Improvement of Catalytic Properties by Combination of Trace Amount of Platinum and Investigation of Its Mechanism with Using XAFS

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Noble metals are important elements in industrial field and used in various applications, such as catalysts. However noble metals are scarce and expensive elements. Therefore, development of the catalysts which show high performance but include no or less amount of noble metal is strongly demanded. Combination of noble metal and non-noble metal i.e. bimetallic catalyst is one of the potential strategies for reducing quantity of noble metal in the catalysts. We focus on Pt bimetallic catalysts containing trace amount of Pt and other metal. We prepared different kinds of Pt bimetallic catalysts, applied to the reaction, and investigated role of the Pt in the catalyst by means of XAFS and other characterization techniques.

1) Pt-Co bimetallic catalyst for automotive exhaust purification; Pt is one of the important components of modern automotive catalyst but reduction of Pt amount is strongly demanded. In this study, we prepared Pt-Co bimetallic catalyst (Pt-Co/γ-Al_2O_3). Pt-Co/γ-Al_2O_3 showed high NOx reduction activity at low temperature compared to each mono metal catalysts. Such improvement of NOx reduction activity was ascribed to unique surface electronic state which is induced by alloying Co and Pt.

2) Improving durability of CO preferential oxidation catalyst by Pt addition; In domestic fuel cell systems, H_2 is produced by steam reforming of natural gas. Reformate gas produced by steam reforming contains CO and it poisons electrode catalysts of fuel cells. Therefore, CO in the reformate gas is reduced to less than 10 ppm *via* preferential oxidation (PROX) with using Ru/αAl_2O_3[1]. The Ru/αAl_2O_3 is deactivated by NH_3 with low concentration generated from N_2 in natural gas. However, detail mechanism of deactivation was yet to be elucidated. In this study, we revealed that cause of deactivation of Ru/αAl_2O_3 is oxidation of surface of Ru particles by means of operand-XAFS technique. Furthermore, we found Pt is very effective dopant for inhibition of oxidation of Ru and contributes to keep the high PROX activity.

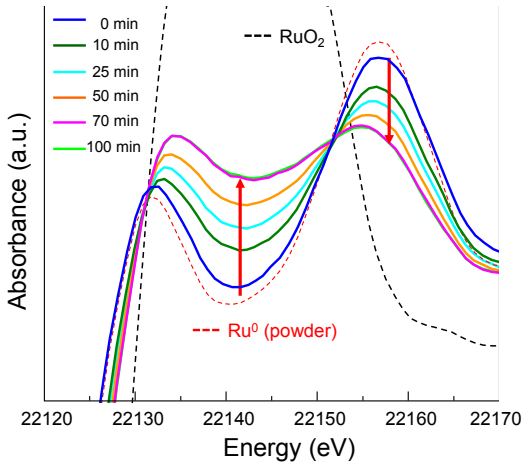

Fig.1. Changes of Ru-K edge XANES spectra in Ru/αAl_2O_3 during CO PROX with presence of NH_3.

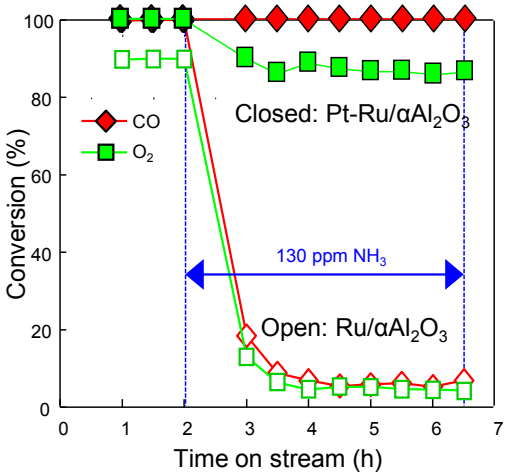

Fig.2. Improvement of durability of Ru/αAl_2O_3 against NH_3 by Pt addition.

Bibliography

[1] K. Sato, et al. ChemSusChem, 7 (2014) 3264-3267.