

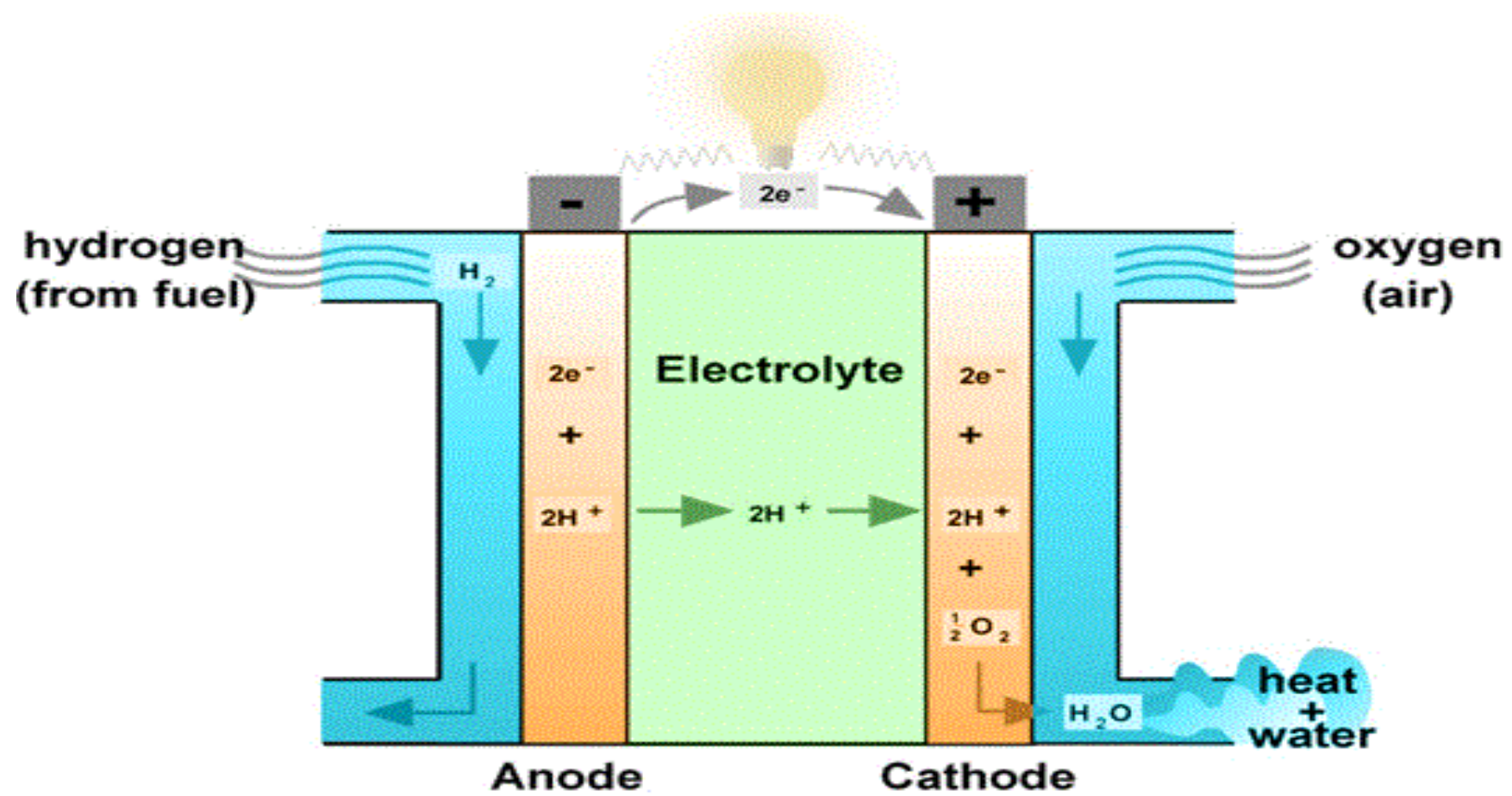
Chapter:6

(Fuel Cell)

Lecture-2

Working Principle of Fuel Cell:

- A fuel cell is a lot like a battery. It has two electrodes where the reactions take place and an electrolyte which carries the charged particles from one electrode to the other. In order for a fuel cell to work, it needs hydrogen (H_2) and oxygen (O_2). The hydrogen enters the fuel cell at the anode. A chemical reaction strips the hydrogen molecules of their electrons and the atoms become ionized to form H^+ . The electrons travel through wires to provide a current to do work. The oxygen enters at the cathode, usually from the air. The oxygen picks up the electrons that have completed their circuit. The oxygen then combines with the ionized hydrogen atoms (H^+), and water (H_2O) is formed as the waste product which exits the fuel cell. The electrolyte plays an essential role as well. It only allows the appropriate ions to pass between the anode and cathode. If other ions were allowed to flow between the anode and cathode, the chemical reactions within the cell would be disrupted.



Advantages & Disadvantages of Fuel cell:

- **Advantage:**
- As many companies search for an emission-free alternative to internal combustion engines in their forklifts, some are turning to hydrogen fuel cell technology.
- Hydrogen fuel cells do not produce any CO₂ emissions during operation, even if their production is not necessarily carbon-free. This gives them an advantage over combustion engine vehicles, which can emit small amounts of poisonous carbon monoxide and require well-ventilated rooms for indoor use.
- The refueling process for hydrogen fuel cells is easy and takes about three minutes, compared to the longer and more complex process of changing out a large, heavy lead acid battery when it needs to be charged.
- In comparison to refueling a propane-powered forklift, the hydrogen fuel cell refueling process has an advantage. Because, the energy density of hydrogen fuel cells is very high, hydrogen-powered equipment can operate for longer times and with less frequent refueling than with a propane cylinder.
- Hydrogen fuel cells and lithium-ion battery energy densities are very similar, making them great choices for busy operations who need equipment to last a full shift.

- **Disadvantage:**

- While it is true that hydrogen fuel cells do not emit harmful gases during operation, the same is not true for the production process to make hydrogen fuel. In fact, hydrogen power is nearly energy-neutral - which means that it takes almost as much energy to produce as what it produces.
- Hydrogen is one of the most abundant elements on earth, but it is typically bonded to other elements and must be isolated to be used for energy purposes.
- A common way to isolate hydrogen is to extract it from natural gas in a process called reforming. This process is costly and emits carbon dioxide, which is counterproductive to using an emission-free energy source.
- The other way to isolate hydrogen is through electrolysis, where it is extracted from water and separated from the oxygen molecule using an electrical current.
- The source of this electrical current can be anything, but today, electricity is most commonly generated from natural gas-powered plants.
- The only truly carbon-free way to use hydrogen fuel cell power is to use solar or wind power (which is not accessible in some areas of the world) to generate electricity for the electrolysis process.