

# Fuel cell

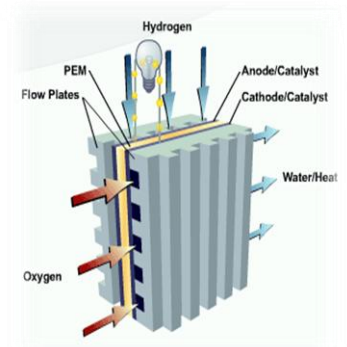
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One of the biggest topics of research which is very useful in improving the life style of human beings, to reduce pollution and will be helpful in many other things is the fuel cell, an eco-friendly device which produces electricity.

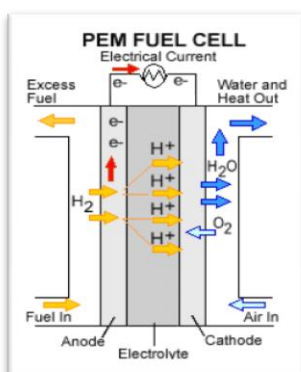
The fuels used in the fuel cell are methanol, hydrogen, oxygen etc. The principle behind the fuel cell was given by the German scientist Fredrich Schonbein in 1838, and on the basis of his idea Welsh scientist and barrister Sir William Robert Grove made the first fuel cell in 1839. There are many kinds of fuel cells like Proton exchange membrane fuel cell, Oxygen exchange fuel cell, Direct methanol fuel cell, Direct formic acid fuel cell, Solid oxide fuel cell etc. Each fuel cell works in a particular required environment (temperature, pressure, etc.)

The basic requirements of the fuel cell are :

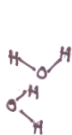
- (1) **the electrolyte** used should be conducting (eg.  $\text{NaOH}$ ,  $\text{CuSO}_4$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{KOH}$  etc)
- (2) **a proton exchange membrane** which should be highly permeable to protons alone, should be chemically stable, and have high thermal stability (eg. Nafion)
- (3) **a catalyst** which is mainly coated on the cathode and anode (like platinum black). There are certain types of catalysts which reduce the sensitivity towards impurities as well as increase the efficiency of the fuel cell (like  $\text{Pt}_3\text{Ni}$ ).



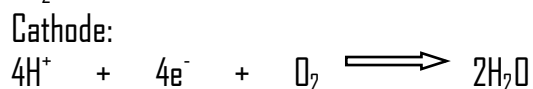
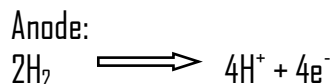
We need fuel cells that work at room temperature so they can be helpful to us in our daily electricity-led lives without creating pollution. But up to now the lowest temperature required for efficient working of a fuel cell is more than the room temperature ( around  $50^\circ\text{C}$  ).



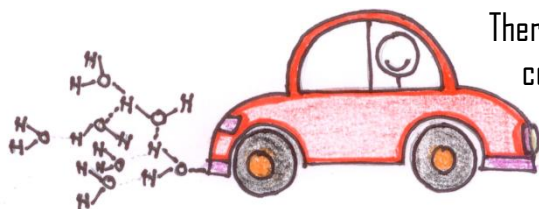
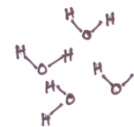
Here I mainly discuss the Proton Exchange Membrane (PEM) Fuel Cell .The PEM technology was developed by Russell Hodgdon (while in General Electric ) in the early 1960's. This cell was called 'Solid Polymer Electrolyte fuel cell' (SPEFC) in the early 1970's before the proton exchange mechanism was well understood. In this type of cell the anode and cathode are made up of carbon rods coated with platinum black. There is a proton conducting polymer membrane which separates the anode and cathode. On the anode hydrogen gas diffuses and gets oxidized to protons, simultaneously oxygen diffuses at the cathode and gets reduced to oxygen ions. Now the protons from the anode side move toward the cathode through the PEM and combine with oxygen ions to form water. This creates a huge amount of energy.



The reactions involved in this cell are :



Total emf of the cell is 1.299 eV.



There is a huge scope for applications of the fuel cell. The PEM fuel cell was used by NASA in the "GEMINI" program as well as many other projects. NASA thus found an indispensable part of their projects. The German navy has used submarines run by fuel cell.



Fuel cells can be used in interesting situations because of their versatility. One such example is of a fuel cell coupled with a waste-water treatment plant. The methane generated by bacterial fermentation is fed into the the fuel cell, which then generates clean energy ; this energy is in turn used to treat the same water.



There is much scientific-drive in this field of research, as to enable fuel cells to become a practical, feasible technology. In the current quest for new sources of renewable energy, fuel cells play an integral role, and who knows, the next time you read about fuel cells is when you're buying one !

## References:

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- 3) [www.fuelcell.com](http://www.fuelcell.com)
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