

FUEL CELL

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* INTRODUCTION

- A fuel cell is an electrochemical energy conversion device. A fuel cell converts the chemicals hydrogen and oxygen into water and in the process it produces electricity.
- It is much like a battery that can be recharged while you are drawing Power from it.
- it provides a DC voltage that can be used to power motors, light and any number of electrical appliances.
- fuel cell was first demonstrated by welsh scientist Sir William Robert Grove in February 1839.



* FUEL CELL VS BATTERY

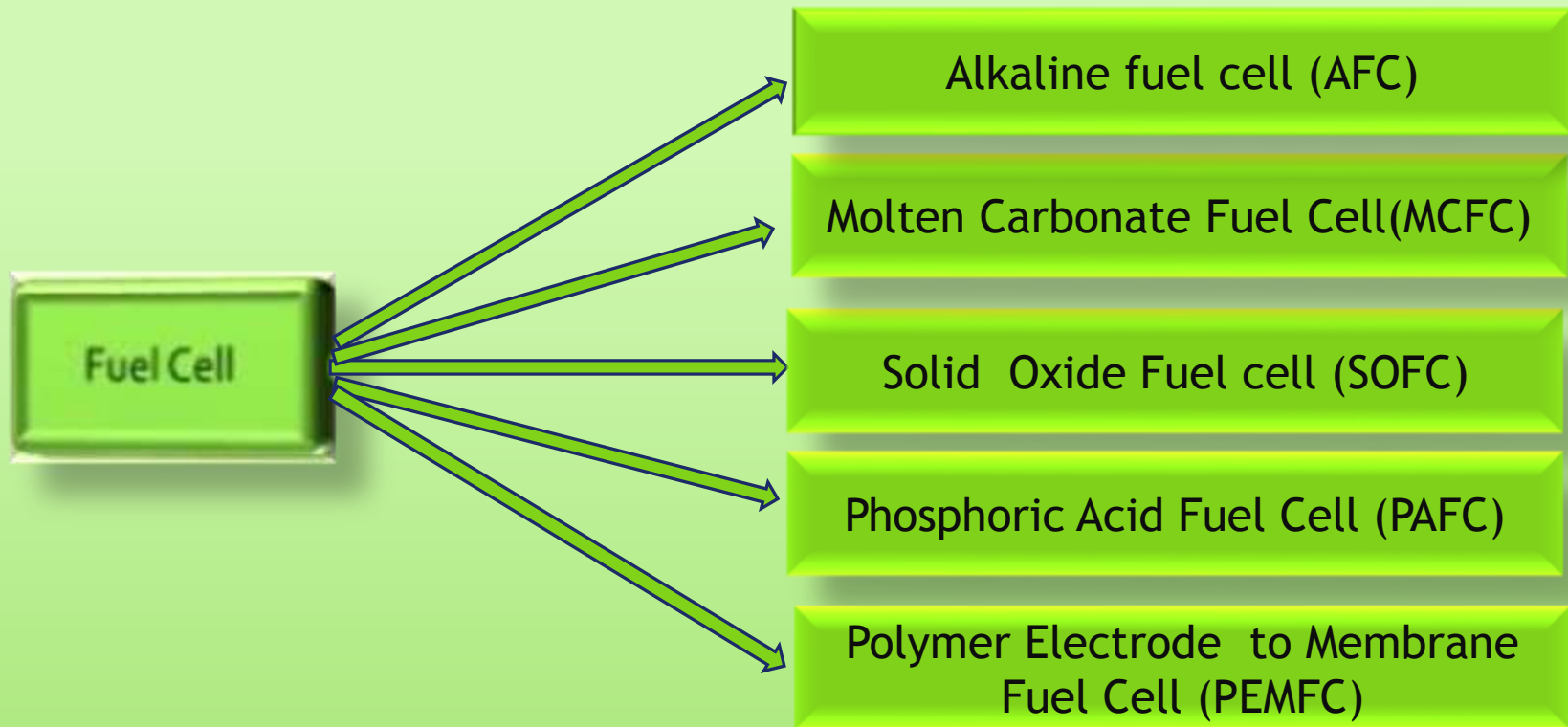
❖ FUEL CELL

- ✓ In a fuel cell, chemicals constantly flow into the cell so it never goes dead.
- ✓ As long as there is a flow of chemicals into the cell, the electricity flows out of the cell.

❖ BATTERY

- ✓ A battery has all of its chemicals stored inside, and it converts those chemicals into electricity too. This means that a battery eventually "goes dead."
- ✓ But in case of battery it eventually "goes dead" we either throw it away or recharge it

* TYPES OF FUEL CELLS



* PARTS OF FUEL CELL

Anode & Cathode

- Materials which have high electron conductivity & zero proton conductivity in the form of porous catalyst (porous catalyst or carbon).

Catalyst

- Platinum

Electrolyte

- High proton conductivity & zero electron conductivity.

* *The Anode*

- The anode is the negative post of the fuel cell.
- It conducts the electrons that are freed from the hydrogen molecules so that they can be used in an external circuit.
- It has channels etched into it that disperse the hydrogen gas equally over the surface of the catalyst.

* *The Cathode*

- The cathode is the positive post of the fuel cell.
- It has channels etched into it that distribute the oxygen to the surface of the catalyst.
- It also conducts the electrons back from the external circuit to the catalyst, where they can recombine with the hydrogen ions and oxygen to form water.

* *The Catalyst*

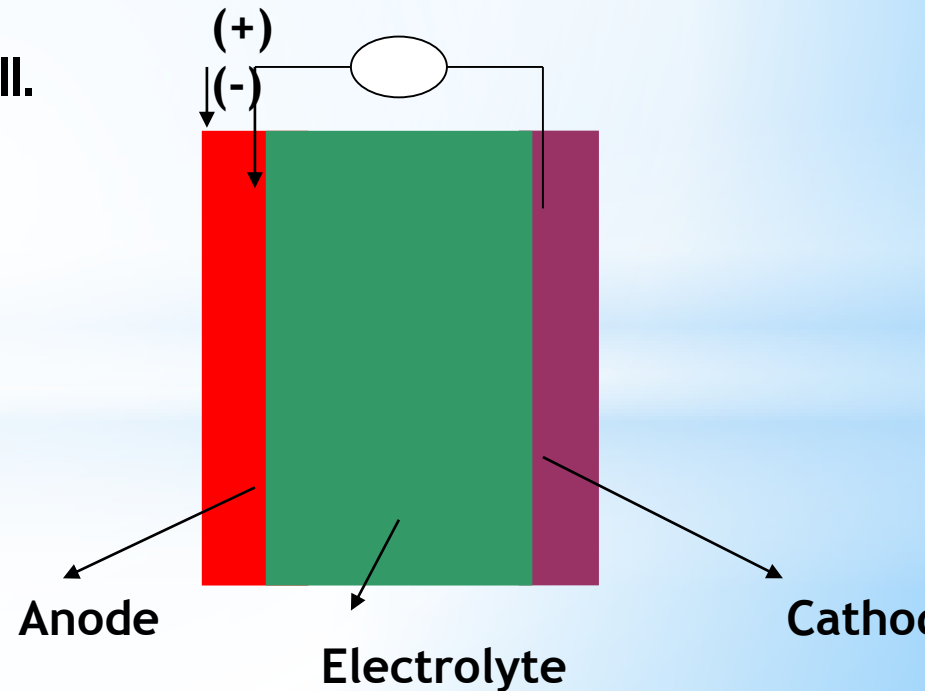
- The catalyst is a special material that facilitates the reaction of oxygen and hydrogen.
- It is usually made of platinum powder very thinly coated onto carbon paper or cloth. The catalyst is rough and porous so that the maximum surface area of the platinum can be exposed to the hydrogen or oxygen.
- The platinum-coated side of the catalyst faces the PEM.

* *The Proton Exchange Membrane*

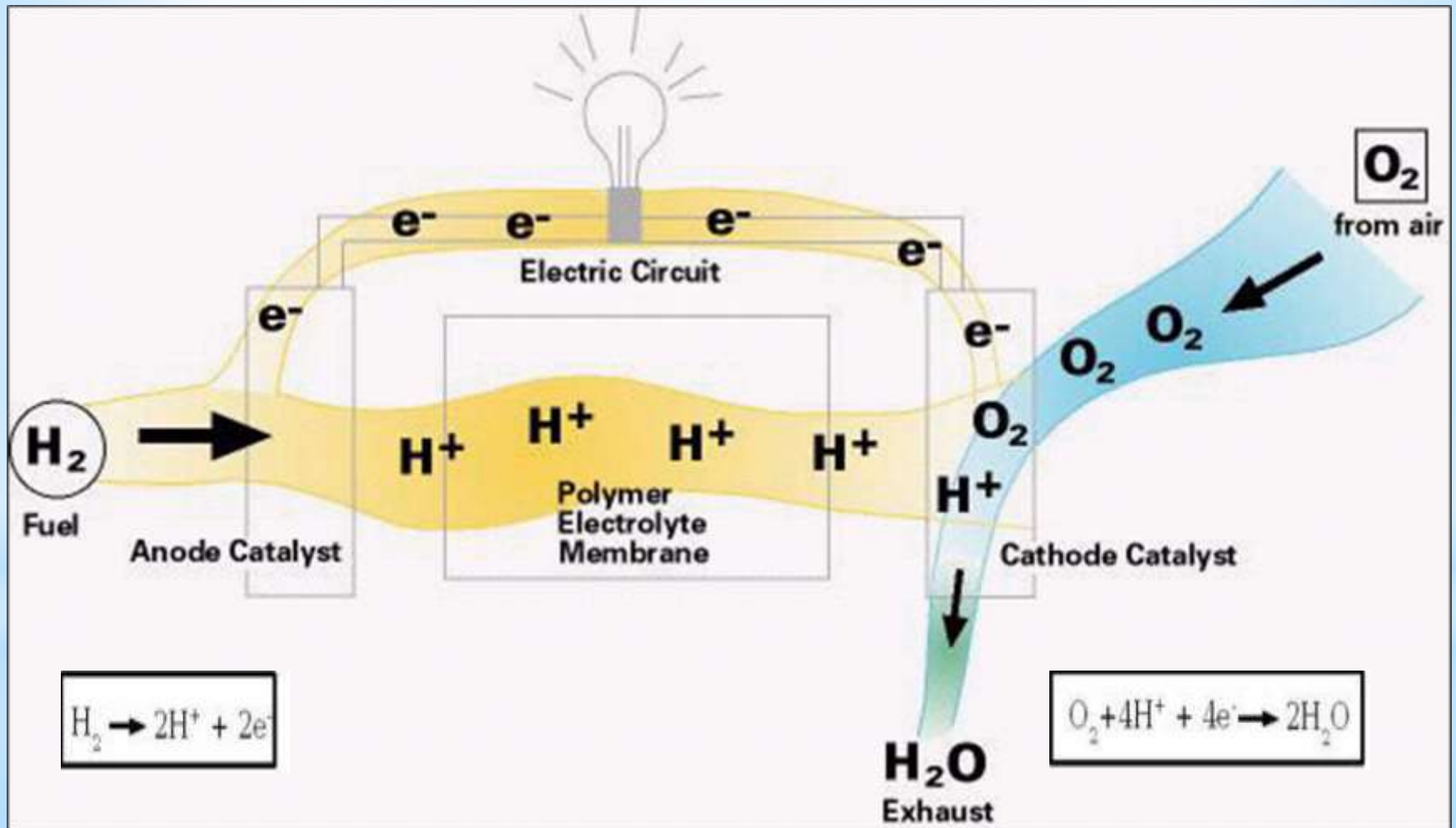
- The electrolyte is the proton exchange membrane.
- This is a specially treated material that only conducts positively charged ions.
- The membrane blocks electrons.

* FUEL CELL THEORY

- A fuel cell consists of two electrodes - Anode and Cathode and sandwiched around an electrolyte.
- An electrolyte is a substance, solid or liquid, capable of conducting moving ions from one electrode to other.
- Hydrogen and Oxygen are fed into the cell.

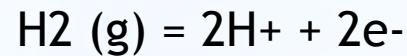


* FUEL CELL WORKING



* Cont.....

The Fuel gas (hydrogen rich) is passed towards the anode where the following oxidation reaction occurs:



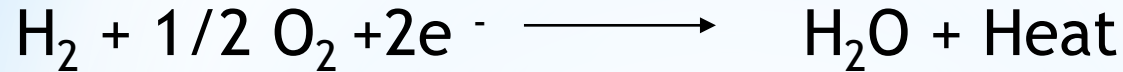
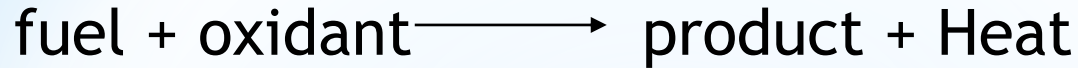
The liberated electrons from hydrogen in anode side do not migrate through electrolyte.

Therefore, they pass through the external circuit where work is performed, then finally go into the cathode.

On the other hand, the positive hydrogen ions (H^+) migrate across the electrolyte towards the cathode.

At the cathode side the hydrogen atom reacts with oxygen gas (from air) and electrons to form water as byproduct according to:

The overall cell reaction is



The liberated electrons from the hydrogen are responsible for the production of electricity.

The water is produced by the combination of hydrogen, oxygen and liberated electrons and is sent out from the cell.

The DC current produced by fuel cell is later converted into AC current using an inverter for practical application.

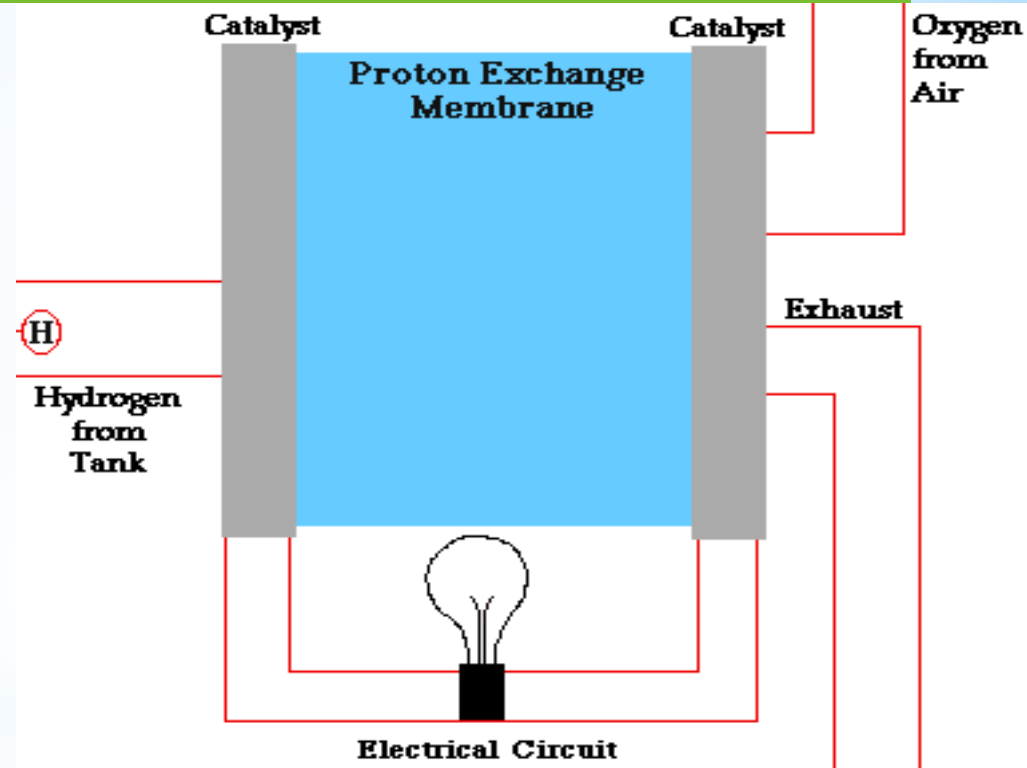
The voltage developed in a single fuel cell varies from 0.7 to 1.4 volt.

More power can be obtained by arranging the individual fuel cell as a stack. In this case, each single cell is sandwiched with one another by an interconnect.

Therefore, electricity power ranging from 1 kW to 200 kW can be obtained for domestic as well as industrial application.

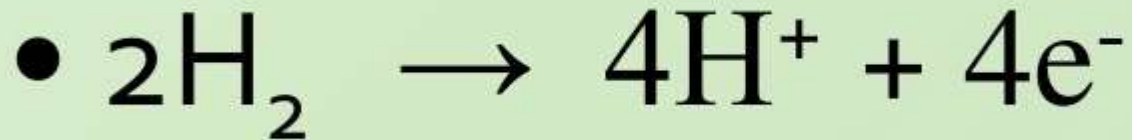
* Graphic showing working of Fuel Cell

- Pressurized hydrogen gas (H_2), enters the fuel cell on the anode side .
- Oxygen gas (O_2) is forced through the catalyst on the Cathode side
- This reaction in a single fuel cell produces about 0.7 volts

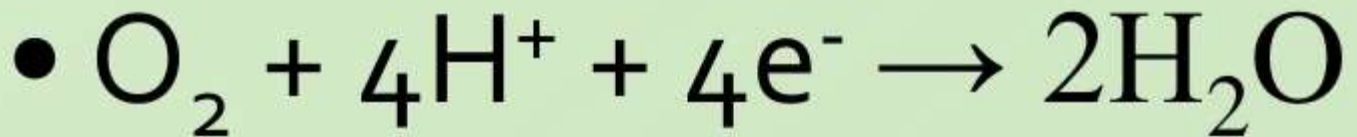


* THE CHEMISTRY OF A FUEL CELL

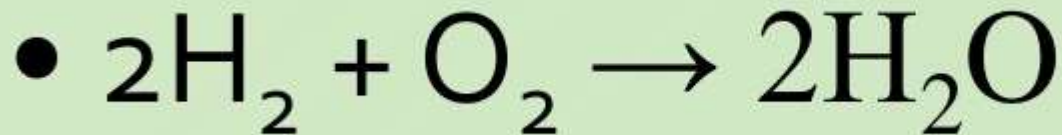
At
anode



At
cathode



Overall
reaction



* ADVANTAGES

- **Zero Emissions:** a fuel cell vehicle only emits water vapour. Therefore, no air pollution occurs.
- **High efficiency:** Fuel cells convert chemical energy directly into electricity without the combustion process. As a result, Fuel cells can achieve high efficiencies in energy conversion.
- **High power density:** A high power density allows fuel cells to be relatively compact source of electric power, beneficial in application with space constraints.
- **Quiet operation:** Fuel cells can be used in residential or built-up areas where the noise pollution can be avoided.
- **No recharge:** Fuel cell systems do not require recharging

* *DISADVANTAGES*

- It is difficult to manufacture and stores a high pure hydrogen.
- It is very expensive as compared to battery.
- Large weight and volume of gas fuel storage system.

* APPLICATIONS

- The first commercial use of fuel cell was in NASA space program to generate power for satellites and space capsules.
- They are used to power fuel vehicles including automobiles, Aeroplanes , Boats and Submarines.



Portable power for laptop



Nokia mobile with fuel cell battery



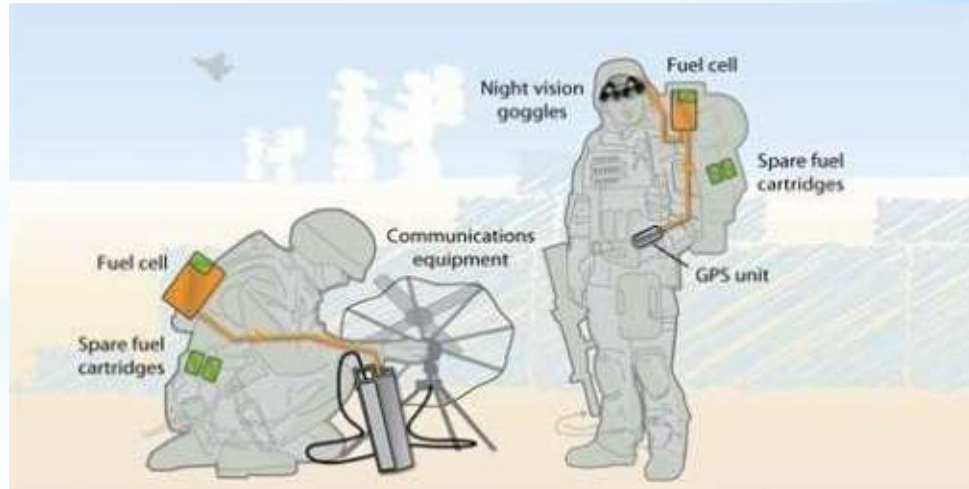
Wheel chair powered by fuel cell



Toshiba mp3 with a fuel cell



Fuel cell vehicle 2003 HONDA



Communication equi. Powered by fuel cell

* MAJOR ORGANIZATIONS WORKING IN THE FIELD

- Ministry of NCES
- IITS
- CSIR labs
- BHEL
- GAIL
- BARC
- MIT

* RECENT DEVELOPMENT

- ❖ LLC,NY has successfully developed 50KW power plant.
- ❖ fuel cell of capacity 1.5 KW powering houses in Australia.
- ❖ GAIL is actively involved in establishing fuel infrastructure for fuel cell vehicles in INDIA.

* CONCLUSION

- The above discussion prove the existence of huge Market for fuel cell.
- future cities can be planned on fuel cell system for their power and energy requirements.



REFERENCE

- WWW.seminaronly.com
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- www.slideshare.net
- www.seminatopics.com

ANY

QUERIES...?

