



1. What is a fuel cell, and how does it work?
2. What are the chemical reactions that occur within a fuel cell?
3. How do fuel cells convert chemical energy into electrical energy?
4. What are the key components of a fuel cell, and what roles do they play?
5. What are the advantages of fuel cells over traditional energy sources (e.g., fossil fuels)?
6. How are fuel cells being applied in industries such as transportation, energy generation, and electronics?
7. What environmental benefits do fuel cells offer compared to conventional energy technologies?
8. How can fuel cells contribute to reducing greenhouse gas emissions and promoting sustainability?

Definition

Fuel cell is a voltaic cell, which converts the chemical energy of the fuels directly into electricity without combustion. It converts the energy of the fuel directly into electricity. In these cells, the reactants, products and electrolytes pass through the cell.

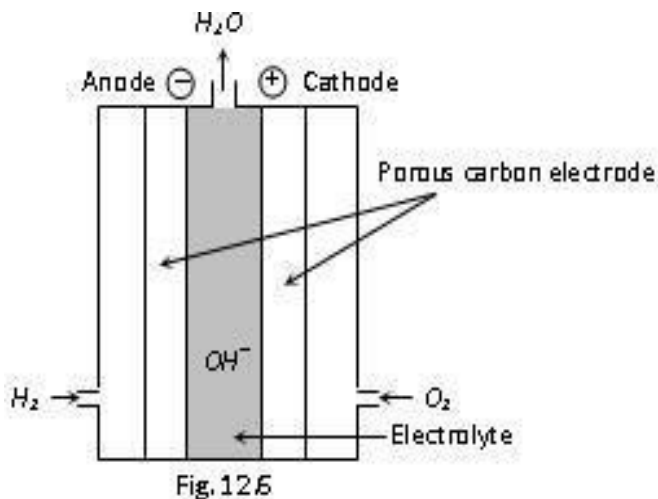
Fuel + Oxygen \longrightarrow Oxidation products + Electricity.

Examples

Hydrogen-oxygen fuel cell; Methyl alcohol-oxygen fuel cell.

Hydrogen-Oxygen fuel cell

Hydrogen-oxygen fuel cell is the simplest and most successful fuel cell, in which the fuel-hydrogen and the oxidizer-oxygen and the liquid electrolyte are continuously passed through the cell.



Description

It consists of two porous electrodes anode and cathode. These porous electrodes are made of compressed carbon containing a small amount of catalyst (Pt, Pd, Ag). In between the two electrodes an electrolytic solution such as 25% KOH or NaOH is filled. The two electrodes are connected through the voltmeter.

Working

Hydrogen (the fuel) is bubbled through the anode compartment, where it is oxidised. The oxygen (oxidiser) is bubbled through the cathode compartment, where it is reduced.

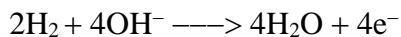
At cathode

The electrons produced at the anode pass through the external wire to the cathode, where it is absorbed by oxygen and water to produce hydroxide ions.



At anode

Hydrogen molecules are oxidised at the anode with the liberation of electrons, which then combine with hydroxide ions to form water.





Cell reaction

At anode: $2\text{H}_2 + 4\text{OH}^- \longrightarrow 4\text{H}_2\text{O} + 4\text{e}^-$

At cathode: $\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^- \longrightarrow 4\text{OH}^-$

Overall cell reaction: $2\text{H}_2 + \text{O}_2 \longrightarrow 2\text{H}_2\text{O}$

The emf of the cell = 0.8 to 1.0V

Fuel battery

When a large number of fuel cells are connected in series, it forms fuel battery.

Applications

1. H_2O_2 fuel cells are used as auxiliary energy source in space vehicles, submarines or other military-vehicles.
2. In case of H_2O_2 fuel cells, the product of water is proved to be a valuable source of fresh water by the astronauts.

True or False

1. Fuel cells produce electricity by burning hydrogen (True or False)
2. The only byproduct of a hydrogen fuel cell is water (True or False)
3. Fuel cells are more efficient than internal combustion engines (True or False)
4. Fuel cells require a constant supply of fuel and oxygen to operate (True or False)
5. Fuel cells store energy like a battery (True or False)
6. Hydrogen is the only fuel that can be used in all fuel cells. (True or False)
7. Fuel cells can be used to power vehicles. (True or False)