

課題番号 : 2019B-E05

Program Title (English) : CO oxidation of Pt nanoparticles on CeO<sub>2</sub> nanocrystals with cube and octahedral shape: Shape effect of support oxide

Username (English) : O. Seo<sup>1)</sup>, J. Kim<sup>1)</sup>, S. Hiroi<sup>1)</sup>, and O. Sakata<sup>1)</sup>

Affiliation (English) : 1) National Institute for Materials Science

キーワード : *In-situ* XAFS, CO oxidation, Absorption behavior

## 1. 概要 (Summary)

Local structural studies on bimetallic nanoparticles under the realistic reaction condition are an important area of research for the design of catalysts, with applications in various fields. The oxidation ratio, coordination numbers, and radial distance on the metal nanoparticles are key parameters in understanding the reaction mechanism. To investigate the atomic scale behaviors of Pd, Ru, and PdRu NPs, we were performed the *in-situ* X-ray absorption fine structure (XAFS) measurement under O<sub>2</sub>, CO, and CO oxidation condition with annealing temperature.

## 2. 実験(目的,方法) (Experimental)

Kusada *et al.*, reported that PdRu solid-solution nanoparticles (NPs) exhibit enhancement of CO oxidation reaction, compared with monometallic Ru and Pd NPs. Especially, Pd<sub>0.5</sub>Ru<sub>0.5</sub> NPs exhibit the highest CO oxidation activity. In addition, a comparison between the HAXPES spectra of PdRu NPs revealed that the charge transfer from Pd to Ru occurs in the PdRu alloy, causing electron enrichment of the Ru surface. However, there is a lack of research aimed at understanding the CO oxidation process in PdRu NPs. Besides, understanding the reaction behaviors of CO and O<sub>2</sub> molecules with Pd and Ru atoms on the surface region of NPs under ambient environment is an important issue. The objective of this beamtime is to investigate variation in the absorption site of the metal surface and local structure on the PdRu solid-solution NPs at different temperatures (300-473 K) under the CO oxidation condition. A comparative study was performed on PdRu solid-solution NPs as a function of chemical composition. We attempted to elucidate the difference of absorption sites of CO and O<sub>2</sub> known as theory.

## 3. 結果と考察 (Results and Discussion)

Figure 1 shows the oxide component of the PdRu and Pd NPs at the Pd K edge under the O<sub>2</sub>, CO, and CO<sub>2</sub> condition. We were observed the oxidation ratio of metal NPs under ambient condition, from evaluated the linear combination analysis of near edge position. After H<sub>2</sub> treatment at 573 K, the oxide ratio is reduced and metallic phase is increased. This means that the surface component is changed after pretreatment. There is no difference between PdRu and Pd NPs at 373 K under CO and CO-O<sub>2</sub> condition.

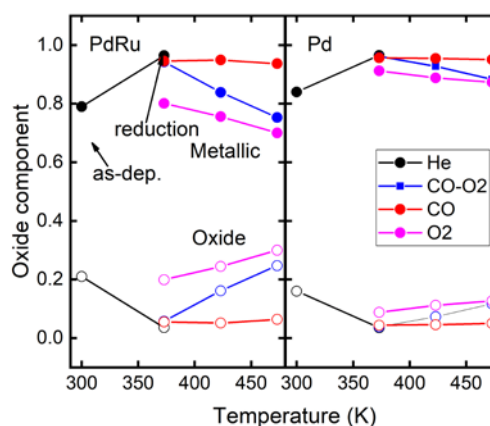


Figure 1. Oxide component of the PdRu and Pd NPs at the Pd K edge position.

Before CO oxidation reaction on the metal NPs, CO gas absorbed on the metal surface at 373K. O<sub>2</sub> gas directly dissociated on the metal surface and CO gas at 423 and 473 K. Therefore, metal oxides are formed on the metal surface after the CO oxidation reaction takes place.

## 4. その他・特記事項 (Others)

This work was partly supported by ACCEL, Japan Science and Technology Agency (JST) under Grant No. JPMJAC1501