Investigation of Carbon Supported Ru–Pt Nanoparticles for High–Performance Electrocatalytic Oxidation of Methanol

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Platinum-nanoparticle-based catalysts are fascinating and widely used in fuel cells. This study is an attempt to develop low-cost and high performance of carbon supported Ru-Pt nanoparticles (NPs) for direct methanol fuel cells (DMFCs). We have synthesized RuPt/C, Ru@Pt/C, RuPt/MWCNT, and Ru@Pt/MWCNT nanomaterials by a facile two-step reduction method. X-ray diffraction (XRD) shows the f.c.c. Pt and h.c.p. Ru phases and the NPs are under a slight compressed strains. The synthesized NPs obtained small mean sizes ($d_{\text{mean}} \leq 3.9$ nm) and narrow size distributions (1 – 9 nm). STEM-EDS line scan profiles reveal that architecture of Ru@Pt NPs composes of Ru-core and Pt-rich–Ru alloy shell, while that of RuPt alloy NPs exhibits random arrangement of Ru and Pt atoms. The Ru@Pt/MWCNT possessed the highest methanol oxidation activity with current density (J_f) of 182.4 mA.cm⁻² and the lowest electron transfer resistance (R_{et}) of 606 Ω as compared with the other samples. The outstanding performance of Ru@Pt/MWCNT could be attributed to the high Pt dispersion, the strong synergetic effect of the Ru@Pt NPs (i.e. improving CO poisoning tolerance and enhancing the intrinsic activity of Pt), and the high porosity and electrical conductivity of MWCNT support.

Keywords: Electrocatalysts, Ru@Pt nanoparticles, carbon support, methanol oxidation, cyclic voltammetry.

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