

Electrochemical study of glycerol oxidation on gold surfaces covered by metallic monolayers

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Abstract

In this work we are investigating the glycerol electrooxidation on polycrystalline gold disks covered by monolayers of different metals (Cu, Bi, Pb). Cyclic voltammetry is used both to deposit the monolayers on the gold disk surface, as well as to investigate the presence of oxidation peaks related to the mechanism of glycerol oxidation.

Key words:

Glycerol, Cyclic Voltammetry, Electrocatalysis.

Introduction

The increasing demand for fuels in the recent years has been stimulating the research for alternative and renewable sources. The biodiesel, produced from biomass conversion, has proven to be one of the major fuel sources for renewable fuels, however the main obstacle for the development of this industry is its low value-added subproducts, such as glycerol (GIOH)¹.

The oxidative conversion of GIOH is a very promising way for the generation of value added compounds from the biodiesel waste, which can in turn be coupled with a hydrogen conversion cell, depending on the electrochemical reactor setup.

In the present work, we aim to investigate the oxidative conversion of GIOH on gold electrodes covered with metallic (Cu, Bi, Pb) ad-atom monolayers.

The glycerol electrooxidation (GEO) was performed in a CV experiment with an electrolyte solution consisting of 0,5 M NaOH solution with 1 mM glycerol concentration. The oxidation was performed in both clean Au surface and after deposition of metallic Cu monolayer.

Image 2 shows the profiles obtained after the oxidation, and it indicates an increase in the oxidation current after the Cu deposition, suggesting that the Cu monolayer improves the GEO on gold surfaces. Since the Cu is capable of increasing the oxidation current, it is likely also interfering with the oxidation mechanism of GIOH on gold.

Results and Discussion

We have characterized the gold disk electrodes by using cyclic voltammetry (CV) in a 0,5M H₂SO₄, followed by deposition of Copper ions on the electrode surface by performing an underpotential deposition (UPD) from a 1mM CuSO₄ solution, as shown in Image 1. A monolayer of Cu atoms was deposited on the electrode by holding the potential at 0,27 V for 5 minutes, and bulk deposition of Cu ions was shown to begin at 0,23 V.

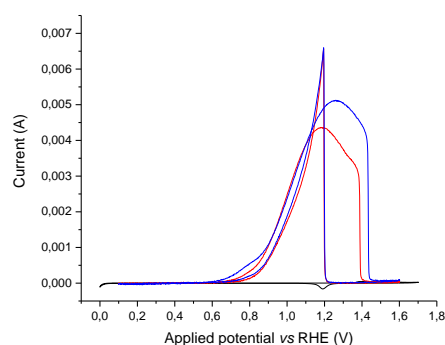


Image 2. CV profile of the GEO in a 0,5M NaOH solution containing 1 mM GIOH. Blank profile (*black*), GEO in a clean Au electrode (*red*) and after deposition of Cu monolayer (*blue*). Scan rate 5 mV s⁻¹.

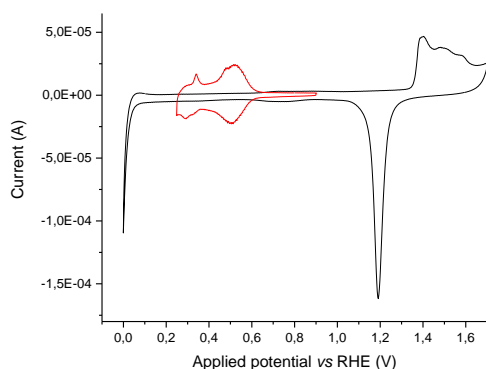


Image 1. CV profile of the gold electrode in 0,5 M H₂SO₄ solution (black) and a profile of Cu deposition from 1 mM CuSO₄ solution. Scan rate 10 mV s⁻¹

Conclusions

We concluded that the GEO was improved by Cu deposition. The next step will be to investigate the reaction pathways, followed by further investigation with different metals of other ad-atoms, such as Pb, Bi, etc and their effects on the GEO.

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