

Noble metallic alloy nanoparticles synthesized by femtosecond laser irradiation of solution supported on oxide

IMRAM, Tohoku University, [○]Md. Samiul Islam Sarker, Takahiro Nakamura, and Shunichi Sato

E-mail: samiul@mail.tagen.tohoku.ac.jp

Palladium, rhodium, and platinum are the three major elements of functional nanoparticles (NPs) for modern three-way catalysts in automobile emission control. Among a large number of elemental compositions, Rh, Pd and Pt based bimetallic and trimetallic NPs with the control of composition, size and shape are of special interests because of their essential role in the three-way catalysis [1]. Although CO oxidation has been studied extensively, many open questions remain regarding catalytic behavior in these systems, especially the composition and oxidation state [2]. While metallic alloy NPs through chemical methods are widely used as catalysis, most of the techniques are not environment-friendly due to the use of hazardous chemicals in the process. Moreover, the chemical methods need in some cases a special technique to prepare multimetallic particles on supporting materials. On the other hand, laser generated NPs are basically free from any dangerous chemical and directly attached to any supporting materials. In this respect, here we intend to estimate the catalytic activity of supported Pd and Pd based bimetallic and trimetallic NPs.

Pd, Rh-Pd and Rh-Pd-Pt NPs fabricated by femtosecond laser [3] were supported on aluminum oxide (γ -phase, 99.97 %, metal basis, Alfa Aesar) having the surface area of 80-120 m²/g. In a typical procedure, 1.8 g γ -Al₂O₃ firstly was dispersed in 60 ml distilled water and stirred for 1 h (solution A). Initially, 1 ml of the solution A was added to the 3 ml colloidal solutions by laser irradiation (solution B). Then, 9 ml of the solution A was again added to the solution B for the preparation of homogeneous mixture. The sample was dried using a freeze dryer. Granules of 212–335 μ m in diameter were formed from the obtained powder of supported material (Fig. 1). Catalytic activities of unsupported and supported samples will be compared with respect to the conversion of CO.

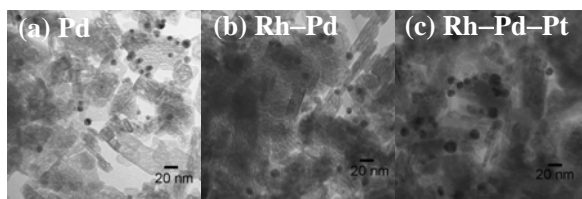


Fig. 1. TEM images of the γ -Al₂O₃ supported NPs fabricated by laser irradiation of solutions with (a) Pd, (b) Rh-Pd and (c) Rh-Pd-Pt.

References

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