Synthesis of Pt/C catalysts for glycerol electrochemical oxidation and application in Direct Alcohol Fuel Cell

Fabiano dos Santos Cursi*

Adalgisa Rodrigues de Andrade

FFLCRP / USP

*fabiano.cursi@usp.br

Objectives

The present work aimed to study the preparation and characterization of Pt electrocatalyst supported on high surface area carbon for electrochemical oxidation of glycerol in alkaline medium for application of the material as an anode in a direct alcohol fuel cell, a clean and efficient source of energy.

Materials and Methods

The catalyst is prepared by the method of reduction by a polyol assisted by microwave irradiation, where a platinum precursor is reduced generating metallic nanoparticles supported on carbon Vulcan, in the ratio of 20% by weight of noble metal. The material obtained had been subjected to electrochemical investigation, glycerol oxidation and differential thermogravimetric analysis.

Results

The yield of the synthesis of the Pt/C catalyst was 98%. Analyzed by differential thermogravimetry, the prepared material showed 23.21% of Pt and 76.56% of carbon. Cyclic voltammetry (VC) reveals the characteristic regions of adsorption/desorption of hydrogen on the platinum, in addition to the oxidation and reduction peaks of the metal (fig. 1a). CO-stripping analysis showed 41.56 m^2g^{-1} of electrochemically active area (fig. 1b). The analysis of the Pt/C catalyst for oxidation of 0.1 M glycerol in 0.1 M NaOH, an onset oxidation potential of 650 mV vs. RHE was obtained, in addition to the re-oxidizing peak of the fuel.

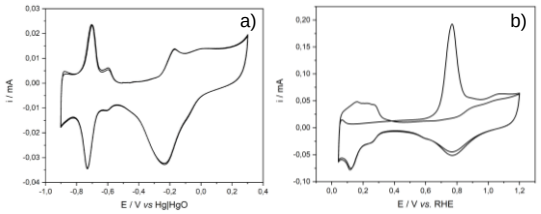

Figure 1: a) VC of Pt/C in NaOH 0,1 M at 10 $mV.s^{-1}$. b) CO-*stripping* in 0,5 M H_2SO_4 at 10 $mV.s^{-1}$.

Conclusions

The synthesis yield was satisfactory, together with the Pt:C percentage obtained in the material compared to the nominal one. The ~3.4% loss of carbon by oxidation may justify this small deviation. The polyol method coupled to microwave irradiation was efficient to obtain the nanostructured material supported over carbon. In the half cell test the catalyst material was able to oxidize glycerol, however the onset potential for this reaction still very high, it will be necessary to seek for catalysts capable to diminishes the overpotential for glycerol oxidation thus, able to oxidize the fuel at smaller overpotentials (< 600 mV vs. RHE), in order to justify the investment as anodic material. The modification of the Pt nanoparticles with non-noble metals can help to increase catalytic capacity, as already demonstrated in the literature, and it will be the nest step of this investigation.

References

1. *Journal of Power Sources*, v. 196, p. 920-927, **2011**.
2. *Journal of Power Sources*, v. 214, p. 33-39, **2012**.
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