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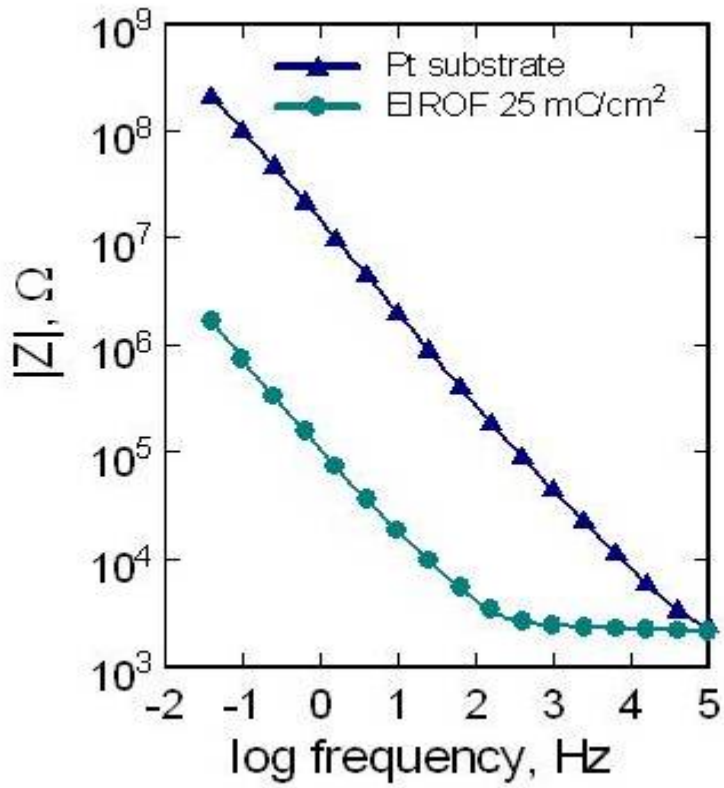
Electrochemical Impedance Spectroscopy (EIS)

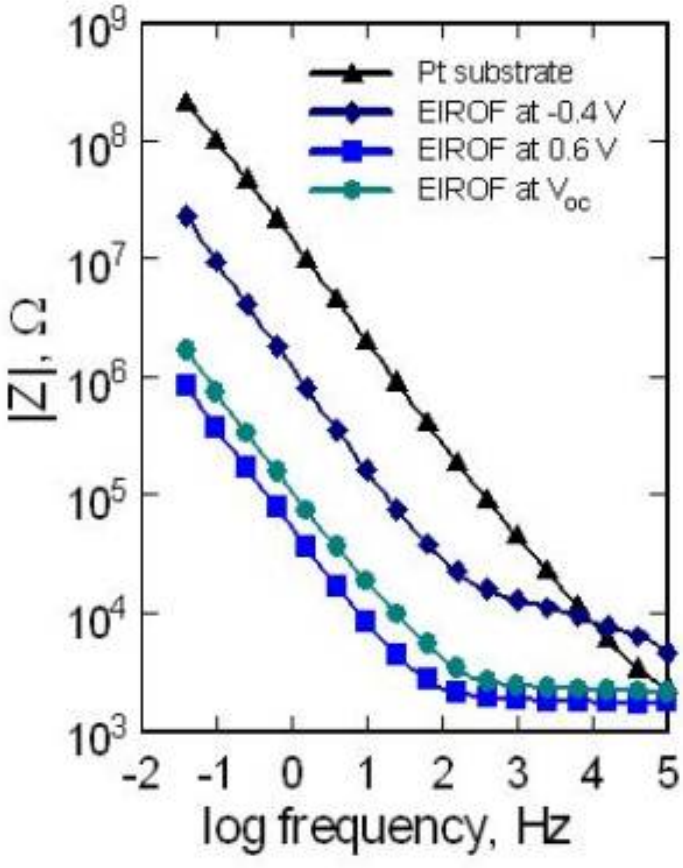
EIS measurements are typically near-equilibrium measurements in which the electrode is subjected to a low amplitude sinusoidal voltage or current waveform and the impedance calculated from the magnitudes of the voltage and current waveforms and the phase angle between them. EIS spectra are used for the following:

- to determine relative charge-injection capacities for stimulation
- to determine likely thermal noise contributions for neural recording
- to differentiate between changes in electrolyte environment or degradation of electrode coatings
- to assess electrode stability during long-term testing
- to investigate reaction mechanisms

Most impedance measurements are made with the excitation imposed around the open-circuit potential of the electrode being testing. In some circumstances, the potential of the electrode may be deliberately maintained at an off-equilibrium potential to investigate reaction mechanisms or changes in the electrode as a function of potential.
Impedance spectra are typically presented as Bode plots of log frequency versus log impedance magnitude or as Nyquist plots of the real versus imaginary components of the complex impedance. Examples of impedance spectra for various materials are provided below.



EIROF deposited on a platinum electrode reduces impedance over a broad frequency range. The EIROF has a cathodal charge storage capacity (CSCc) of 25 mC/cm2. The measurements were made in PBS at room temperature.



The impedance of EIROF is potential dependent. At a potential of 0.6 V (vs. Ag|AgCl) the EIROF is highly conductive and provides a low impedance interface between the electrode and buffered saline in which the measurements were made. As the EIROF potential is made negative, -0.4 V Ag|AgCl in this example, the film transitions from an electronically conducting to insulating state with corresponding increase in electrode impedance.

Limitations: The use of test results and test articles for any application is the sole responsibility of the end-user. Results of in vitro testing do not establish in vivo safety. The performance of electrodes and electrode devices and the robustness of encapsulation may depend on the manner of use, post-fabrication history, and other factors that are not predictable.