



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)



UNIT-III- Fuel cells



Fuel cells



Fuel cells require a continuous input of fuel and an oxidizing agent (generally oxygen) in order to sustain the reactions that generate the electricity.

Therefore, these cells can constantly generate electricity until the supply of fuel and oxygen is cut off. fuel cells began commercial use only a century later when they were used by NASA to power space capsules and satellites. Today, these devices are used as the primary or secondary source of power for many facilities including industries, commercial buildings, and residential buildings.

A fuel cell is similar to electrochemical cells, which consists of a cathode, an anode, and an electrolyte. In these cells, the electrolyte enables the movement of the protons

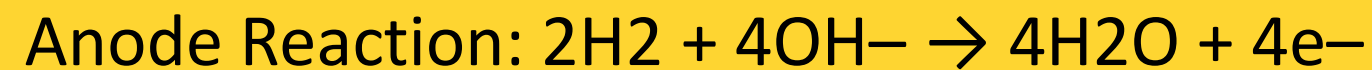
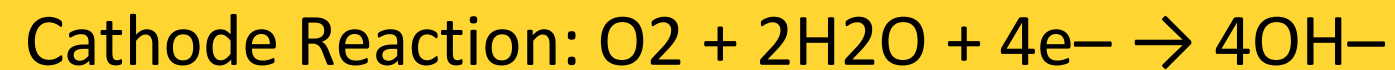


Working of Fuel cells



The reaction between hydrogen and oxygen can be used to generate electricity via a fuel cell. Such a cell was used in the Apollo space programme and it served two different purposes – It was used as a fuel source as well as a source of drinking water (the water vapour produced from the cell, when condensed, was fit for human consumption).

The working of this fuel cell involved the passing of hydrogen and oxygen into a concentrated solution of sodium hydroxide via carbon electrodes. The cell reaction can be written as follows:



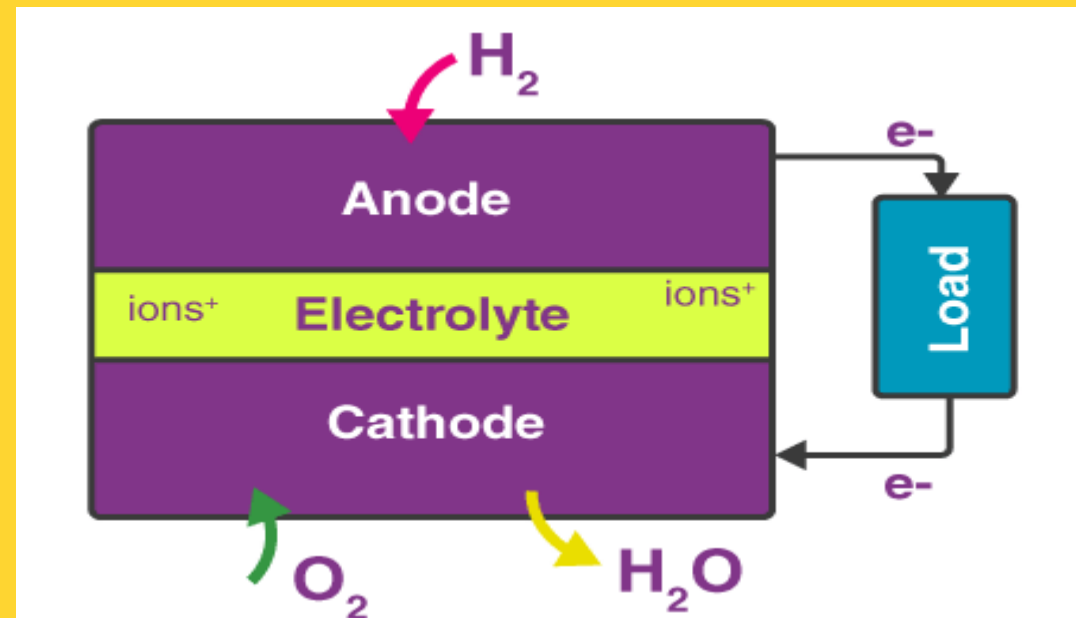
However, the reaction rate of this electrochemical reaction is quite low. This issue is overcome with the help of a catalyst such as platinum or palladium. In order to increase the effective surface area, the catalyst is finely divided before being incorporated into the electrodes.



Working of Fuel cells



The efficiency of the fuel cell described above in the generation of electricity generally approximates to 70% whereas thermal power plants have an efficiency of 40%. This substantial difference in efficiency is because the generation of electric current in a thermal power plant involves the conversion of water into steam, and the usage of this steam to rotate a turbine. Fuel cells, however, offer a platform for the direct conversion of chemical energy into electrical energy.





Types of Fuel Cells



- 1. Proton Exchange Membrane Fuel Cells (PEMFC):** These operate at relatively low temperatures (usually around 80°C) and are commonly used in transportation (like fuel cell vehicles) and stationary power generation.
- 2. Solid Oxide Fuel Cells (SOFC):** SOFCs operate at higher temperatures (around $800-1000^{\circ}\text{C}$) and are suitable for stationary power generation applications due to their high efficiency.
- 3. Molten Carbonate Fuel Cells (MCFC):** MCFCs operate at high temperatures (around 650°C) and are often used for large-scale power plants.
- 4. Alkaline Fuel Cells (AFC):** AFCs use an alkaline electrolyte and have been used in space missions by NASA.



Applications of fuel cell



Fuel cell technology has a wide range of applications. Currently, heavy research is being conducted in order to manufacture a cost-efficient automobile which is powered by a fuel cell. A few applications of this technology are listed below.

Fuel cell electric vehicles, or FCEVs, use clean fuels and are therefore more eco-friendly than internal combustion engine-based vehicles.

They have been used to power many space expeditions including the Appolo space program.

Generally, the byproducts produced from these cells are heat and water.

The portability of some fuel cells is extremely useful in some military applications.

These electrochemical cells can also be used to power several electronic devices.

Fuel cells are also used as primary or backup sources of electricity in many remote areas.



Advantages of Fuel Cells



- **High Efficiency:** Fuel cells are more efficient than internal combustion engines in converting fuel to energy.
- **Clean Energy:** They produce electricity with minimal or zero emissions, depending on the fuel source.
- **Versatility:** They can be used in various applications, including vehicles, stationary power generation, and portable devices.
- **Reduced Dependence on Fossil Fuels:** If hydrogen is used as a fuel, fuel cells can reduce dependence on fossil fuels.



THANK YOU