Synthesis of Ni@Pt Core-Shell Nanoparticles Supported on MWCNTs for Hydrogen and Methanol Electrooxidation

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ABSTRACT

Platinum has been used in fuel cell because have a good electrocatalytic activity for hydrogen oxidation. However, the platinum is a precious metal, therefore is expensive and affects the final cost of a fuel cell. The use of Pt in Direct Alcohol Fuel Cells (DAFCs) has been affected by low tolerance to CO poisoning, an intermediate produced during the oxidation of methanol. In these cases have been used bimetallic catalysts such as PtRu, but Ru is an expensive transition metal too. A solution is to use Pt nanoparticles with cheaper metals such as Ni, Co and Fe in core-shell configuration. This helps to optimize the amount of Pt, covering metal nanoparticles (Ni, Co or Fe) with a few layers of Pt. The presence of a second metal affects the electronic structure of Pt, decreasing the binding energy with the intermediates produced during the oxidation of methanol (mainly CO), avoiding poisoning. In this work we have synthesized Ni-Pt nanoparticles supported on multiwall carbon nanotubes (MWCNT) at different Ni:Pt atomic ratios. The synthesized materials were characterized physically and chemically by Scanning Electron Microscopy (SEM), High Resolution Transmission Electron Microscopy (HRTEM), X-ray diffraction (XRD), Energy Dispersive Spectroscopy (EDS) and Fourier Transform Infrared Spectroscopy (FTIR). For the study of the hydrogen oxidation, three electrode cell was used, with Ni-Pt/MWCNT deposited on a glassy carbon working electrode, with Ag/AgCl (KCl sat) reference and Pt wire counter electrode, in 0.5M H_2SO_4 electrolyte. The study of methanol oxidation reaction, the same cell configuration was employed with a 0.5M H_2SO_4 + 0.5M CH_3OH electrolyte.

Keywords: core-shell; nanoparticles; platinum