IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO - IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

TUBULAR PEM FUEL CELL AND CELL STACK THEREOF

IITM Technology Available for Licensing

Problem Statement

- Environmental pollution at the current state of fossil fuel consumption has led clean energy devices like **proton exchange membrane fuel cells (PEMFCs) to emerge as alternative energy generation solutions**. However, the use of PEMFCs for portable applications is less feasible because of the heavy subsystems which are required for its efficient operation.
- Fuel cells produce less than ideal voltage outputs **due to the ohmic losses within the fuel cell caused by electronic impedances through the electrodes**, contacts, and current collectors. Therefore, **stack component development, diagnosis, and management are essential** to ensure improved stack design and operation for tackling the existing implementation challenges of PEMFCs.
- Additionally, improving PEMFCs performance and durability can be achieved by **fundamentally understanding and tuning their catalyst layer structures** and compositions.

Technology Category/ Market

- **Energy Storage**
- **Fuel Cells**

Applications - Powering Buildings, Cars or Trucks to Portable electronic devices and Backup Power Systems.

Market - The global proton exchange membrane fuel cell (PEMFC) market was valued at **USD 5.16 billion in 2021** and is expected to expand at a **CAGR of 15.6% from 2022 to 2030.**

Technology

- The present technology is a **tubular proton exchange membrane fuel cell** and a **fuel cell stack** with a number of single fuel cells in a modular arrangement for larger energy requirements through the **integration of several base stacks.**

Fuel cell - Parts

An anode current collector tube provided with slots comprising a fuel inlet and a fuel outlet, a membrane electrode assembly (MEA) wrapped around the anode tube to allow contact between an anode gas diffusion layer and the anode tube.

A cathode current collector tube comprising two hollow semi cylindrical components placed over a cathode gas diffusion layer, wrapped around the MEA and a plurality of compression ties wrapped around the cathode tube to compress the MEA.

The slots in the anode tube allow the fuel supplied to the tube to reach an anode catalyst layer.

The cathode tube has slots of optimal rib thickness on the tube to allow the cell to breathe air from the atmosphere.

Intellectual Property

- IITM IDF Ref. **1700**
- **IN 422977 - Patent Granted**
- PCT/IN2019/050562 - Published
- Australia National Phase Appl. No.2019323842

Key Features / Value Proposition

- This tubular **PEMFC** and a fuel cell stack provides significantly **greater volumetric power density.**
- Stable electronic conductivity.
- Easy to mass-produce.
- The proposed fuel cell and stack provides optimized operating conditions, **significant reduction in volume, and weight without the need for required supporting equipment**.

TRL (Technology Readiness Level)

TRL - 4 / 5, Experimentally demonstrated at lab environment.

Research Lab

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Fuel Cell Stack - Parts

- A Plurality of tubular fuel cells connected in series or parallel and forming the stack having two ends. The optimal breathing space between two cells in a stack is in the range of **1-10 mm**.
- A **Support plate** placed at either end of the fuel cell stack to hold the cells in the stack together.
- A **Gas flow distribution plate** to distribute fuel to individual cells, and
- A Plurality of **threaded rods** to compress the support plates to **prevent fuel leak.**

Images

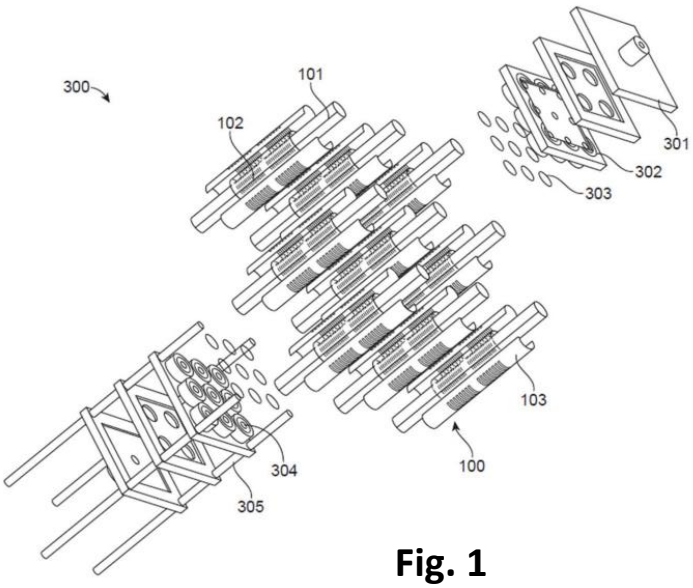

Fig. 1

Fig. 1 Exploded view of tubular PEM fuel cell stack.

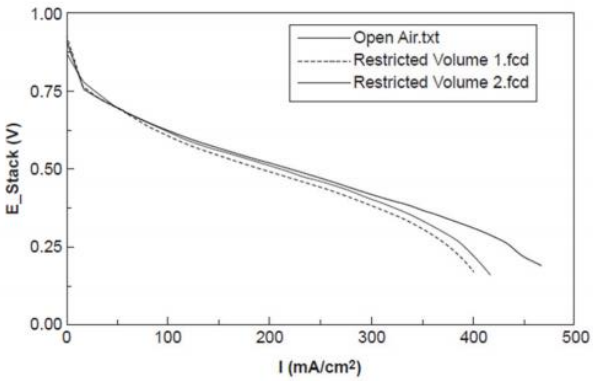

Fig. 3

Fig. 3 shows performance of single cell in open ambient air.

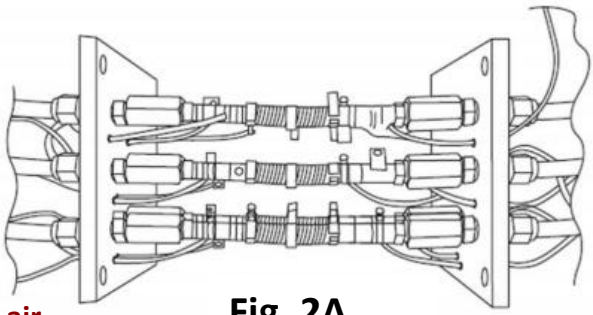

Fig. 2A

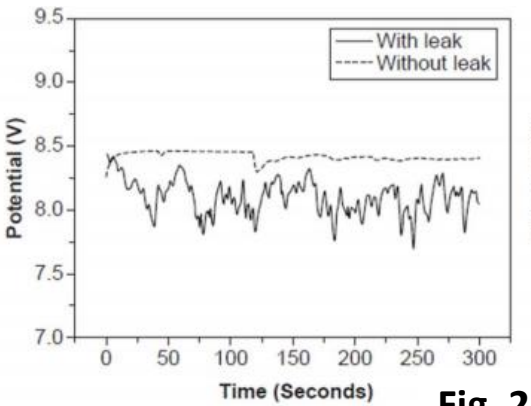

Fig. 2B

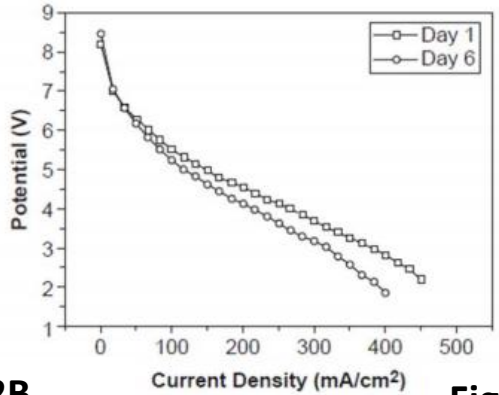

Fig. 2C

Fig. 2A Stack prototype of tubular PEM fuel cell.
Fig. 2B Open Circuit Voltage (OCV) of initial prototype stack before and after leak prevention.
Fig. 2C Polarization curves of initial stack prototype.

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