Preparation of PtSn/C Skeletal-Type Electrocatalyst for Ethanol Electro-Oxidation

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In a recent study Peter Strasser and co-workers showed a new class of electrocatalysts (PtCu/C) with high activity. This behavior can be obtained by the structural modification of the Pt-Cu alloy by partial leaching of Cu utilized an electrochemical treatment (dealloying process). The PtCu/C electrocatalysts treated by this process and applied in reduction of oxygen in PEMFC showed an improvement of 4 times in terms of electrocatalytic activity for mass of Pt and more than 10 times in terms of specific activity if compared with Pt/C electrocatalysts .When a metal is leached from an alloy by electrochemically or chemically in acidic solutions, it results in a skeletal-type electrocatalyst. The present work aims obtaining PtSn/C (skeletal-type) more active for the electrochemical oxidation of ethanol through dealloying processes. Pt/C, PtSn/C (50:50) and PtSnCu/C (with different Pt:Sn:Cu atomic ratios) electrocatalysts were synthesized with 20 wt% of metals by borohydride reduction method, where 2-propanol was used as solvent, $H_2PtCl_6.6H_2O$, $SnCl_2.2H_2O$ and $CuCl_2.2H_2O$ as sources of metals, a $NaBH_4$ solution as reducing agent and carbon black Vulcan XC72 as support. In a second step, the PtSnCu/C electrocatalysts were treated with HNO_3 and the best result observed was for the electrocatalysts treated electrochemically The obtained materials were characterized by X-ray diffraction and EDX. Tests for the electrochemical electro-oxidation of ethanol were carried by cyclic voltammetry and chronoamperometry in medium acid at room temperature. The X-ray diffractograms of the electrocatalysts synthesized showed the typical face-centered cubic (FCC) structure of platinum, however, after acid treatment of the PtSnCu/C electrocatalyst also was observed the structure (FCC). The electrochemical studies (cyclic voltammetry and chronoamperometry) showed that all PtSnCu/C electrocatalysts after acid treatment had improvement in electrocatalytic activity for ethanol electro-oxidation, however the PtSnCu/C (50:10:40) and PtSnCu/C (50:40:10) electrocatalysts obtained showed the best results. These two electrocatalysts also were treated electrochemically. The electrochemical analysis showed that the PtSnCu/C (50:40:10) electrocatalyst treated with acid was more efficient for ethanol electro-oxidation in relation to treated electrochemically. However the PtSnCu/C (50:10:40) electrocatalyst with acid and electrochemical treatment not showed signification variation for ethanol electro-oxidation. The PtSnCu/C (50:40:10) and PtSnCu/C (50:10:40) electrocatalysts, after acid and electrochemical treatment, had superior performance for ethanol electro-oxidation in comparison with synthesized PtSn/C (50:50) electrocatalyst and commercial electrocatalyst (BASF – PtSn/C (75:25)) in all potential range of interest

(0.05-0.9V).