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NEW ELECTRODES PREPARED BY Pt/Ru E-BEAM EVAPORATION FOR APPLICATION IN FUELL CELL

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Direct methanol fuel cells (DMFC), as environmentally friendly energy devices, are being intensively studied due to their numerous advantages with respect to other energy storing systems, including low environmental impact, high-energy density, high efficiency and low noise, portable applications. One of the main problems of these fuel cells is the cost of the MEA due to the platinum content as catalyst.

The Pt-Ru binary alloy electrocatalyst appears as the most promising formulation to oxidize the methanol at DMFC anodes. Pt sites in Pt-Ru alloys are especially involved in both the methanol dehydrogenation step and strong chemisorption of methanol residues.

The aim of this work is to investigate the electron beam evaporation for preparing Pt/Ru layers deposited on the un-catalysed gas diffusion layers for DMFC, Freudenberg H2215 T10A. Pt/Ru films in atomic ratio 1:1 (50.4 μg Pt cm^{-2}, 26.1 μg Ru cm^{-2}) were evaporated in a vacuum chamber using an e-beam evaporator QUAD-EV-C, Mantis.

Electrochemical measurements were carried out in a three electrode cell with a Pt wire used as auxiliary electrode connected to a Schlumbeger 1286 potentiostast/galvanostat connected to a frequency analyser Solarton 1255B.

The prepared e-beam PtRu electrode and a commercial of 3 mg PtRu cm^{-2}, BC-M100-30F T10A were measured using membrane electrode assemblies (MEAs) in a single DMFC of 3.8 cm^2 of active area. A commercial cathode: Quintech H2315 IX91CX320 containing 1 mgPt cm^{-2} has been used to fabricate the MEAs. Polarization curves were registered at different temperatures and methanol concentrations with each DMFC.

The electrochemical behaviour of the catalyst support and the electrodes has been studied by cyclicvoltammetry in 0.5M H_2SO_4 and 0.5M H_2SO_4 + 1M MeOH medium. The electrochemical active surfaces were determined and their morphological characteristics were examined by SEM. Low Pt/Ru electrodes shows more electroactivity than carbon paper without e-beam evaporation and they are also comparable with commercial ones.

The e-beam MEA maximum power density (Wm, mW per mg of PtRu at the anode) is higher than that of the commercial MEA. At 80°C and 1M of methanol the ratio between Wm of e-beam and commercial MEAs is 3.5. This ratio decreases when the temperature decreases, but it is always greater than 1. Thus, PtRu e-beam electrode makes better use of the catalyst.

Therefore, at low Pt-Ru loadings, the e-beam evaporation technique seems to be an easily scalable preparation method for fuel cell electrodes.

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