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Research on Methanol-Tolerant Catalysts for the Oxygen Reduction Reaction

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ABSTRACT

Direct methanol fuel cells (DMFCs) represent an interesting alternative to obtain electricity in a clean and efficient way, potentially valuable to substitute traditional environmentally harmful technologies.

Portable power sources are one of the most promising applications of passive DMFCs. One of the requirements in these devices is to use high alcohol concentration. Unfortunately, the methanol permeation across the polymer electrolyte membrane (methanol crossover) causes a considerable loss of the fuel cell efficiency because both the oxygen reduction reaction (ORR) and the methanol oxidation reaction (MOR) occur simultaneously in the cathode.

In order to develop methanol tolerant cathodes with suitable activity at low temperature, different PtM, PtMRu and PtMPd catalysts, with M = Co or Fe were prepared either via poliol reduction (*EG catalysts*) or alloy (*AL catalysts*) methods, the latter followed by a thermal treatment in a reducing atmosphere.

All cathode-catalysts were studied to determine the role of the components in enhancing the ORR and discouraging the MOR, simultaneously.

The physical characterization of the synthesized materials was accomplished by TEM, XPS and EDS. According to the synthesis procedure, XPS spectra showed that the amount of metal oxides on the catalyst varies. Small and well distributed particles on the carbon support were shown by TEM.

The catalysts electrochemical characterization was accomplished in a three electrodes electrochemical cell with a glassy carbon rotating disk electrode covered with a thin catalytic layer as the working electrode. Linear sweep voltammetry, chronoamperometry and electrochemical impedance spectroscopy were employed.

Electrochemical results showed that the AL catalysts have better activity for the ORR. However, the enhanced activity of *AL catalysts* is completely lost when the ORR is accomplished in presence of methanol. On the other hand, binary or ternary *EG catalysts* showed higher methanol tolerance, the role of metal oxides according the synthesis method is discussed.

Keywords: ORR; Methanol Crossover; DMFCs