

Adsorbate-induced Surface Segregation for PtCo Nanoparticles as Investigated by X-ray Absorption Spectroscopy

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The surface composition of bimetallic nanoparticles is crucial catalytic reaction. The use of platinum as the catalyst for cathode materials of PEMFC. In this study, the commercial available PtCo nanoparticles was reduced by hydrogen gas first, and then treated by adsorbate gas, which is strongly interact with platinum, with different time of treatment. The platinum can be drawn to the surface to form a Pt-rich surface. The population of surface Pt atom with adsorbate treatment is higher than that without adsorbate treatment, which can be characterized by X-ray absorption spectroscopy. The XAS experiment was conducted in NRSSC, beamline 17C1.

The FT EXAFS spectra at Co K-edge for the samples with different time of treatment are shown in Fig. 1. It is clearly to show the peak intensity of the Co-Co bond was increased with the time of treatment increase.

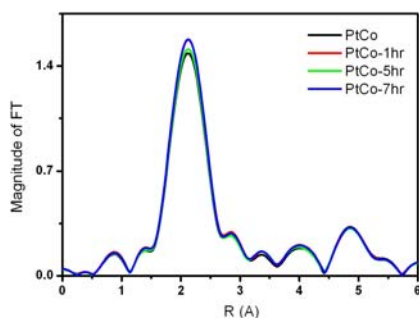


Fig. 1: FT EXAFS spectra at Co K-edge

The fitting results of EXAFS data for Co K-edge and Pt L_{III}-edge was shown in Table 1. The coordination number of Co-Co was increased after the treatment and the total coordination number also increase, indicating that the Co atoms segregate together, the Co atom diffuse to core region. For Pt atoms, the coordination number of Pt-Pt decreased, indicating that the Pt move to the surface region.

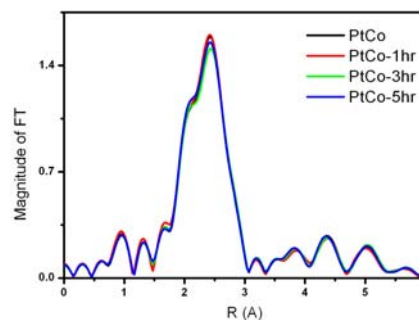


Fig. 2: FT EXAFS spectra at Pt L_{III}-edge

In summary, the adsorbate gas is effective to alter the surface composition of PtCo nanoparticle in the absence of particle size effect. The surface with higher population of Pt atoms would shows better electrochemical activity for oxygen reduction reaction.

Table 1: the fitting results of PtCo samples with different time of adsorbate gas treatment

Sample	N _{PtCo}	N _{PtPt}	ΣN _{Pt-i}	N _{Co-Co}	N _{Co-Pt}	ΣN _{Co-i}
PtCo-0hr	3.00	5.65	8.65	4.38	2.90	7.28
PtCo-1hr	2.79	6.57	9.36	4.30	2.70	7.00
PtCo-5hr	2.85	5.93	8.78	4.61	2.76	7.37
PtCo-7hr	3.12	5.44	8.56	4.89	3.02	7.91