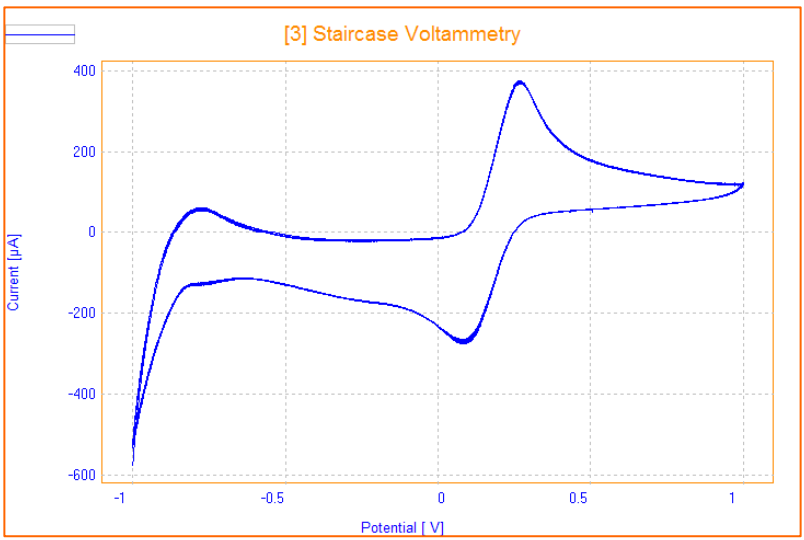
Application Note

General Electrochemistry
AP-GE05

Staircase Voltammetry



This Application Note describes how the Staircase Voltammetry method works by giving an example with Ferri/Ferrate solution.

Introduction

The Staircase Voltammetry is a flexible method to investigate and record voltammograms of any electrochemical samples. You can set the potential points versus OCP or reference electrode, define the step potential, step duration, scan rate and then start the test.
What makes this method special is that the user can define the number of **segment**. By defining the segment, the number of sweeping (scanning) potential between two vertexes is defined. When the number of segment is 1, then there will be a single-sweep voltammogram. When the number of segment is even means to have complete cycles.

Parameters

The Parameters of the staircase voltammetry are shown in figure 1.
With the above default settings, the potential 1 is set to -1000 mV versus REF electrode, then scan rate is set at 10 mV/s up to achieve to potential 2 which is defined as 1000 mV.

In the segment part, the user can define the number of sweeps.

In figure 2, different results corresponding to different number of segments are shown.

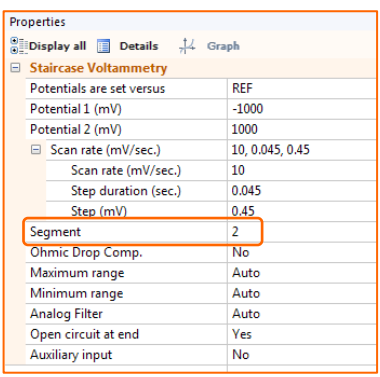


Figure 1: The parameters

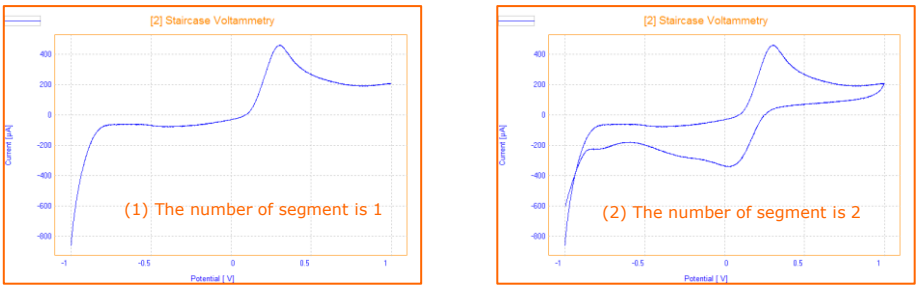


Figure 2: Final result, Potential vs Current

When the segment is defined as 1, only single-sweep voltammogram will be gained. When the segment is defined as 2 (or any even number) the result will be a cyclic voltammogram. If the user defines an odd number (more than 1), then the voltammogram will be cyclic voltammetry curves and a single-sweep voltammogram at the end.

How to select a specific segment

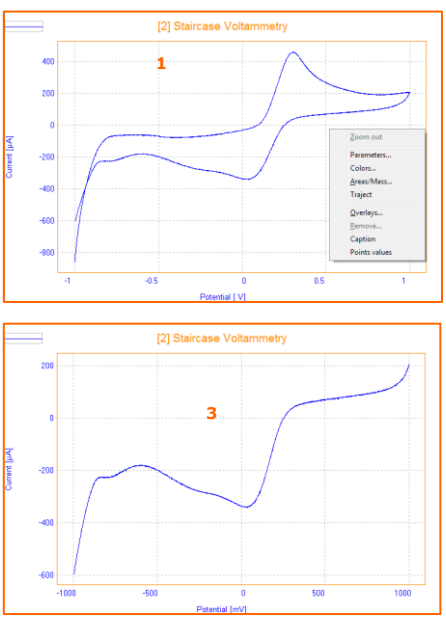


Figure 3: How to choose a segment

The other interesting point of this method is the users can extract any segment among all segments according to their application:

1- Right click on the curve and select "Traject"

2- Select "Segment"

3- In the segment define which segment number you want to extract.

Difference between the CV and the Staircase Voltammetry

Figure 4 shows the two voltammogramms of two different methods: CV and Staircase Voltammetry and the curves of Potentiel vs time.

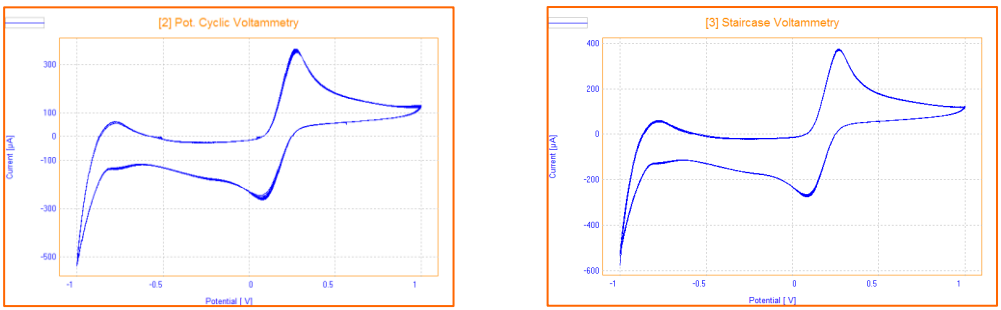


Figure 4: Voltammograms of CV and Staircase Voltammetry, Potential vs Current

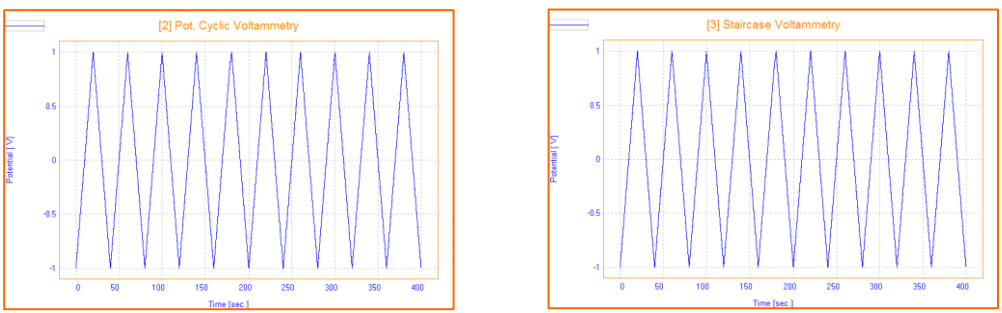


Figure 5: Voltammograms of CV and Staircase Voltammetry, Time vs Potential

In fact the parameters of both methods were exactly the same, because the potential 0 and potential 1 were defined the same in CV method (Potential 0 = Potential 1). If the Potential 0 is not important, the users can choose staircase voltammetry too.

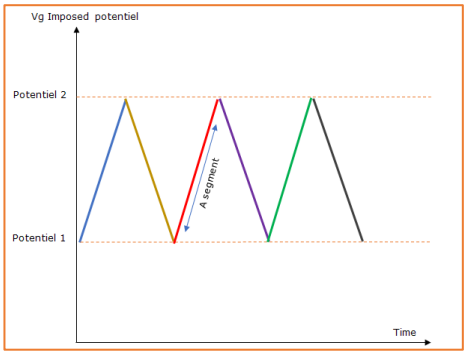


Figure 6: Scheme of the Staircase

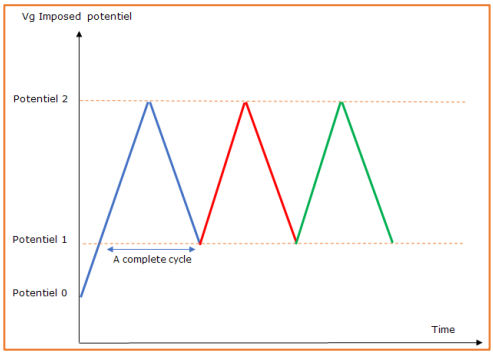


Figure 7: Scheme of the CV

Figure 6 shows the diagram of potential vs time for the **staircase voltammetry**. The users can define any number of segments according to their application.

Figure 7 shows the diagram of potential vs time for the **cyclic voltammetry**. The potential 0 is where the sweep starts. When the potential reaches the potential 1, then the first cycle starts. The potential 0 and the potential 1 can be the same.

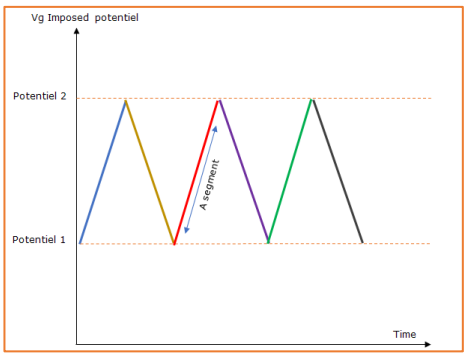


Figure 6: Scheme of the Staircase

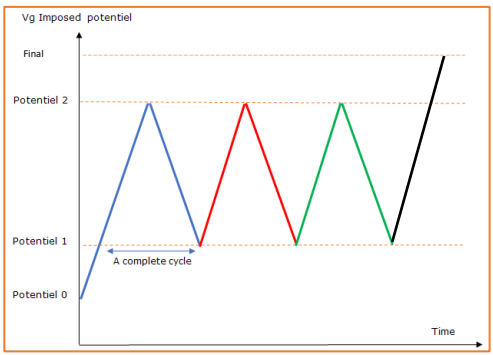


Figure 8: Scheme of the CV 4 limits

Figure 8 shows the diagram of potential vs time for the **cyclic voltammetry 4 limits**. The users set the parameters as the Cyclic Voltammetry except that the sweep ends at another potential.

Results

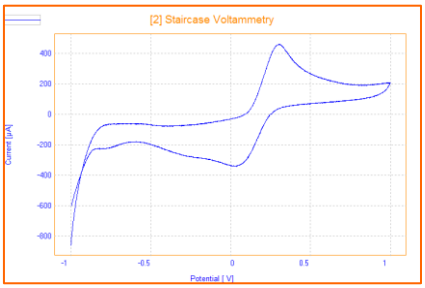


Figure 9: Final result

Compared to the **Cyclic Voltammetry** and **Cyclic Voltammetry 4 limits**, the results from the Staircase can be very similar.

The positive aspect of this method is really its flexibility. To select only the reduction or the oxidation part, it's the perfect method.

Instrument and Electrodes

Figure 10: OrigaFlex OGF500

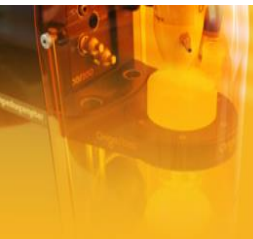
Figure 11: Electrochemical cell

Electrode setup	
Reference Electrode (REF)	Calomel Type: OGR003
Counter Electrode (AUX)	Platinum wire Ø1mm Type: OGV005
Working Electrode (WRK)	Platinum Ø5mm Type: EMEDTPTD5
Electrolyte	Ferri/Ferrate solution 5 x 10^{-3} M in KCl
Instrument	OrigaFlex OGF500
Software	OrigaMaster

REF
Calomel

AUX
Platinum wire Ø1 mm

WRK
Platinum Ø5 mm



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