

**Wolfson Department of Chemical Engineering Seminar
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Online seminar via Zoom

<https://technion.zoom.us/j/96214023785>

Studying the Effect of Operating Conditions and CO₂ Cathode Contamination on PEMFCs Using Distribution of Relaxation Times Analysis

Gal Avioz Cohen

Grand Technion Energy Program (GTEP)

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Advisor: Prof. Yoed Tsur

Polymer electrolyte membrane fuel cells (PEMFCs) are considered environmentally friendly energy convertors, exhibiting many advantages, including low operating temperatures (70-100 °C), high power density (~1.4 kW/kg), high electrical efficiency (40-60%), quiet operation, and low emissions. However, challenges like cost and durability remain barriers to the sustainable commercialization of PEMFCs technologies. In particular, PEMFC's contamination, caused by impurities in feed streams, contribute significantly to durability issues. Intensive R&D thus still needed for PEMFC technology development.

EIS has played an essential role in PEMFCs' research as a diagnostic tool. EIS's main advantage is in identifying the contributions from different components or processes within the PEMFC to the total impedance. In order to perform contributors' identification correctly, a reliable method for analyzing EIS data is needed. For that, we have used Impedance Spectroscopy Genetic Programming (ISGP) as an analysis tool.

In the following research, EIS measurements were performed *in operando* on PEMFCs, and the ISGP analysis method was implemented for the first time on data derived from PEMFCs. We demonstrated that this analysis method yields a consistent model that include the major contributors to the total impedance. In addition, by changing the operating conditions of the PEMFC, we gained further information on the fundamental processes within the fuel cell. Then, the obtained model was used in a contamination study. In this part, PEMFCs were operated under different CO₂ cathode contamination levels, and *in operando* EIS measurements were performed. The data was analyzed using ISGP and according to the previously obtained model, revealing the effect of CO₂ cathode contamination on each of the fundamental processes within the fuel cell. This work can be further continued to the study of many PEM FC's contaminations.