PtSnCe/C Electrocatalysts for Ethanol Oxidation: DEFC and FTIR "in-situ" studies

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The electrocatalysts for ethanol oxidation reaction (EOR) are very attractive to the development of direct ethanol fuel cells. This alcohol is produced in large quantities from biomass and it is much less toxic than methanol. However, its complete oxidation remains a great challenge and the main products formed are acetaldehyde and/or acetic acid. PtSn/C [1] and PtCe/C [2] electrocatalysts prepared by polymeric precursors method were very active for EOR. In order to study a synergic effect of Sn and Ce with Pt for EOR this process was investigated using PtSnCe/C electrocatalysts in different mass ratios (72:23:5, 68:22:10, 64:21:15) prepared using the polymeric precursor method [2], where the metal loads used were 20 % on carbon. The catalytic performance towards ethanol oxidation for the different catalysts was evaluated by cyclic voltammetry, chronoamperommetry, and polarization curves performed on DEFC single cells. As a way to gain some information about the intermediates and products of the reaction the electrooxidation of ethanol was investigated by "in situ" FTIR spectroscopy. Among the catalysts investigated the best composition for ethanol oxidation was 68:22:10. In this case, the current density observed by chronoamperommetry for EOR in acidic media (H_2SO_4 0.5 M + Ethanol 1 M) after 30 min at E = 0.5 V, (21 mA mg_{Pt}^{-1}) was 50% higher than that observed for PtSn/C E-Tek (15 mA mg_{Pt}^{-1}). During the experiments performed on single fuel cells, the configurations used were: $T = 100^{o}C$, nafion 117 membrane, with a pressurization of 2 Bar, ethanol 2 mol L^{-1}, and inlet ethanol flow = 2 ml min^{-1}. The maximum power density for a DEFC using PtSnCe/C 68:22:10 electrocatalyst as anode was 45 mW cm^{-2} which is nearly 40 % bigger than PtSn/C E-TEK for the same process (32 mW cm^{-2}). FTIR data show that the observed behavior may be explained by the favoring of the acetic acid pathway, whilst CO_2 show a low level of formation for all the catalysts.

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