Pt-based Linked Monometallic Nanoparticles Supported on Nanostructured Carbon for Electro-Oxidation of Methanol

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ABSTRACT

In this work, electrocatalysts as nanostructured carbon (NC) supported pt-based linked monometallic nanoparticles Pt, PtFe and PtCo (with different atomic ratios) samples have been prepared by sequential impregnation reduction method in which Pt, Co and Fe precursors are reduced by sodium borohydride, ammonium hydroxide, citric acid and Ar-H_2 atmosphere. SBA-15 was prepared via sol gel using pluronic 123 as surfactant and TEOS as silica precursor. NC sample was synthesized via nanomolding method and pyrolysis at 1273 K using SBA-15 as hard template and purified sucrose as carbon source. The prepared materials were characterized by means of N_2 physisorption analysis, XRD, FT-IR, RAMAN, SEM and TEM. The performance of electrocatalysts for methanol oxidation reaction was measured by CV. The characterization techniques revealed that SBA-15 sample having a high specific surface area, a large channels with high degree of hexagonal mesoscopic organization and a rope-like morphology characteristic of mesoporous silica materials. NC proved to be a negative replica of SBA-15 having hard template morphology with carbon nanopipes surrounded turbostratic carbon. On the other hand, all the electrocatalysts exhibit high dispersion of spherical nanoparticles with average particle sizes of 12, 6 and 3.5 nm respectively. Three transition metals show face cubic centered crystalline structures. In the case bimetallic nanoparticles a linked monometallic system of nanoparticles is confirmed. In comparison with commercial Pt/XC-72 and PtRu/XC-72, Pt/NC, PtFe/NC (1:1.2), PtFe/NC (1:3.5), PtCo/NC (1:1.1) and PtCo/NC (1:3.3) exhibit higher electrocatalytic specific activity and better resistance to carbonaceous intermediate poison for electro-oxidation of methanol.

Keywords: Electrocatalysts, SBA-15, nanoparticles