THE REDUCTION OF PLATINUM CONSUMPTION IN ENVIRONMENTAL CATALYSTS FOR COMPLETE OXIDATION OF VOLATILE ORGANIC COMPOUNDS

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$Pt/Co_3O_4/CeO_2$-ZrO_2-SnO_2/□-Al_2O_3 catalysts were successfully prepared by both conventional co-precipitation and impregnation methods. The catalytic performances for toluene oxidation on these materials indicate that the addition of Co_3O_4 to the Pt/CeO_2-ZrO_2-SnO_2/□□-Al_2O_3 catalyst was significantly effective in reducing the platinum amount without further reduction in its activity. In fact, complete oxidation of toluene was realized by using the 1wt%Pt/11wt%Co_3O_4/16wt%$Ce_{0.62}Zr_{0.20}Sn_{0.18}O_{2.0}$/□□-$Al_2O_3$ catalyst at the temperature as low as 160 °C, which was lower than that with the 5wt%Pt/□□-Al_2O_3 catalyst (170 °C). Since the oxidation activities of both 1wt%Pt/16wt%$Ce_{0.62}Zr_{0.20}Sn_{0.18}O_{2.0}$/□□-$Al_2O_3$ and 1wt%Pt/11wt% Co_3O_4/□□-Al_2O_3 were below compared to that of the present 1wt%Pt/11wt%Co_3O_4/16wt%$Ce_{0.62}Zr_{0.20}Sn_{0.18}O_{2.0}$/□□-$Al_2O_3$, the main reason for the high toluene oxidation activity in the 1wt%Pt/11wt%Co_3O_4/16wt%$Ce_{0.62}Zr_{0.20}Sn_{0.18}O_{2.0}$□/□□-$Al_2O_3$ catalyst can be ascribed to the concerted effect of Pt, Co_3O_4, and $Ce_{0.62}Zr_{0.20}Sn_{0.18}O_{2.0}$ on □-Al_2O_3.

In addition, novel type of refractory and noble Pt metal-free 17wt%$La_{1-x}Ca_xCoO_{3-x/2}$/$Ce_{0.76}Zr_{0.19}Zn_{0.05}O_{1.95}$ ($0 \le x \le 0.15$) catalysts was also tested for complete toluene oxidation. The composition was optimized to obtain the optimum toluene oxidation activity. Catalytic tests for toluene oxidation and characterization of oxygen release/storage properties of these materials suggest that the Ca^{2+} addition in the $LaCoO_3$ lattice was appreciably effective in the enhancement of the toluene oxidation even after high-temperature treatment as high as around 1400 °C. In fact, complete oxidation of toluene was realized at 320 °C by using the 17wt%$La_{0.9}Ca_{0.1}CoO_{2.95}$/$Ce_{0.76}Zr_{0.19}Zn_{0.05}O_{1.95}$ catalyst treated at 1400 °C. $La_{0.9}Ca_{0.1}CoO_{2.95}$ oxide on the $Ce_{0.76}Zr_{0.19}Zn_{0.05}O_{1.95}$ support promoted toluene oxidation without using any precious platinum metal, and, therefore, the present catalyst has an advanced potential as the novel toluene oxidation catalyst.