Comparative Study of Ethylene glycol Electrooxidation onto Rh, Pt and Rh-Pt Electrodes

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Introduction

Over recent years, ethylene glycol (EG) has attracted increasing attention as a fuel for direct alcohol fuel cells (DAFCs) due to its low toxicity, high boiling point, high energy density and relatively high reactivity.[1] Extensive efforts have been devoted to investigating the electrochemical adsorption and electrooxidation of EG on electrodes containing different metals, especially noble metals such as Pt and Pt-based electrocatalysts.[2] The electrooxidation of EG is a complex process, its complete oxidation to CO_2 delivers $10e^-$ per molecule, which may proceed via several consecutive and/or parallel steps involving different reaction intermediates such as glycolaldehyde, glyoxal, glycolic acid, glyoxylic acid, oxalic acid and formic acid.[3] For this purpose EG oxidation reaction was investigated using Pt, Rh and Rh-Pt surfaces.

Results and Discussion

The Rh and Pt electrodes were characterized electrochemically in H_2SO_4 0,1 M. The Fig. 1 shows the CV profile and its peculiar regions that comprises the hydrogen and oxide process onto theses surfaces.

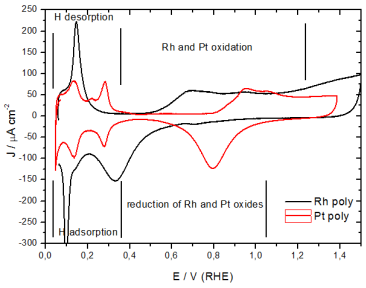

Figure 1. CV of Rh and Pt poly (50 mV s^{-1}).

The activity of these electrodes for EG oxidation were studied by CV (Fig. 2A, B and 3). As expected, the currents for the Rh poly are negligible. When the Rh poly electrode is modified with small amounts of Pt, the activity of the electrode increases significantly. It should be highlighted that the coverage in this case is only 0.05 and the currents densities are so considerable, once EG oxidation is slightly more negative when compared to Pt the maximum current observed remains for Pt poly electrode. Since Rh atoms are almost inactive for the oxidation of EG, only 5% of the surface atoms are active is capable to produces great performance if considering a Pt surface. For a real comparison with the Pt, the current density should be referred to the platinum active area, i.e., dividing the measured current density for this electrode by 0.05. When this current density is calculated (Fig. 2), it can be observed that the activity of this electrode is more than 13 times higher than that measured for the Rh poly and very close of Pt poly electrode.

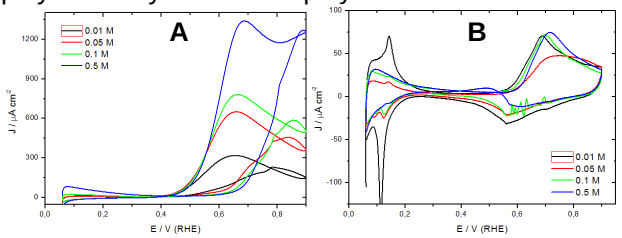

Figure 2. Electrooxidation of EG in different concentrations: A) Pt poly and B) Rh poly.

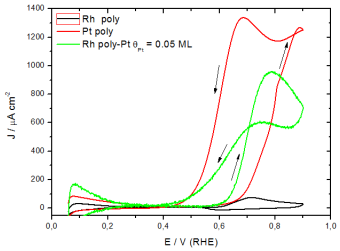

Figure 3. Electrooxidation of EG onto: Rh poly, Pt poly and Rh poly modified by Pt adatoms.

Conclusions

EG electrooxidation onto Rh poly, Pt poly and Rh poly modified by Pt adatoms was very interesting for a electrocatalysis comparison. The use of small amounts of Pt adatoms (0.05 ML) onto Rh showed great performance for this purpose as a preliminary study.

Acknowledgments

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