TechnicalNOTE

GAMRY INSTRUMENTS

Measuring the Impedance of Your Reference Electrode

Introduction

It's very important for optimum potentiostat performance that the impedance of the Reference Electrode in your cell is low! A high impedance Reference Electrode will cause problems that range from simple overloads to potentiostat oscillation. When in doubt...check your Reference Electrode.

For Gamry users, be aware that the Reference Family Potentiostats are less tolerant of high-impedance Reference Electrodes than the Series G Potentiostats. The Reference Family is designed for high-performance and high-speed and it does not appreciate a Reference Electrode with a high impedance!

The impedance of your Reference Electrode should be less than 1 kohm. An impedance higher than 1 kohm is not good and an impedance higher than 5 kohm is unacceptable and must be corrected. With a Gamry Reference Electrode, the problem is easily corrected by changing the Porous Glass Frit.

Testing Procedure

This procedure can be used to quickly estimate the impedance of your Reference Electrode. You must have EIS capability in your electrochemistry system to perform this test.

1. Partially fill a beaker with electrolyte. If you normally use a Luggin capillary, the concentration of this electrolyte should be approximately the same as that of your test solution.

2. Immerse the tip of your Reference Electrode into the solution. If you will be using a Luggin capillary, place the tip of the Luggin capillary in the solution and place your reference in the Luggin. Make sure you have an unbroken electrolyte path from the tip of the Reference to the tip of the Luggin capillary.

3. Add a high surface area platinum wire or graphite rod counter electrode to the solution.

4. Connect the Reference Electrode to the Working (green) and Working Sense (blue) leads of your potentiostat. (Yes, we said the Working Electrode leads!)

5. Connect the graphite rod to the Reference (white) and Counter (red) electrode leads.

6. Set up a Potentiostatic EIS scan starting from about 5 kHz and scan to about 100 Hz. Make sure that the applied DC potential is zero versus the open circuit potential (E_{oc}). A 5 mV AC amplitude should be sufficient.

7. Start the scan. Make sure that the DC current is less than 10 mA. If it isn't, turn off the potentiostat as soon as possible.

CAUTION: Do not allow the test to run if significant DC currents are flowing. Your Reference Electrode could be damaged if this occurs.

8. Let the scan run for about a decade in frequency, then stop the scan and turn off the cell. Note the magnitude and phase of the measured impedance.

The measured impedance at high frequency should be resistive (the phase angle should be near zero). If it is, the impedance magnitude is a good estimate of your Reference Electrode's resistance. If the phase angle isn't near zero, the impedance cannot be trusted.

We have used this test on several electrodes in our lab. It gives reasonable results on the Gamry Saturated Calomel Reference Electrode (P/N 930-03) with a Porous Glass Frit.

If the impedance is too high, replace the Porous Glass Frit. Spare Porous Glass Frits are available from Gamry (Part No. 955-03, package of 5 frits).

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