Synthesis of novel Pd–Pt–P amorphous nanoparticles and catalytic activity

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Atomic arrangement is one of the dominant factors to control materials' property.[1] Especially, amorphous materials have attracted much attention because of their complex structure and high performance as a solid catalyst derived from many dangling bonds.[2] For Pt nanoparticles showing high activity for electrochemical reactions such as hydrogen evolution reaction (HER), however, there have been a few reports on the control of its atomic arrangements. This is due to the high stability of fcc crystalline structure and low stability of amorphous state for Pt.

We succeeded to synthesize Pt-containing amorphous nanoparticles (ANPs) by alloying Pt with PdP ANPs.[3] All the syntheses were conducted by a wet chemical reduction method in oleylamine system. The amorphous structure was characterized by XRD (Figure 1) and atomic resolution HAADF-STEM image. By STEM-EDX and STEM-EELS (Figure 2), it was confirmed that Pd, Pt and P are homogeneously distributed in the particle. The catalytic activity for HER was investigated by a three-electrode electrochemical measurement and compared with the same composition crystalline nanoparticles.

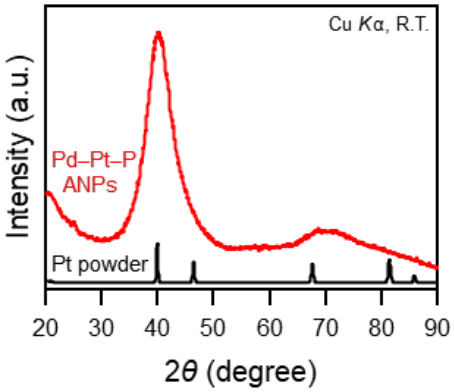

Figure 1. PXRD profile of Pd–Pt–P ANPs

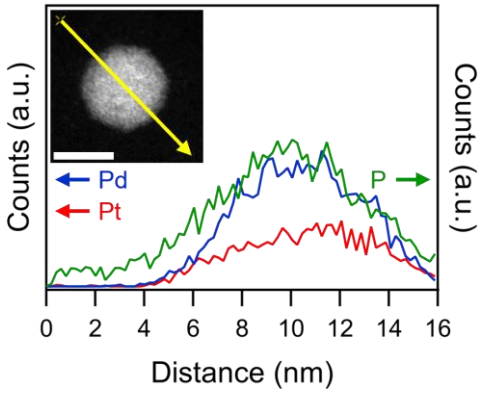

Figure 2. EDX line scan profiles of Pd (blue) and Pt (red) and EELS line scan profiles of P (green) of the ANP. The arrow shows the region of interest. Scale bar is 5 nm.

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