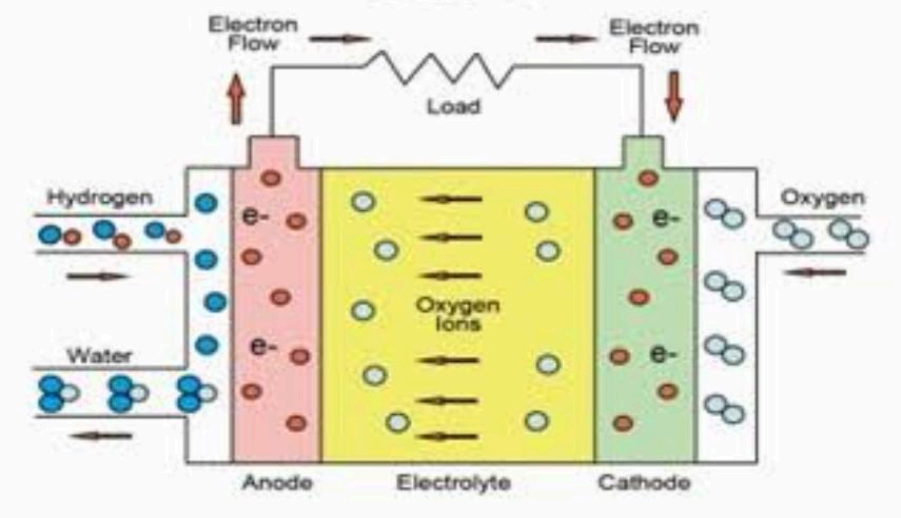
FUEL CELL (OR) SOLID FUEL CELL (OR) SOLID OXIDE FUEL CELL

❖ Introduction :-

- ❖ The fuel cell was discovered by German scientist G.H. Shoenbein and developed by William Grove.
- ❖ NASA has used fuel cells on almost every space mission since the 1960's
- ❖ A fuel cell is an electrochemical device which generates electricity without combustion by combining Hydrogen & Oxygen.
- ❖ **Definition:-** Solid Fuel Cell is an electrochemical device, which converts chemical energy directly into electricity with high efficiency.

❖ Construction:-

- ❖ Solid oxide fuel cell consists of electrolyte sandwiched between two thin electrodes namely porous anode & cathode.
- ❖ It uses a solid ceramic electrolyte such as zirconium oxide stabilized with yttrium oxide.
- ❖ The fuel used in the fuel cell is H_2 gas (or) other hydrocarbon fuels such as CH_4 (or) natural gas.
- ❖ The oxidant used for fuel cell is oxygen from air.



❖ Working Principle:-

- ❖ Solid oxide fuel cells work by using H_2 and O_2 to generate electricity by an electrochemical process.

❖ Working:-

- ❖ H_2 is fed to the anode from the hydrogen-rich fuels such as CH_4 or natural gas.

- At the same time, O_2 is fed to the cathode from the air and combines with free electrons to form oxide ions (O^{2-}) : $O_2 + 4e^- \rightarrow 2O^{2-}$
- At the anode, oxide ions react with H_2 to form steam (H_2O) : $2H_2 + 2O^{2-} \rightarrow 2H_2O + 4e^-$

Applications:-

- **Stationary power generation for:**
- Residential & commercial buildings
- Industrial facilities for manufacturing
- Remote or off-grid locations, where electric power supply is unavailable
- **Auxiliary Power Units (APUs) in:**
- Various vehicles, military applications
- Marine vessels
- Hybrid systems
- Satellites
- Portable power
- Cars and buses
- Grid & backup power

Advantages:-

- High efficiency
- Reduced transmission losses
- Grid independence
- Quiet operation
- Longevity & durability
- Fuel flexibility
- Low pollution
- Cogeneration capabilities
- Modularity & stability

Disadvantages:-

- SOFCs operate at high temperature, so the materials used are thermally challenged
- Relatively high cost and complex fabrication are also significant problems that need to be resolved