



Hawai'i Natural Energy Institute Research Highlights

Electrochemical Power Systems

Advanced Characterization of PEMFC with Open Flow Field Architecture

OBJECTIVE AND SIGNIFICANCE: Proton exchange membrane fuel cells (PEMFCs) are energy conversion devices that offer high power densities at low operating temperatures making PEMFCs the most promising technology for many applications, such as automobiles, back-up power generating units, and portable devices. Commercial PEMFC systems utilize open flow field (OFF) architectures ensuring high power generation and excellent performance at high currents. The project objective is to conduct a detailed evaluation of PEMFCs employing OFF design using advanced approaches like electrochemical impedance spectroscopy (EIS) and segmented cell system.

BACKGROUND: Application of a conventional land-channel flow field architecture for PEMFC results in non-uniform performance over the active area of membrane electrode assembly (MEA) due to incremental O₂ consumption from air stream, water production and accumulation. These results lead to higher performance of the inlet of the fuel cell and lower performance at the outlet. In order to address this nonhomogeneous performance, open flow field architecture is applied for commercial PEMFCs (Figure 1). The main benefits of metal based OFF are its high durability and cost-effectiveness. Moreover, OFF increases utilization of MEA geometrical area.

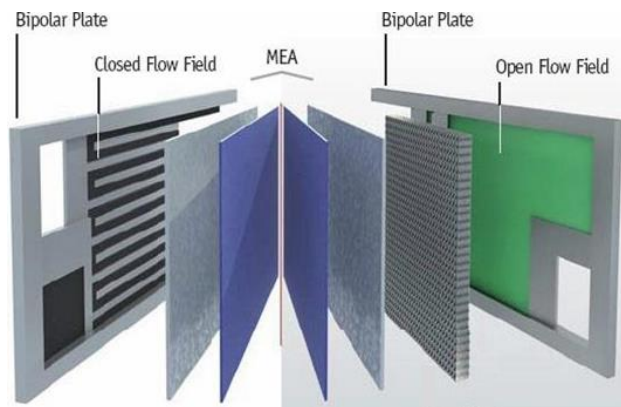


Figure 1. Schematic representation of fuel cell with open flow field.

Previously, HNEI developed a segmented cell system to study non-uniform phenomena in a working fuel cell. The segmented cell system

allows us to record current/voltage/impedance responses from 10 segments simultaneously and provide valuable information on local performance (Figure 2).

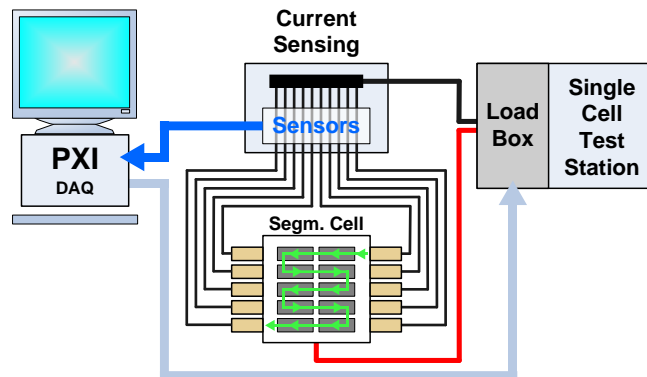


Figure 2. Schematic of segmented cell system.

PROJECT STATUS/RESULTS: Under this effort, HNEI has reached the following results:

- Demonstrated feasibility of incorporation of the OFF to HNEI's segmented cell system;
- OFF ensured uniform performance over MEA compared to the conventional land-channel flow field architecture;
- OFF demonstrated superior performance than the land-channel flow field especially in high power generating conditions; and
- OFF ensures better heat transfer and dissipation, which is important for operation at high current.

Future work will include a continuation of studies of PEMFCs with the OFF.

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