Effects of Solvent Properties on the Electrocatalytic Response of Highly Active Pt-Sn/C and Pt-Ru/C Catalysts for the EOR

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ABSTRACT

Pt-M/C catalysts (where M: Sn and Ru) with nominal Pt:Mratio of 1:1 (at. %) were synthesized by a polyol reduction process. The metal: Vulcan support ratio was 20:80 (wt. %). The effects of different ethylene glycol:ethanol:water (EG:EtOH:H_2O) volume ratios as solvent on the physicochemical characteristics of the Pt-Sn/C and Pt-Ru/C catalysts was evaluated. Afterwards, the electrocatalytic activity of the alloys for the Ethanol Oxidation Reaction (EOR) was studied in acid media. XRD characterization for Pt-Sn/C catalysts showed that the degree of alloying calculated by using Vegard's law ranged from about 15 % (synthesis in the presence of water) to roughly 49 % (synthesis in the absence of water). The average particle size was calculated with the Scherrer equation to be within 1.8-4.7 nm, with the smaller sizes obtained in the absence of water. The XRD patterns of Pt-Ru/C showed a material with low crystallinity, which prevented the estimation of the particle size and degree of alloying for these catalysts.Chemical analysis by EDS indicated the formation of oxides for both alloy systems regardless of the presence or not of water during the synthesis, attributed to the presence of tin and ruthenium oxide phases in the materials. The electrochemical characterization showed that the synthesis conditions have an important effect on the electrocatalytic activity of the Pt-Sn/C and Pt-Ru/C catalysts for the EOR. In general, the alloys synthesized in the absence of H_2O delivered higher performances for the EOR. Overall, the Pt-Sn/C catalysts obtained without water showed higher current densities than Pt-Ru/C and Pt/C catalysts. The Pt-Ru/C catalysts showed current densities roughly similar to those of Pt/C. However, the onset of the reaction and the peak current density at the alloy were at lower potentials compared to Pt/C.

Keywords: Pt-Sn/C; Pt-Ru/C; Ethanol Oxidation Reaction.