Synthesis of Bimetallic Pd-Rh nanoparticles onto Graphene Nanosheets as Electrochemical Catalysts

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Abstract
This work adopts an efficient microwave-assisted method to synthesize Pd-Rh nanocatalysts onto graphene nanosheets (GNs) and carbon black as electrochemical catalysts for methanol oxidation. The as-prepared Pd-Rh nanoparticles are well characterized by using transmission electron spectroscopy (TEM), X-ray diffraction, and X-ray photon spectroscopy. The electrocatalytic activity and durability of Pd-Rh catalyst electrodes are investigated by cyclic voltammetry and electrochemical impedance spectroscopy (EIS). As compared with pure Pd, the bimetallic Pd-Rh catalyst is capable of offering higher electrochemical surface area in 1 M H_2SO_4 and better catalytic activity toward the electro-oxidation of methanol. Moreover, the Pd-Rh catalyst displays long-term anti-poisoning effect over 1000 potential cycles. On the basis of the experimental results, the addition of Rh element shows the positive effect on the CO tolerance, referring as modified bi-functional theory. The EIS measurement incorporated with equivalent circuit indicates that an equivalent series resistance of Pd-Rh/GN catalyst is significantly improved, as compared with Pd-Rh/carbon black one. The improved inner resistance can be attributed to the fact that the GNs serve as excellent support for well-dispersion of binary nanoparticles but also good conductor for charge transfer. Accordingly, the design of Pd-Rh/GN catalyst electrodes could as a promising candidate for high-performance fuel cells in the near future.

References
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Figures

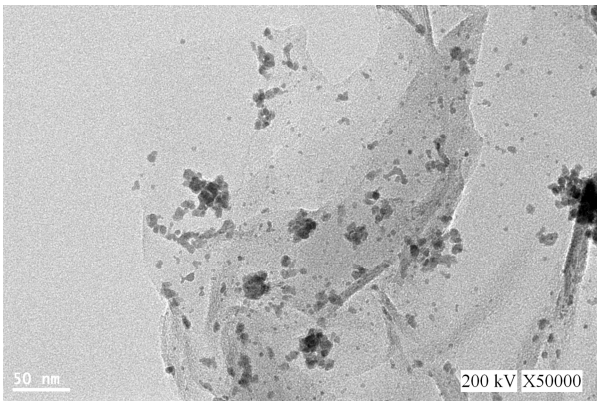

Figure 1. TEM micrograph of binary Pd-Rh nanoparticles over the surface of reduced graphene sheets.