BE-M260/EE-M255/NS-M206
Homework 2 - Part 2
Assigned: Oct. 17, 2023
Due: Oct. 31, 2023

1. Cyclic Voltammetry (note that CV scan rate is 100mV/s)

a. Usually, many cycles of CVs are conducted and the average is then obtained. A spreadsheet file (*be260-hw2-2023-fall-cv-platinum.csv*) is recorded at a particular cycle for the given electrode in Figure 1 (***HW2 - Part 1***). Using the spread sheet to construct a Cyclic Voltammogram and then calculate the overall charge **Q** corresponding to its opening.

b. Calculate the effective area of the electrode using the formula, Area=**Q**/210mC cm^{-2}. Compare your result with the data given in Problem 2 (***HW2 – Part 1***). Comment on the difference if any?

c. The electrode in 1.a is then chemically deposited with a layer of Iridium Oxide (IrOx) and a spreadsheet file is given at *be260-hw2-2023-fall-cv-irox.csv*. Repeat 1.a and 1.b. Comment on the difference between platinum and IrOx electrodes?

2. **EIS and CV study**

As shown in the Figure 1, two impedance spectra (pink and black curves) were recorded for electrode material X. The only difference in the two measurements was the biased DC voltage at the electrode during the measurement. Most potentiostats can specifically set the DC electrode potential and then superimpose an AC sine wave with the DC bias. The AC impedance signals were identical at amplitude of 10 mV.

a. Using CV curve as shown in Figure 2, explain why do two measurements behave differently? Taking into the consideration of the current magnitude of these two measurements, indicate the most likely positions for these two DC potentials at the CV curve.

b. What is the water window for this electrode X?

c. What are R_{ct}, $R_{s,}$ and C_{dl} for the blue curve in Figure 1? (justify your assumptions)

d. Construct a Randles cell model for this electrode.

e. Show the Bode plot of the impedance corresponding to this Randles cell.

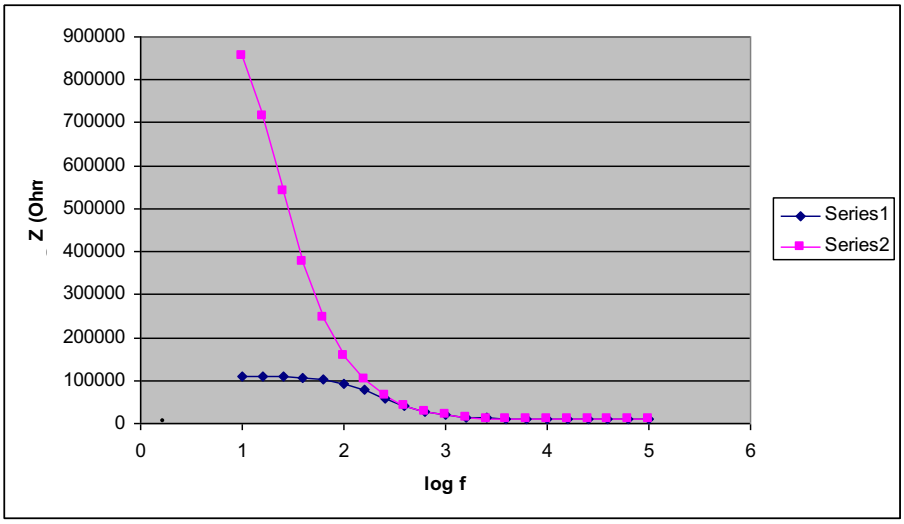

Figure 1: Two EIS measurements for Electrode X

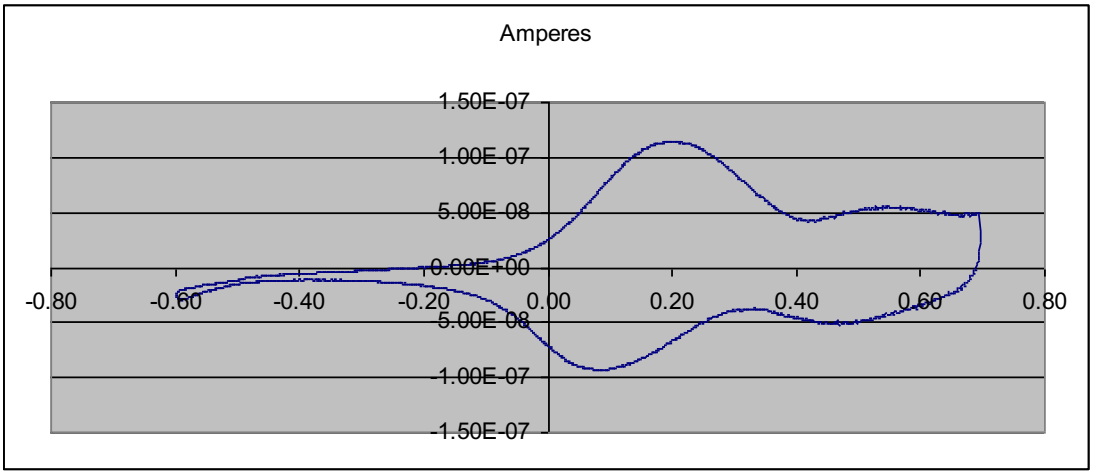

Figure 2: CV for Electrode X