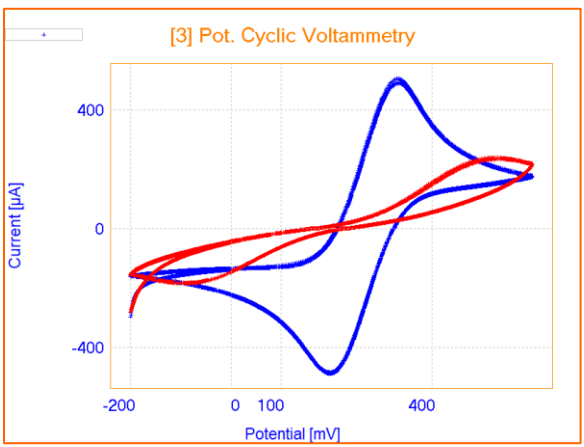
Application Note

General Electrochemistry
AP-GE12

Activation of Glassy Carbon Electrode



One of the most used carbon base electrodes in electrochemical research is Glassy Carbon (GC) electrode. Despite that its electrochemical properties largely depend on its surface-state, a standardized procedure for its activation is playing a significant role in the field of electrochemistry. This application note presents a detailed of a GC electrode activation process based on potential cyclic voltammetry in Sulfuric Acid 0.1 M solution.

Origalys Electrochem

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INTRODUCTION

Thanks to Glassy Carbon (GC) physical and chemical properties, glassy carbon electrode as working electrode has become an interesting and widely applied in electrochemical research by many users. High stability and inertness, low oxidation rate make it a convenient electrode in wide range of electrochemical application.

The efficiency of Glassy Carbon electrodes highly depends on its surface pretreatment. The glassy carbon electrode surface needs to be activated before each electrochemical test, enabling users to have high accurate results.

In this application note activation of GC surface electrode is investigated through cyclic voltammetry method. At the end, the comparison curves of cyclic voltammetry in Ferri/Ferro Cyanide solution is shown before and after activation of surface of the electrode indicates the importance of this process.

TIPS: The goal of this application note is to indicate users the importance of activation of GC electrode surface and its influence on results.

ACTIVATION PARAMETERS

1. In the first step you need to prepare Sulfuric Acid solution of 0.1 M

2. The second step conclude performing Cyclic Voltammetry by immersing GC electrode, Reference and Auxiliary electrodes in Acid solution.

The parameters of Cyclic Voltammetry for activating of GC electrode is shown in figure 1, and figure 2 shows the related results.

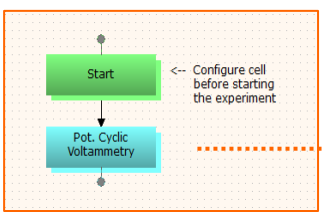
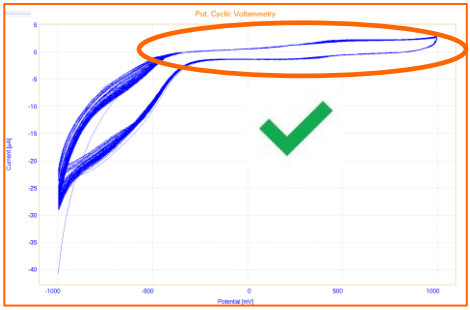


Figure 1: Parametres of the CV method for activation of GC electrode surface

Pot. Cyclic Voltammetry	
Potential 0 (mV)	-1000
Potential 1 (mV)	1000
Potential 2 (mV)	-1000
Scan rate (mV/sec.)	20, 0.0225, 0.45
Sampling rate	1:5
Maximum current (mA)	500
Minimum current (mA)	-500
Ohmic Drop Comp.	No
Maximum range	Auto
Minimum range	Auto
Analog Filter	Auto
Digital Filter	0
Cycle	100
Open circuit at end	Yes
Save points	Yes
Auxiliary input	No



Between -300 to 1,000 mV there is no peak and the curve is straight enough (like a baseline), so the electrode is ready for electro-chemical tests.

Figure 2: Voltammogram of activation process

NOTE: Before running the treatment CV, make sure that the surface of GC electrode is clean enough. If not, it is needed to polish the GC electrode on very soft polish paper with Alumina powder with a little amount of water.

CYCLIC VOLTAMMETRY BEFORE ACTIVATION

Figure 3 shows voltammogram of Ferri/Ferro Cyanide solution on GC electrode without any treatment.

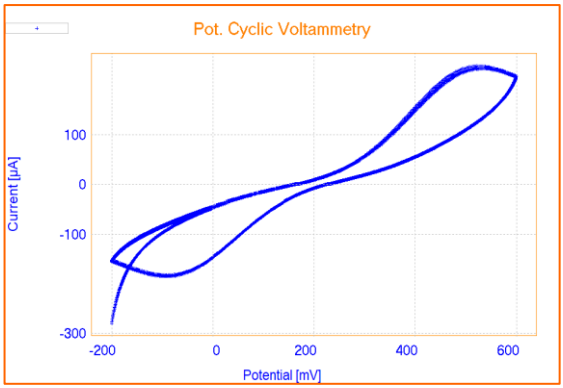
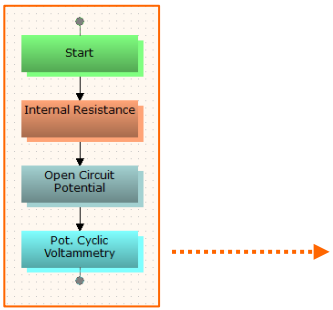


Figure 3: Cyclic Voltammetry of GC electrode in Ferri/Ferro Cyanid solution without treatment

It can be seen from the curve that the peak height and peak position related to electrochemical reaction of Fe ions are not accurate. The parameters of the CV method is shown in figure 4.



Pot. Cyclic Voltammetry	
Potential 0 (mV)	-200
Potential 1 (mV)	600
Potential 2 (mV)	-200
Scan rate (mV/sec.)	20, 0.0225, 0.45
Sampling rate	1:1
Maximum current (mA)	500
Minimum current (mA)	-500
Ohmic Drop Comp.	No
Maximum range	Auto
Minimum range	Auto
Analog Filter	Auto
Digital Filter	0
Cycle	3
Open circuit at end	Yes
Save points	Yes
Auxiliary input	No

Figure 4: Cyclic Voltammetry parameters on GC electrode

NOTE: "Internal Resistance" and "Open Circuit Potential" methods were run in order to verify the stability of electrochemical cell.

CYCLIC VOLTAMMETRY AFTER ACTIVATION

Figure 5 corresponds to cyclic voltammogram of GC electrode in Ferri/Ferro Cyanide solution after activating the GC electrode surface. The parameters of test are the same as Figure 4.

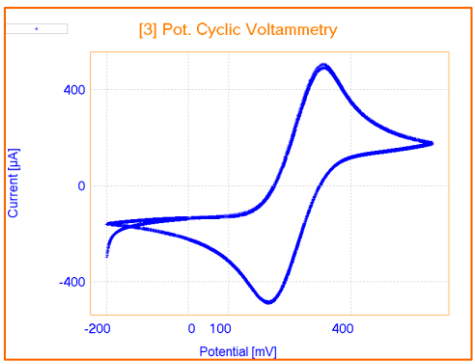


Figure 5: Cyclic Voltammetry of GC electrode in Ferri/Ferro Cyanide solution after treatment

After activation of surface electrode, the results are more accurate, the sensitivity of electrode increased, and the peak position become more closed to standard values. See below an overlay of figures 4 and 5 to show the importance of treating the GC surface on the results.

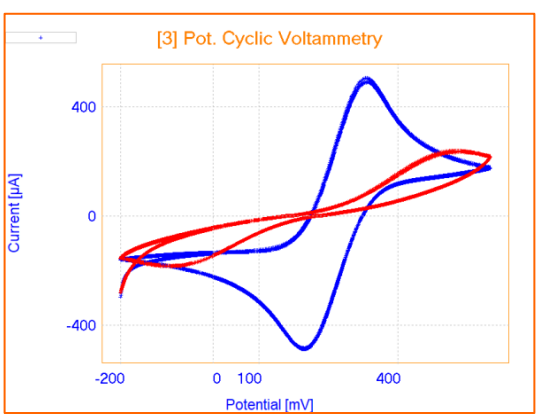


Figure 6:

***Red curve -** CV on GC electrode without treatment*

***Blue curve -** CV on GC electrode after treatment*

INSTRUMENT AND ELECTRODES

Figure 7: OrigaStat OGS100

Electrode setup	
Reference Electrode (REF)	Ag/AgCl Type: OGR007
Counter Electrode (AUX)	Platinum wire Ø1mm Type: OGV005
Working Electrode (WRK)	GC tip Ø3mm
Electrolyte	KCl 0.1 M
Instrument	OrigaStat OGS100
Software	OrigaMaster

REF
Ag/AgCl

AUX
Platinum wire Ø1 mm

WRK
Glassy carbon Ø5 mm

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