FUEL CELL

It is feasible to construct batteries where reactants are continuously supplied to the electrodes. Electrical cells designed to convert the liberated energy from the combustion of fuels such as hydrogen, carbon monoxide, or methane directly into electrical energy are termed Fuel Cells. One notably successful fuel cell employs the reaction of hydrogen with oxygen to generate water (see figure). This cell played a vital role in providing electric power during the Apollo space programs, with the produced water vapor condensed and added to the astronauts' drinking water supply. In this cell (depicted in the figure), hydrogen and oxygen are passed through a porous carbon electrode into a concentrated aqueous sodium hydroxide solution, with catalysts integrated into the electrode.

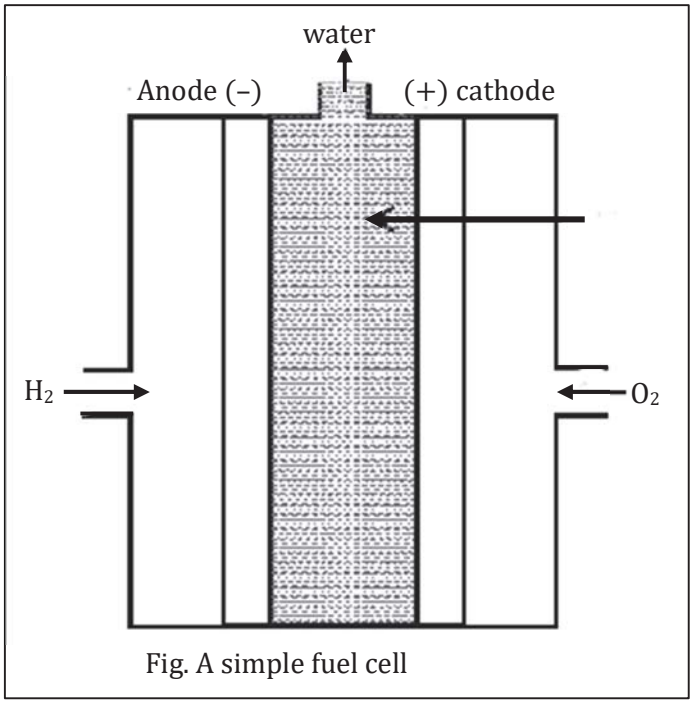

Fig. A simple fuel cell

The electrode reactions are:

Anode $2[H_2(g) + 2OH^-(aq) \longrightarrow 2H_2O(l) + 2e^-]$

Cathode $O_2(g) + 2H_2O(l) + 4e^- \longrightarrow 4OH^-(aq)$

Overall reaction: $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$

This cell runs continuously as long as the reactants are supplied.

Advantages of fuel cells over ordinary batteries

(1) High efficiency

The Fuel cells excel in efficiency by directly converting the energy from a fuel into electricity, surpassing traditional methods of large-scale electricity generation through the combustion of hydrogen and carbon fuels. Conventional approaches involve burning fuel to generate heat, which is then utilized for electricity production, yielding an efficiency of only around 40%.

(2) Continuous source of energy

Unlike regular batteries that require the replacement of electrode materials, fuel cells enable continuous fuel supply for uninterrupted power generation.

(3) Pollution free working

The absence of objectionable by-products in fuel cells results in a pollution-free operation, mitigating environmental concerns.