XIV International Congress of the Mexican Hydrogen Society
Cancun, Mexico, 2014

Pd/MWCNT and PdAg/MWCNT Electrocatalysts for Ethanol Oxidation in an Air-breathing Microfluidic Fuel Cell

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ABSTRACT

In this work, two electrocatalysts based in Pd (Pd/MWCNT and PdAg/MWCNT) were used for ethanol oxidation into a fuel cell. Pd and PdAg nanoparticles (NPs) were synthesized by reverse microemulsion and supported on multiwalled carbon nanotubes (MWCNT). The average nanoparticle size was estimated using TEM resulting in 5-6 nm for both electrocatalysts. TGA showed that both electrocatalysts have similar metallic loading (24% for Pd and 22% wt. for PdAg). Both materials were tested toward the ethanol electro-oxidation reaction in alkaline media (1 M ethanol + 1 M KOH). 50 cycles using the cyclic voltammetry technique were performed with the aim to evaluate the stability of the Pd-based electrocatalysts. Fuel cell experiments were carried out in a closed microfluidic fuel cell (µFFC) feeding with 1 M ethanol in KOH as fuel and oxygen-saturated KOH as oxidant at 12 mL h^{-1} flow rate in both channels. Commercial Pt/C was used as cathodic catalyst. The results were compared with those obtained using an air-breathing microfluidic fuel cell (ABµFFC), where the oxygen is taken from the air improving the cathodic reaction performance. In this device, two streams were injected, one with fuel and other with electrolyte (1 M KOH) at 12 mL h^{-1} flow rate. The ABµFFC that use PdAg/MWCNT as anodic electrocatalyst exhibited better performance (almost 70% more power harvested) compared to that obtained using Pd/MWCNT. The power density harvested from ABµFFC is 4 times higher than that obtained with the µFFC.

Keywords: PdAg Nanoparticles, Multiwalled carbon nanotubes, Ethanol Oxidation Reaction, microfluidic fuel cell, Air-Breathing.