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Pt nanoparticles on the External Surface of HOPG for the Model of Fuel Cell Catalysts Studied by Bent Laue Crystal Analyzer

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Pt nanoparticles structure on HOPG external surface was studied by fluorescence XAFS using bent crystal Laue analyzer (BCLA) under the electrochemical conditions. We could observe the Pt nanoparticles XAFS signals even under the presence of water.

1 Introduction

Fuel cells are considered to be the next generation energy source because of their high conversion efficiency and relatively low CO_2 emission. Pt is the typical catalyst and in order to improve the performance of fuel cells, the structure and interaction between Pt and the electrode (graphite) have to be investigated. We have carried out the *in situ* XAFS measurement of the model system where Pt was deposited on the flat substrate (HOPG) with back-side illumination configuration where X-ray irradiates the very thin platinum nanoparticle monolayer (1×10^{14} atoms·cm^{-2}) from the back side of the HOPG substrate in the fluorescence X-ray mode at the same side. We have successfully obtained XANES spectra with a bent crystal Laue analyzer (BCLA, 0095; FMB Oxford, UK) under the electrochemical conditions. [1]

2 Experiment

Figure 1 shows the experimental setup. We carried out the XAFS measurements at NW-2A The florescence signal was analyzed by BCLA and detected by 19 elements Solid State Detector or Pilatus.

The amount of Pt on HOPG was 10^{14} Pt·cm^{-2}.

3 Results and Discussion

Figure 2 shows the fluorescence XAFS results with and without BCLA. Without BCLA no edge jump was observed. Using BCLA, we could effectively remove the elastic scattering from the solutions so that we could observe the clear edge jump though the S/N ratio was not so good. The quality of these spectra was not enough for EXAFS measurements.

Figure 3 shows the fluorescence signal images taken by Pilatus set after the BCLA. Figure 3a and b are the images before and after the edge of PtO_2. We found the X-ray was monochromatized partially by the BCLA and many regions could not work as an analyzer. Therefore the S/N ratio was not so good.

We have concluded that the low S/N ratio was caused by the low throughput of BCLA and the total count was reduced to ca 1/1000 through BCLA. We are now developing a new BCLA to analyze the data in whole regions.

[1] 1.Uehara, H.; Uemura, Y.; Ogawa, T.; Kono, K.; Ueno, R.; Niwa, Y.; Nitani, H.; Abe, H.; Takakusagi, S.; Nomura, M.; Iwasawa, Y.; Asakura, K., Phys Chem Chem Phys 2014, 16 (27), 13748-13754.

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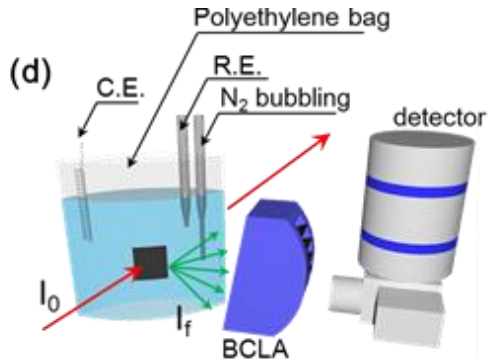

Figure 1 XAFS measurements in back-side illumination configuration.

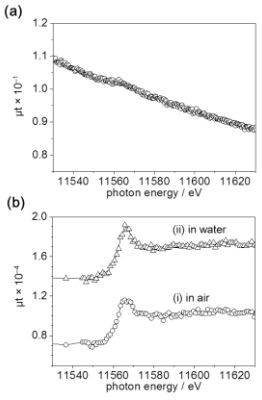

Figure 2 XANES spectra of 10^{14} Pt cm^{-2} (a) without BCLA and (b) with BCLA

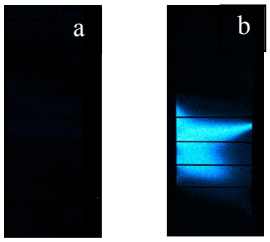

Figure 3 XANES spectra of PtO_2 (a) before and (b) after L_3 edge.