A Pt_3Sn/C Electrocatalyst Used as the Cathode and Anode in a Single Direct Ethanol Fuel Cell

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Direct ethanol fuel cells (DEFCs) have received attention as the next alternative power source because of their high efficiency. However, many problems still need to be solved, such as finding a more effective catalyst than Pt for the oxygen-reduction reaction (ORR) [1]. For the ethanol oxidation reaction, one of the best binary electrocatalysts described in the literature is the intermetallic alloy Pt_3Sn [2]. This is because the electronic effect [3]. A problem that occurs in the cathode of DEFCs is the cross-over effect, and it has serious negative consequences for cell performance by reducing its coulombic and voltage efficiencies [4].

In this work it was performed a study showing the use of a Pt_3Sn/C alloy produced by the polymeric precursor method (PPM) and utilized as both the cathode and anode of a DEFC. To investigate the tolerance to ethanol crossover, we made a study of activity and kinetics of the ORR using a rotating disk electrode. A comparison of the polarization curves for ORR on the electrocatalysts in 0.5 M H_2SO_4 with O_2 saturation with and without 0.1 mol L^{-1} ethanol obtained demonstrated that in the presence of ethanol there is a decrease in the mass current densities related to ORR. For Pt_3Sn/C PPM, the mass current density for ORR diminished with the addition of ethanol (about 9 %) and using Pt/C, this value was 13 % smaller than that using the same electrocatalyst without ethanol. These results can be explained since the strength of adsorption of both CO [3] and O_2 [5] is reduced in Pt_3Sn alloy. The experiments using a DEFC performed were carried out with and without oxygen pressurization in order to observe the performance of the Pt_3Sn/C as a cathode and anode compared to Pt_3Sn/C as an anode and Pt/C Etek as a cathode. The polarization and power density curves in a direct ethanol fuel cell without pressurizing the cathode demonstrated the superiority of the electrocatalyst Pt_3Sn/C MPP compared to the catalysts Pt/C E-Tek as cathodes, with a full power density about 20 % higher than the one using Pt/C E-tek. This could be explained by the fact that the ORR reaction is less affected by the presence of ethanol (crossover), which indicates that the Pt_3Sn/C electrocatalyst is not only good for the ethanol oxidation reaction [5], but also for the ORR with and without ethanol in the electrolyte. When the cathode was output pressurized to reduce the crossover, the performance of the Pt/C and Pt_3Sn/C catalysts were quite similar.

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