Electrochemical Impedance Spectroscopy

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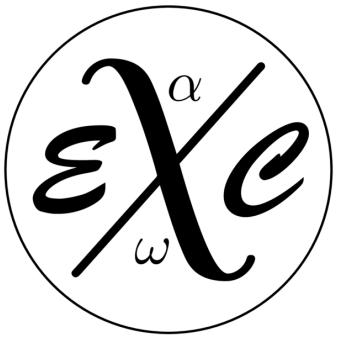


$\mathcal{E}$lectrochemistry χpertise $\mathcal{C}$orrosion

Contents

Introduction

Time domain (incomplete!) [1]:

- Polarisation: $I = f(U)$
- Potential step: ΔU, $I(t)$
- Zero Resistance Ammeter: $\int j_{gal} \cdot dt$

Frequency domain [1]:

- Electrochemical Impedance Spectroscopy

Advantages of EIS [1]:

- Measurement in small perturbations (approximately linear)
- Different processes have different time constants
- Large frequency range from μHz to GHz

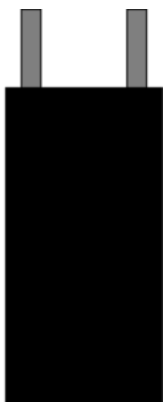
Black Box Approach

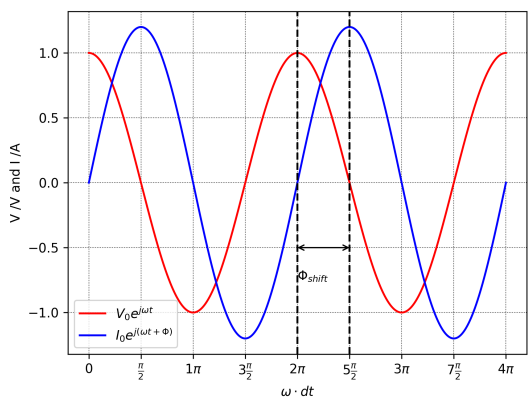
Assume a black box with terminals .

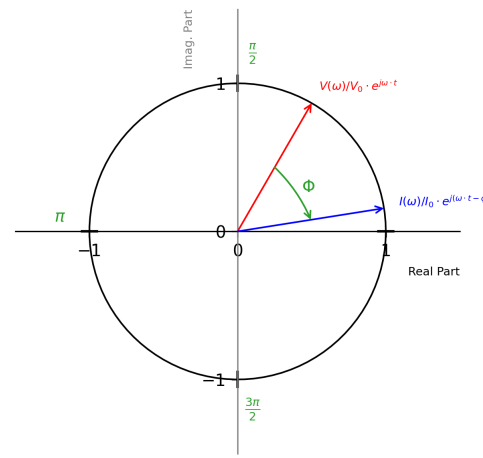
One applies a voltage and measures the current response (or vice versa).

Periodic signal with an angular frequency $\omega = 2\pi f$ with $0 \leq \omega < \infty$:

- Voltage $V(\omega) = V_0 e^{j\omega t}$
- Voltage $I(\omega) = I_0 e^{j\omega t}$







What is EIS?

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References I

[1] A. J. Bard and L. R. Faulkner, *Electrochemical Methods: Fundamentals and Applications*, 2nd ed. New York: John Wiley & Sons, Inc., 2001.