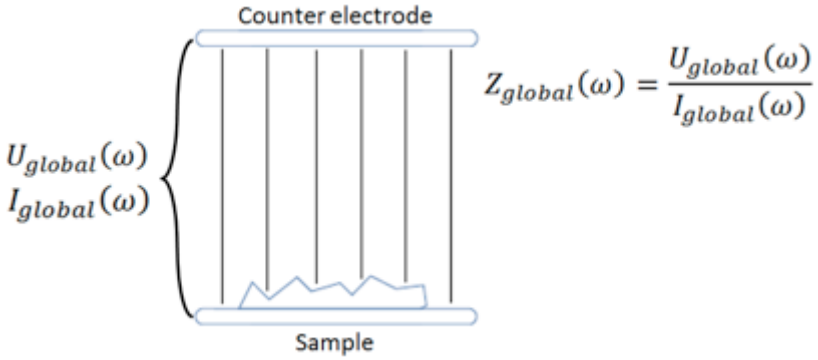
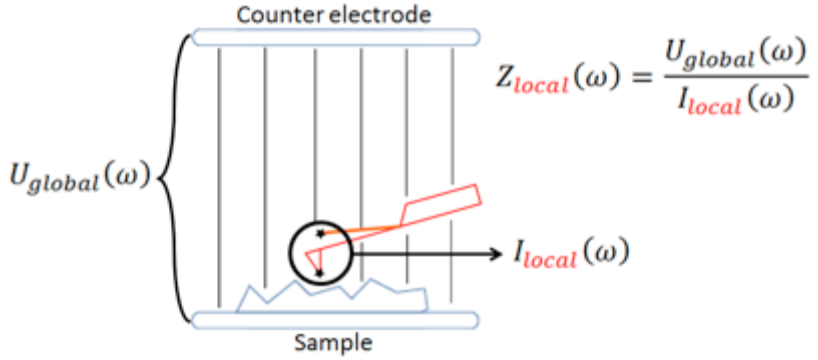
Local Electrochemical Impedance Spectroscopy - LEIS

Electrochemical Impedance Spectroscopy (EIS) consists of applying a periodic voltage across a sample and a counter electrode. This excitation signal will cause a current to flow between both electrodes. As the excitation signal is a superposition of multiple sinusoidal signals at chosen frequencies, the resulting current will also contain components at those excited frequencies. Dividing the input voltage by the output current provides the impedance of the system at all excited frequencies. This often results in imaginary numbers, due to the presence of a phase shift between input and output signals. This data may contain information about, for example, barrier properties of coatings and corrosion resistance.



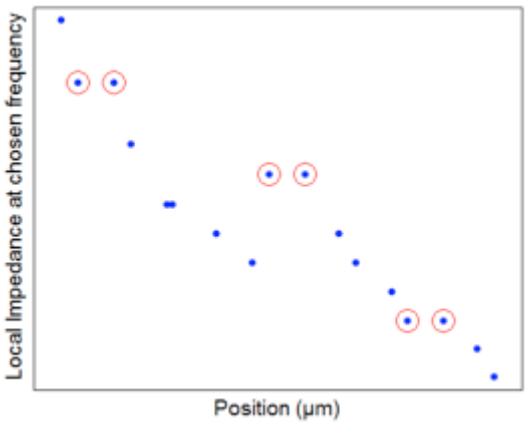
Schematics of a typical Electrochemical Impedance Spectroscopy set-up. Both input potential and output current are measured globally

Local Electrochemical Impedance Spectroscopy (LEIS) is based on the same principle but relies on the local measurement of the output current, which allows calculating the local impedance. This thus provides impedance spectra in all points where such measurement was carried out. The LEIS set-up in the SURF lab is based on an Atomic Force Microscope (AFM), using the same probe for both topographic and LEIS measurements. Therefore, one measurement provides both height information and local impedance data in each point.



Schematics of a typical Local Electrochemical Impedance Spectroscopy set-up. The output current is measured locally with the AFM probe, as required to calculate the Local Impedance

The local determination of the impedance allows making a distinction between the impedances of different areas of the sample's surface. Furthermore, the set-up in the SURF lab allows linking electrochemical properties to topographic features, due to its combination with an AFM.



Local impedance at one frequency as a function of the position along one scan line. This measurement was performed on a test sample with periodic variations, as highlighted by the red circles