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Short communication

Carbon supports for methanol oxidation catalyst

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Abstract

Highly mesoporous carbon was synthesized employing conventional sol–gel technique using resorcinol and formaldehyde. The porous carbon electrodes were characterized by X-ray powder diffraction, N_2 adsorption isotherm, atomic absorption spectroscopy (AAS). Platinum was anchored on support by the incipient wetness method and reduced to its metallic form using sodium formate as a reducing agent. The electrocatalysis for methanol oxidation on carbon supported Pt in acid and alkaline solutions were investigated. It was found that the activity of Pt for methanol oxidation was higher in alkaline than in acid medium. High mesopore surface area of carbon can significantly increase the metal dispersion and affect particle size, which favoured the progress of the electrochemical processes occurring during methanol oxidation.

Keywords: Mesoporous carbon; Electrocatalysts; Methanol oxidation; Direct methanol fuel cells

1. Introduction

In spite of the intense research efforts in the last decade, the lack of efficient and inexpensive electrocatalysts remains one of the challenges to the implementation of low temperature fuel cells [1,2].

Methanol oxidation at platinum based electrodes have been extensively studied in a fuel cells context and is still a subject of interest [3–8], with the applicability of platinum based electrodes restricted due to the accumulation of surface poisoning intermediates, such as CO, leading to loss of activity with time [9].

Poisoning phenomenon can be avoided by alloying platinum with oxophilic metals, such as Ru, Sn, etc. in bimetallic systems [10,11]. Ternary and quaternary Pt-Ru based catalysts are also used: PtRuOs, PtRuW, PtRuMo, PtRuSnW or PtRuOsIr, etc. [12–16]. V, Ni, Fe, Co and Cr oxides have been also investigated for their suitability for methanol oxidation [17–20], as they are less expensive and also possess active sites for the formation of oxy-species. Ni, NiO, nickel-modified manganese oxide or Pt–Ni have been employed [10,19,20]. In recent years, perovskite oxides have been studied as potential materials because they offer surface basicity character, which affect the oxidative dehydrogenation steps in methanol oxidation, and are stable particularly in alkaline medium [21].

A different approach, such as the one used in this work, investigates alternative materials to say Vulcan XC 72, quite often used in fuel cells, as a catalyst support.

Recently, platinum nanoparticles on carbon nanotubes have been investigated as supports for cathode catalyst in direct methanol fuel cells (DMFC) [22]. Zeolites are also found to be efficient bringing about efficient diffusion of the reactants and or the products from its surface during the reaction [23,24]. Nanoporous TiO_2 has also found to be an effective support for the oxidation of methanol [25].

Supports have been found to possess strong influence on the particle size and the dispersion of the metal. The present investigation aims at preparing a highly mesoporous carbon.

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