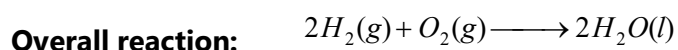
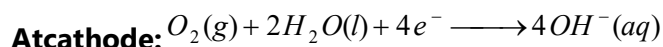
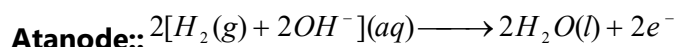


## Fuel cells.

These are Voltaic cells in which the reactants are continuously supplied to the electrodes. These are designed to convert the energy from the combustion of fuels such as  $H_2$ ,  $CO$ ,  $CH_4$ , etc. directly into electrical energy. The common example is **hydrogen-oxygen fuel cell** as described below,

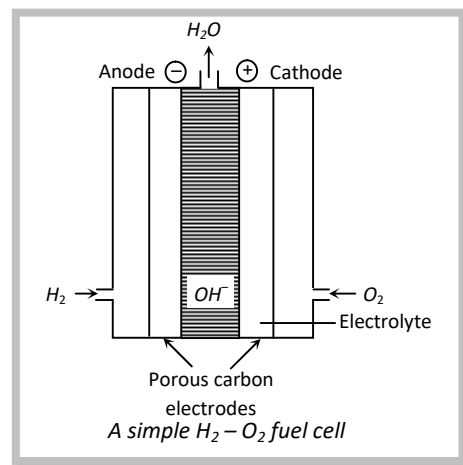
In this cell, hydrogen and oxygen are bubbled through a porous carbon electrode into concentrated aqueous sodium hydroxide or potassium hydroxide. Hydrogen (the fuel) is fed into the anode compartment where it is oxidized. The oxygen is fed into cathode compartment where it is reduced. The diffusion rates of the gases into the cell are carefully regulated to get maximum efficiency. The net reaction is the same as burning of hydrogen and oxygen to form water. The reactions are



Each electrode is made of porous compressed carbon containing a small amount of catalyst ( $Pt$ ,  $Ag$  or  $CoO$ ). This cell runs continuously as long as the reactants are fed. These fuel cells are more efficient than conventionally used methods of generating electricity on a large scale by burning hydrogen, carbon, fuels because these fuel cells convert the energy of the fuel directly into electricity. This cell has been used for electric power in the **Apollo space programme**. Fuel cells offer great promises for energy conversion in future. The important advantages of fuel cells over ordinary batteries are

(1) **High efficiency:** The fuel cells convert the energy of a fuel directly into electricity and therefore, they are more efficient than the conventional methods of generating electricity on a large scale by burning hydrogen, carbon fuels. Though we expect 100 % efficiency in fuel cells, so far **60 – 70% efficiency** has been attained. The conventional methods of production of electrical energy involve combustion of a fuel to liberate heat which is then used to produce electricity. The efficiency of these methods is only about 40%.

(2) **Continuous source of energy:** There is no electrode material to be replaced as in ordinary battery. The fuel can be fed continuously to produce power. For this reason,  $H_2 - O_2$  fuel cells have been used in space crafts.



(3) **Pollution free working:** There are no objectionable byproducts and, therefore, they do not cause pollution problems. Since fuel cells are efficient and free from pollution, attempts are being made to get better commercially practical fuel cells.

Thermodynamic characteristics of some Fuel cells

<b>Fuel cells</b>	<b>Cell reaction</b>	$\Delta G^\circ$ (KJ mol <sup>-1</sup> )	$\Delta H^\circ$ (KJ mol <sup>-1</sup> )	<b>E (volt)</b>
$H_2 - O_2$	$2H_2 + O_2 \rightarrow 2H_2O$	- 237.2	- 258.9	1.23
$C - O_2$	$C + O_2 \rightarrow CO_2$	- 137.3	- 110.5	0.71
$CH_4 - O_2$	$CH_4 + 2O_2 \rightarrow CO_2 + H_2O$	- 818.0	- 890.4	1.060
$CH_3OH - O_2$	$CH_3OH + \frac{3}{2}O_2 \rightarrow CO_2 + 2H_2O$	- 706.9	- 764.0	1.22