Lab-scale EIS Development

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Author(s)	Prathamesh Chikorde	
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Purpose and Application

The Electrochemical Impedance Spectroscopy (EIS) is a highly precise measurement technique to measure the AC resistance (impedance) of various materials and components. It is widely applicable in multiple fields, including electronics, material science, and biomedical research. Impedance measurements provide valuable insights into the electrical properties of components, circuits, and biological tissues, making the device an essential tool for researchers and engineers alike.

In AEL systems, impedance measurements allow for the detailed investigation of electrolyte conductivity, bubble formation effects, and electrode surface changes over time. Since alkaline electrolyzers operate with a liquid electrolyte, understanding the impedance behavior helps optimize electrolyte composition and electrode material choices to enhance efficiency and longevity.

In SOECs, which operate at high temperatures and use ceramic electrolytes, EIS provides insights into the kinetics of oxygen ion transport and degradation mechanisms of the electrodes. By analyzing impedance spectra at different temperatures and operating conditions, material degradation effects can be detected early, leading to improved system durability.

In PEM electrolyzers, impedance measurements are critical for assessing proton conductivity in the membrane, catalyst layer effectiveness, and water management issues. Since PEM electrolyzers rely on a solid polymer electrolyte, EIS enables the detection of membrane hydration levels and degradation pathways such as membrane thinning or catalyst dissolution. This information is vital for improving stack performance and ensuring long-term operational stability.

Electrochemical impedance spectroscopy is known for use in laboratory environments, where it enables precise electrochemical analyses in operando data acquisition and advanced analysis features for remote monitoring. Its capability to operate across a broad frequency range ensures detailed evaluation of electrochemical processes, making it an essential tool for research and development.

With this Deliverable, SIVONIC provides an EIS measurement device which is suitable for the lab-scale validation tests of all three technologies.

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