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The electrooxidation of glycerol on Ag nanoparticles decorated with ultra-low Pt quantities

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Abstract

The oxidation of glycerol (GIOH) can lead to products with a high added value and a large range of applications in different fields. In this work we studied the GIOH electrooxidation reaction (GER) and its selectivity with a 1%Pt catalyst on 20%Ag/C catalytic support and the characterization of the sample and the obtained products.

Key words:

Electrocatalysis, Glycerol, HPLC.

Introduction

We are studying the behavior and selectivity of a catalyst with nominal quantity of Pt(1%)Ag/C 20% w.t. Carbon Vulcan in several electrochemical experiments: cyclic voltammetry, linear voltammetry associated with sample collection for HPLC analysis and chronoamperometry. There is a vast quantity of information that can be extracted from electrochemical experiments and their combination with HPLC experiments, can provide much information towards Glycerol oxidation selectivity and activity^[1,2].

The low Pt concentration is due to its scarcity, the aim is to obtain representative results with the smallest amount of Pt as possible, since we have already studied Ag/C 20% w.t. material but the results shown no Ag significant activity. The catalyst was characterized by XRD and is being studied with TEM and ICP-OES.

Results and Discussion

Firstly the catalyst is deposited in a porous carbon support for the experiment performance. The cyclic voltammetry is the first technique to be applied on the experimental procedure, its results are important to observe the profile of the voltammogram and make qualitative conclusions about the sample, it acts like a screening. The current is normalized by the effective electrode surface area to give the voltammogram in current density, the effective area is obtained by CO stripping experiment. The potentiostat used by the group is from the Autolab series® by Metrohm.

After the CV, a linear voltammetry experiment is run along with the sample collection for HPLC studies. The sample collector utilized by is a LC-20AT® by Shimadzu Corporation. The samples were then injected in an Agilent Technologies 1200 Series HPLC equipment with a Shodex® column and results are shown at Image 1.

Image 1. Chromatograms in different potentials.

The correlation between the generated anodic current and area of the chromatographic peaks for glyceric acid versus applied potential is shown at Image 2.

Image 2. Correlation between current and area of peaks.

It is observed that glyceric acid is the main product obtained with this catalyst at these conditions, however, the correlation graphic shows that it is not the exclusive product.

Conclusions

The chromatogram obtained through the HPLC experiments shows that the oxidation is successful and with some degree of selectivity for glyceric acid, i.e. oxidation took place mainly on terminal carbons.

The voltammetry when compared with the area of chromatographic peaks shows a clear relation between the obtained products quantity and current intensity, it also shows that more than one kind of product is produced.

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² Kwon, Y.; Hersbach, T.J.P.; Koper, M. T. M. *Top Catal.* 57, 14, 1272–1276, (2014).