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Pt–base bimetallic nanoparticles: Synthesis via plasma discharge in solution, characterization, and applications

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A very fast, environmentally friendly, non-toxic process to synthesize nanoparticles using plasma discharge in solution, so-called solution plasma process(SPP) was reported recently. Using this process, various bimetallic nanoparticles could be synthesized easily and cost-effectively. In this work Pt–base bimetallic nanoparticles of diverse compositions and sizes were synthesized using SPP. The obtained nanoparticles were characterized by energy dispersive X-ray spectroscopy, X-ray diffraction spectroscopy, and transmission electron microscopy. During plasma discharge in solution, the nanoparticles were produced from the erosion of electrodes so that the composition of Pt–base bimetallic nanoparticles could be controlled by varying the power types and the electrode configuration. The morphology of the synthesized nanoparticles showed that they were nanowires connected with quasi-spherical nanoparticles with 2–3 nm in diameter and large spherical particles with ~50 nm in diameter were also detected intermittently. The cyclic voltammetric measurement and continuous potential scan in methanol environment demonstrated that the compositions of Pt-base bimetallic nanoparticles have strong effects on the catalytic activity and the resistance to CO poisoning, in that the Pt-base bimetallic electrocatalyst, Pt/M (M=Ag, Pd, Ni, Cu) exhibited enhanced activity and much improved stability toward CO with respect to pure Pt. This could be attributed to the electronic interaction between individual components of bimetal catalysts and the geometric change (particle shape and dispersion state).

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