

Electrochemical Impedance Spectroscopy Problems

1) What actually happens during the impedance experiment? How do you construct equivalent circuit for a Resistor and Capacitor in Series?

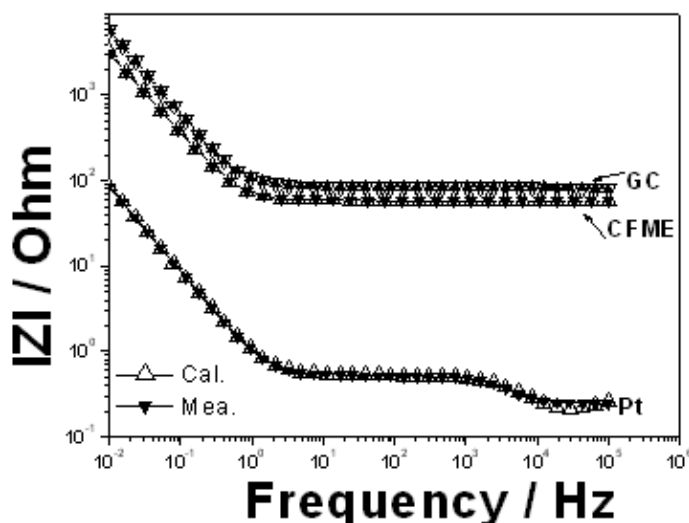
2) a) What is Electrochemical impedance? what is the Response signal in a linear system and AC resistance?

b) Why does the concentration not change if a non-equilibrium potential is applied?

3) Calculate the Impedance of a Capacitor formed by a semiconductive polymeric thin film, presume the capacitance is 30 μ Farads, and the frequency is 400 Hertz.

And presume the capacitor is ideal and has a phase shift of -90 degrees.

4) Electrochemical Impedance Spectroscopic Study of Polyaniline on Platinum, and Glassy Carbon (GC) electrodes were studied (Sarac et al *Int. J. Electrochem. Sci.*, 3 (2008) 777 – 786] The electrode area keeps up constant (Pt plate $\sim 1.5 \text{ cm}^2$, GC $\sim 0.07 \text{ cm}^2$, and CFME $\sim 0.022 \text{ cm}^2$) The low frequency capacitance (C_{sp}) values of Polyaniline (PANI) film (at 0.01 Hz) were calculated by the following equation, $C_{sp} = (2\pi f \cdot Z_{im})^{-1}$ where C_{sp} is the specific capacitance; (Z_{im}) is the slope of a plot of the imaginary component of impedance versus the inverse of the frequency (f)



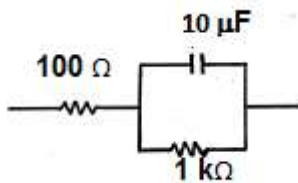
From above bode magnitude graph for the 10 mHz frequency impedance value was found to be $\sim 89 \Omega$ for Pt and $6 \text{ k}\Omega$ for GC and $3 \text{ k}\Omega$ for the CFME calculate the C_{sp} values

5 a) What is the impedance of a pure polymeric resistor having a resistance R of $1.2 \times 10^5 \Omega$.

Draw the Sample Nyquist plots of 'pure' electrical components, shown for a resistor R and a capacitor C.

b) What is the impedance of a pure polymeric capacitor with a capacitance of 10^{-12} F at a frequency of $5 \times 10^5 \text{ Hz}$?

6 a) For the following circuit Calculate the $Z(\omega)$ and Z' and Z'' for the $f = 1.6 \text{ Hz}$, 16.0 Hz etc and show the shape of the Nyquist, bode magnitude plots



b) For the following circuit Calculate the $Z(\omega)$ and Z' and Z'' for $f = 1.6 \text{ Hz}$, 16.0 Hz etc and show the shape of the Nyquist, Bode magnitude plots

