

21c Application of Electrochemical Impedance Spectroscopy (Eis) in PEM Fuel Cells

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AC Electrochemical Impedance Spectroscopy (EIS) is widely used for investigating the performance of electrochemical systems such as PEM fuel cells. EIS is particularly very useful tool for fuel cell performance evaluation and design. It consists of measuring the changes in electrical impedance of fuel cell system upon a variation in frequency of an oscillating current or voltage over a large frequency range (typically 0.1 Hz to 10^7 Hz). The data are reported in the complex impedance plane (Z' , Z'') and analyzed after establishing an equivalent circuit to represent the dynamic characteristics of the system. Various types of equivalent circuit models are used to interpret EIS spectroscopy based on lumped components. Also, the distributed zones in fuel cells can be modeled by transmission line models.

In the present study, our objective is to utilize the capability of the AC impedance method to understand the electrochemical losses in PEM fuel cells under various experimental conditions such as temperature, humidification, reactant and oxidant flow rates and catalyst loading. The main losses in fuel cell consists of ohmic types of losses due to electrolyte, charge transfer losses due to slow oxygen kinetics, double layer capacitance and diffusional resistance in the electrodes. Some reports also show the presence of inductance due to formation of some passive layer on the electrode surface. Hence, this paper is devoted to understand electrochemical phenomena taking place in fuel cells. Also, state of the art impedance models will be described to characterize the performance of fuel cells.