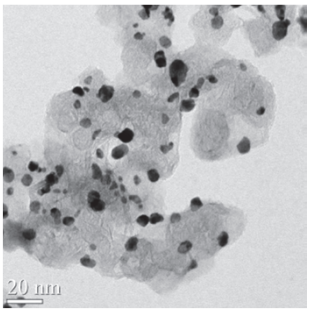
PEFC : Aberration corrected STEM-EDX analysis of core-shell nanoparticles.

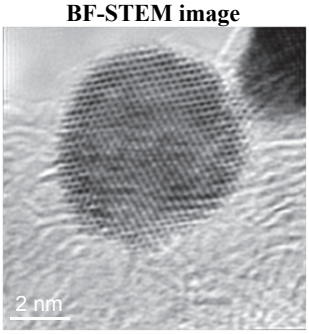
Clear elemental maps of small nanoparticles can be acquired by combination of aberration correction, high sensitive EDX analysis, and low accelerating voltage measurement (80kV).
Distribution of Pt shell thickness in Pd-Pt core-shell structure can be analyzed precisely.

Aberration corrected STEM-EDX analysis

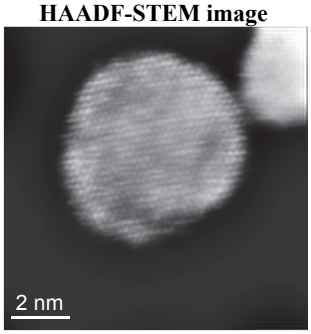
Wide field BF-STEM image



High resolution BF-STEM image

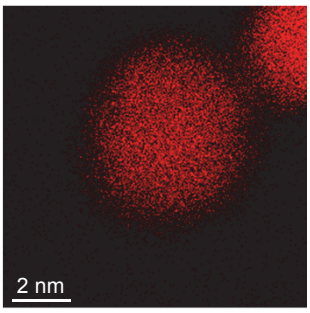


High resolution HAADF-STEM image

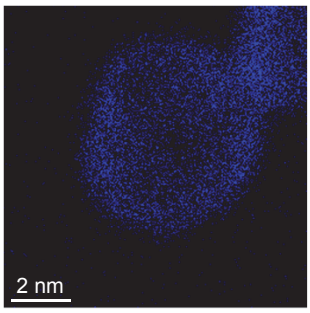


- Sample : Carbon supported Pd-Pt core-shell nano particles
- Equipment : Aberration corrected TEM
- EDX detector : SDD with large detection area
- Accelerating voltage : 80kV
- Acquisition time of EDX maps : About 45 mins

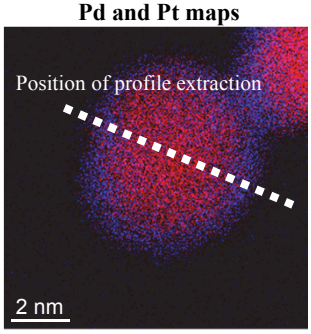
EDX map of Pd



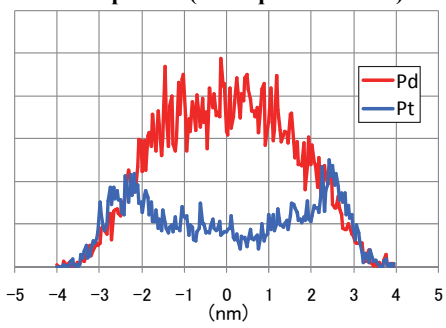
EDX map of Pt



Color overlay image of Pd and Pt maps



EDX profiles(after quantification)

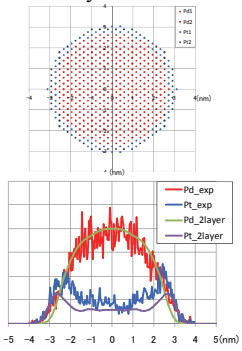


Clear elemental maps of small nanoparticles about 5nm in size can be acquired by combination of aberration correction, high sensitive EDX analysis, and low accelerating voltage measurement (80kV).

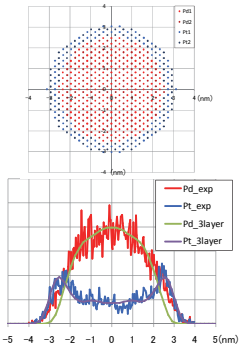
Precise analysis of core-shell structure

－Analysis procedure－
①Preparing profiles of the number of Pd and Pt atoms with different shell thickness.
②Estimation of effective STEM probe size and convolution it to the profiles.
③Comparing with experimental results.

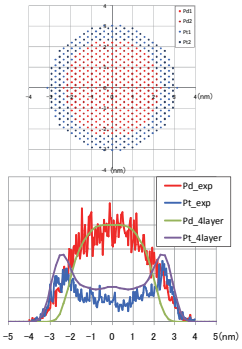
<2-layer model>



<3-layer model>



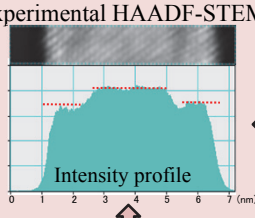
<4-layer model>



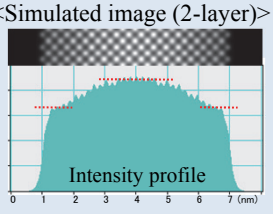
The number of shell layers is determined in an atomic level by fitting core-shell models and experimental EDX profiles. ＊

Evaluation by STEM image simulations

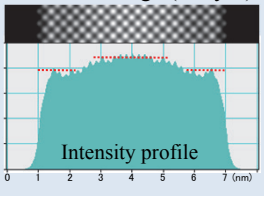
<Experimental HAADF-STEM>



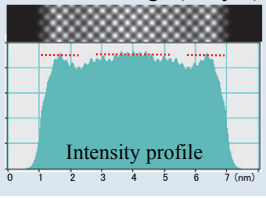
<Simulated image (2-layer)>



<Simulated image (3-layer)>



<Simulated image (4-layer)>



Results of the HAADF-STEM image simulations show the 3-layer model is similar to the experimental data.

＊ S. Inamoto, Y. Otsuka, K. Kobayashi (Daido univ.), M. Hori (Daido univ.), The 69th Annual Meeting of the Japanese Society of Microscopy.

Sample provided by Brookhaven National Laboratory