A Novel Pt/WC_x/C Electrocatalyst Synthesized by a One-Pot Method for Methanol Electrooxidation in Acid Media

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The development of new electrocatalysts with low platinum (Pt) loading and high electrochemical activity is still a challenge for fuel cell technologies. In this work, novel electrocatalysts, Pt nanoparticles alloyed with tungsten carbide (WC) supported on nanocarbon materials (Pt/WC_x/nanocarbon), were synthesized by a newly developed one-pot method for the methanol oxidation reaction (MOR) in direct methanol fuel cells (DMFCs). The so-called one-pot method has two key steps. First, Pt-containing ligands and W-containing ligands were self-assembled on nanocarbon materials, namely, carbon nanotubes or carbon black. Second, the products obtained from the first step were freeze-dried. The composition and structure of the Pt/WC_x/nanocarbon electrocatalysts were characterized by several testing means, such as X-ray diffraction, field emission scanning electron microscopy, transmission electron microscopy, and X-ray photoelectron spectroscopy. The results showed that Pt and WC were alloyed when their ratio was in an appropriate range. The electrochemical performances for the MOR were evaluated by cyclic voltammetry and chronoamperometry in acid media. The results showed that the Pt/WC_{0.15}/C electrocatalyst displayed the highest electrocatalytic activity and the best stability for MOR. The enhancements in electrochemical performance are attributed to the negative shift of the d-band centre of elemental Pt, which can weaken the adsorption strength towards CO molecules, facilitate the removal of the CO groups and improve MOR activity. The newly developed one-pot method has a great deal of potential for synthesizing Pt and carbide nanocomposite electrocatalysts and demonstrates a broad prospect in the application of fuel cells.

Keywords: Electrocatalyst; Self-assembly; Methanol oxidation reaction; Tungsten carbide; One-pot method

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