Analysis and application of spillover in automotive catalyst

"NOx storage analysis using Pt/Ba thin film model catalyst and electro proportion of NOx selective reaction"

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Abstract

It would not be an overstatement to say that a diffusion phenomenon decides the catalytic performance in automotive catalyst. There are some stages of diffusion in automotive catalyst. For example, gas diffusion, heat diffusion and material diffusion. Especially, we recently focus a spillover and it is the one of the most important among the diffusion phenomenon. I would like to introduce two examples of our results as the analysis and application of spillover for automotive catalyst; (1)NOx storage analysis using Pt/Ba thin film model catalyst and (2)electro proportion of NOx selective reaction.

(1) NOx storage analysis using Pt/Ba thin film model catalyst [1]

A NOx storage and reduction catalyst for automotive exhaust gas was investigated using a model catalyst consisting of a Pt/Ba thin film on a Si substrate. The NOx or SOx adsorption/desorption phenomena in the model catalyst were studied using EPMA, AES, XPS, and EELS by changing the treatment conditions, temperature, and atmosphere. Based on measuring the nitrogen and sulfur distributions, the following results were found: NOx was strongly adsorbed around an edge of platinum, and SOx was adsorbed on a barium oxide layer independent of the platinum distribution. The NOx adsorption around the platinum edge within a few micrometers was preferentially decreased; and the SOx adsorption around the platinum edge was decreased for a distance of a few nanometers. These visual results for NOx and SOx adsorption/desorption provided supporting evidence for the phenomenon occurring during practical use of NOx storage and reduction catalysts in the purification for automotive exhaust gases.

(2) Electro proportion of NOx selective reaction

The application of electro-catalysts for automotive exhaust gas purification has found much attention in recent years. It is expected that the electrochemically promoted reduction of NO can be carried out at low temperatures, in excess of oxygen and with a decreased amount of precious metals [2], which are caused by back spillover oxygen from an oxygen conductor to electrodes. We investigated the temperature dependence of the electrochemically promoted NO reduction with C_3H_6 in presence of O_2 in order to define its potential for a practical application. We would like to discuss the relation between the surface morphology of electrode and the electro proportion of NOx selective reaction.

[1]Y. Sakamoto, K. Okumura, Y. Kizaki, S. Matsunaga, N. Takahashi, H. Shinjoh, J. Catal., 238, 2, (2006), 361.

[2]I. Constantinou, D. Archonta, S. Brosda, M. Lepage, Y. Sakamoto, C.G. Vayenas, J. Catal., 251,2, (2007), 400.