Highly Effective PdCu Electrocatalysts Supported on Polyelectrolyte Functionalized Titanium Dioxide for Direct Formic Acid Fuel Cells

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A highly efficient and CO tolerant PdCu electrocatalysts supported on amino-rich, cationic poly(diallyl dimethyl ammonium chloride)(PDDA) functionalized TiO₂ (PdCu/TiO₂(P)-C) has been developed. The catalysts were characterized by transmission electron microscopy (TEM), X-ray diffraction (XRD), cyclic voltammograms and chronoamperometry. The PdCu particles with average size ~3.5 nm are well dispersed on TiO₂(P). PdCu/TiO₂(P)-C catalysts exhibit a superior electrocatalytic activity and stability for the formic acid oxidation reaction compared with the Pd/TiO₂(P)-C. Electrochemical measurements indicate that PdCu/TiO₂(P)-C(1:2) catalyst has the best performance for formic acid electro-catalytic oxidation in terms of durability and Pd-mass activity among three catalysts (Pd₁Cu₁, Pd₁Cu₂, Pd₁Cu₃). The possible reason is that the addition of Cu is beneficial to lower appropriately the d-band center of Pd and increase the electrochemical active surface area of the PdCu/TiO₂(P)-C nanocatalysts, but when the content of Cu rises to a certain extent, the morphology of the catalyst nanoparticles will transform into linear structure leading to increased particle size.

Keywords: Formic acid fuel cells; PdCu; electrocatalysts; titanium dioxide

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