates on V/TSM catalyst

We have been continuously working on our improvement research on De-NOx catalysts aiming to develop catalysts with even higher activity and resistance by capitalizing on the insights we have obtained so far. Improvement in performance will not only save the cost by decreasing the volume of catalyst but also further lower process temperature of exhaust gas resulting in less energy consumption for reheating, and this will lead to CO_2 emission control. Under our corporate mission "TechnoAmenity-Providing affluence and comfort to people and society, with our unique technology", we will contribute to the conservation of the global environment through our excellence in catalyst technologies.

*1 Sulfur oxides: At a high temperature, they are barely adsorbed on catalysts accounting for almost no effects on the catalytic activity however at a lower temperature of roughly 300°C and below, they react with ammonia and produce ammonium sulfates.

*2 Ammonium bisulfate: Produced at a temperature lower than roughly 300°C. It accumulates and plugs pores on a catalyst to cause deactivation of the catalyst.

*3 Ammonium thiosulfate: According to our research, it accumulates and plugs pores on the catalyst as does ammonium bisulfate.

*4 Solid solution: "Solid solution refers to a solid phase where different substances are homogeneously dissolved into one another" Iwanami Rikagaku Jiten, 5th edition

References:

ChemCatChem 2020, 12, 5938–5947. (DOI: 10.1002/cctc.202001155)

Appl. Catal. A Gen. 2020, 595, 117496. (DOI: 10.1016/j.apcata.2020.117496)

Ind. Eng. Chem. Res. 2020, 59, 13467–13476. (DOI: 10.1021/acs.iecr.0c02308)

About NIPPON SHOKUBAI Co., Ltd.: Since 1941, Nippon Shokubai has grown up its business with unique catalyst technology. Nippon Shokubai has supplied, for example, ethylene oxide, acrylic acid, automobile catalysts, process catalysts and so on. Among all, our global market share of superabsorbent polymers is the largest in the world now. Nippon Shokubai is a global chemical company operating under its corporate mission "TechnoAmenity – Providing affluence and comfort to people and society, with our unique technology."
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