実験番号：2019D4005（10 時間）

BL11S2

Study of Metal-Support Interactions between Pd and TiO_2

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Keywords: metal-support effect, palladium, titanium dioxide

1. Background

Supported metal nanoparticles (MNPs), with more exposed surface atoms and strong metal-support effects, have attracted much attention in industrial catalysis owing to their significantly enhanced catalytic activity compared to their bulk counterparts. In addition, compared to homogeneous catalysts, supported MNPs are easy to separate from reaction solvents with excellent reusability and stability. Thus, as a promising class of heterogeneous catalysts, deep understanding of metal-support effects of supported MNPs is highly desirable. Herein, we attempted to synthesize Pd NPs supported on TiO_2 and studied their metal-support effects.

2. Experiments

X-ray absorption near-edge structure (XANES) and extended X-ray absorption fine structure (EXAFS) analyses of TiO_2 supported Pd NPs (Pd/TiO_2) with Ti and Pd foils as references were performed at Aichi Synchrotron Radiation Center (BL11S).

3. Results and Discussion

Synchrotron radiation based X-ray absorption fine structure (XAFS) spectroscopy is very useful to characterize the defects in metal oxides, single-metal-atoms and metal-support effects by verifying the absence of metal-metal, metal-nitrogen or metal-oxide bonds. The coordination environment of Pd NPs anchored on TiO_2 was investigated with XANES and EXAFS methods. As shown in Fig. 1a, the position of the Pd K-edge of Pd/TiO_2 is different from that of the Pd foil. The upshift of Pd K-edge indicates that Pd atoms in Pd/TiO_2 are partially oxidized. Fig. 2b shows r-space of Pd K-edge of Pd/TiO_2 and Pd foil. The clear peak of Pd-O is observed for Pd/TiO_2 compared to Pd foil, indicating the existence of strong metal-support interactions between Pd and TiO_2 [1].

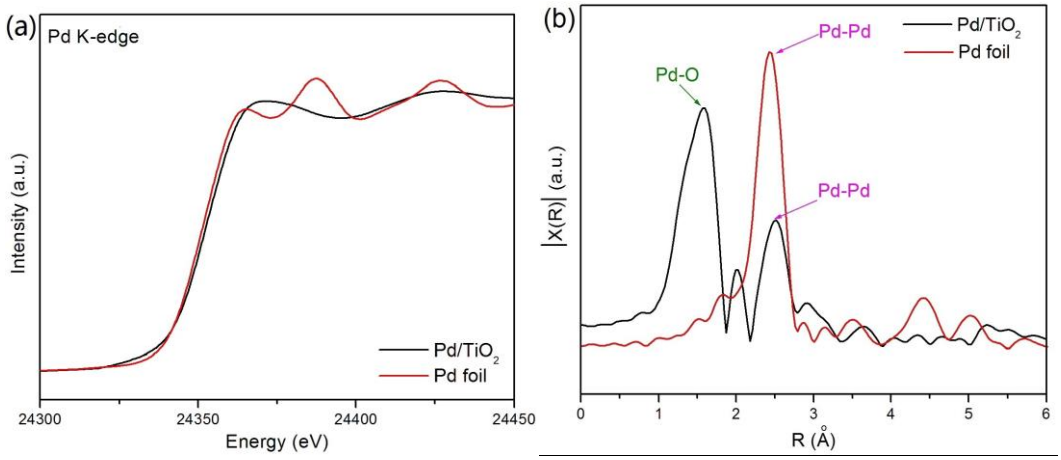

Figure 1. The normalized Pd K-edge XANES spectra (a) and Fourier-transformed r-space data (b) of Pd/TiO_2 compared with Pd foil as reference.

4. References

[1] Zhang, X.; Sun, Z.; Wang, B.; Tang, Y.; Nguyen, L.; Li, Y.; Tao, F. C-C coupling on single-atom-based heterogeneous catalyst. *J. Am. Chem. Soc.* 2018, 140, 954-962.