One of the barriers for the commercialization of fuel cells is the catalysts, in which both anode and cathode consist of Pt-based precious metal. Since Pt is currently costly and scarce, it poses a question of how to lower the Pt loading and increase the efficiency. Most of previous studies focused on Pt alloyed with some 3d-transition metals, such as Fe, Co, Ni, etc. However, the activity and stability are not good enough for fuel cell applications. Recently, dealloyed Pt bimetallic nanoparticles have attracted much attention as electrocatalytic materials for the oxygen reduction reaction (ORR). Voltammetrically dealloyed Pt-Cu nanoparticle electrocatalysts formed a Pt-rich core-shell nanostructure, which exhibited an enhanced ORR activity compared to pure Pt nanoparticles. However, most previous studies have focused on Pt-based alloy nanoparticles. Here we report on carbon-supported, copper-platinum (Cu₃Pt) intermetallic nanoparticles, which were prepared using a simple impregnation-reduction method, followed by a high temperature post-treatment. Electrochemical or chemical dealloying strategies were used on the Cu₃Pt/C ordered intermetallic nanoparticles. The morphology and elemental composition of the dealloyed nanoparticles were determined using an aberration-corrected Nion scanning transmission electron microscopy (STEM) equipped with an Enfina electron energy loss spectrometer (EELS). We compared the electrocatalytic activities of the materials for the oxygen reduction reaction during and after dealloying. The results show that no matter which dealloying method we use, all the dealloyed intermetallic nanoparticles show much better specific and mass activities and stabilities than pure Pt/C catalyst.

Fig. 1. (a) Ordered PtCu₃ intermetallic precursor, and EELS mapping of (b) electrochemically dealloyed Pt (green) Cu (red), showing about 1 nm Pt shell, with (c) chemically dealloyed PtCu 'spongy' nanoparticle. (d) ORR polarization curves at a scan rate of 5 mV/s in 0.1 M HClO₄ and their corresponding mass activity.