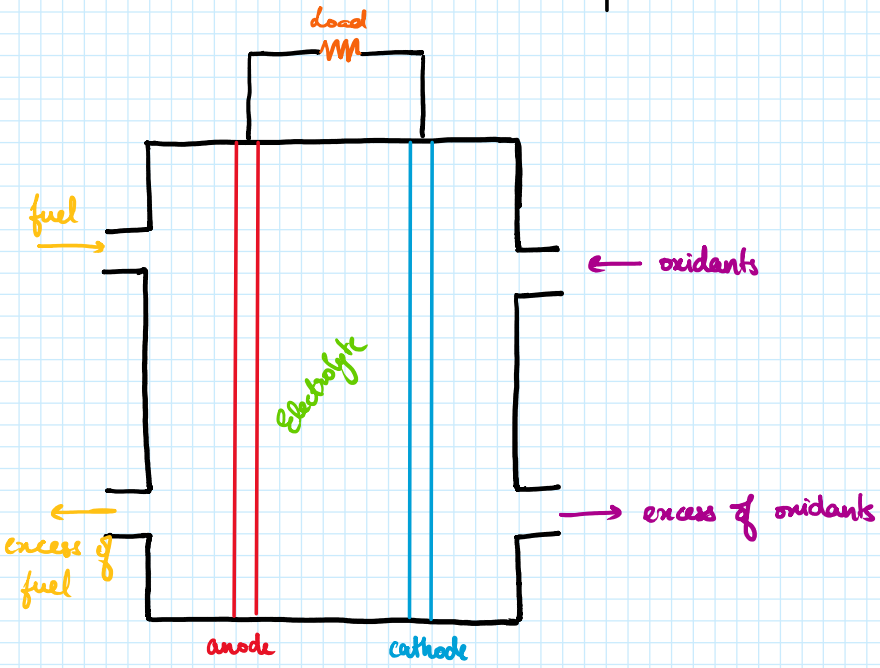
3. Fuel Cells

10 November 2023 08:25

Fuel Cells

Difference Between Batteries & Fuel Cells

Batteries	Fuel Cells
CC ⟶ EE	Fuel energy ⟶ EE
• Storage of chemical energy	• Continuous supplying of fuel
• Storage is easier	• Storage is difficult
• Not eco-friendly	• Eco-friendly



Fuel | Anode | Electrolyte | Cathode | Oxidant

Fuel: H_2, CO, CH_3-OH, C_2H_5-OH ... etc.

Oxidant: O_2, halogens ... etc.

Anode: Fuel ⟶ Oxidised product + ne^-

Cathode: Oxidant + ne^- ⟶ Reduced product

Fuel + oxidant ⟶ Oxidised product + reduced product

Advantages

- Eco-friendly
- Silent operation
- High efficiency

Applications

- Space applications
- Commercial vehicles

Efficiency

$$\eta = \frac{\Delta G}{\Delta H} \times 100$$

$\Delta G = -nEF$

Values of n for different fuel cells

Fuel Cell	n Value
$H_2 - O_2$	2
CH_3-OH, O_2	6
CO, O_2	2

Types of Fuel Cell

Fuel Cell	Fuel	Oxidant	Temp
① H_2-O_2 alkaline fuel cell	H_2	O_2	100°C
② Phosphoric acid fuel cell	H_2	O_2	160-220°C
③ Molten carbonate fuel cell	CO/H_2	O_2	600-650°C
④ Polymer membrane fuel cell	CH_3-OH	O_2	60-90°C
⑤ Solid oxide fuel cell	CO	O_2	650-1000°C

H_2-O_2 Alkaline Fuel Cell

Fuel = H_2 Oxidant = O_2 Temperature = 100°C

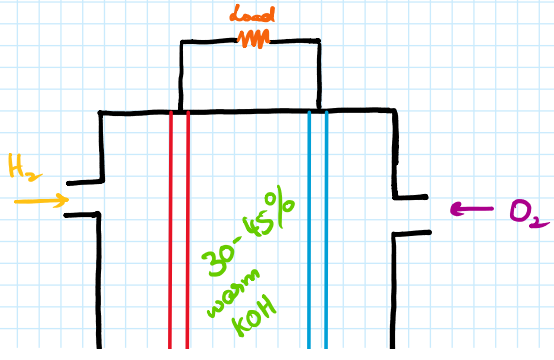
- low temperature fuel cell
- O_2 reduction faster in alkaline medium
- Using non-noble metal catalyst

Anode: Porous carbon with Pt

Cathode: Porous carbon with Pt

Electrolyte: 30-45% warm KOH

H_2 | Porous carbon with Pt | 30-45% warm KOH | Porous carbon with Pt | O_2



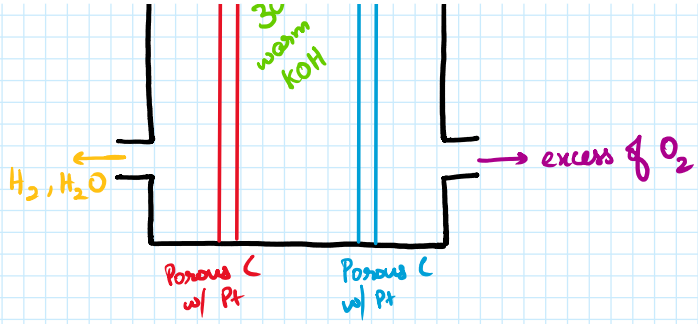
Equations

Anode: $H_2 \longrightarrow 2H^+ + 2e^-$

$2H^+ + 2OH^- \longrightarrow 2H_2O$

$H_2 + 2OH^- \longrightarrow 2H_2O + 2e^-$

Cathode: $H_2O + \frac{1}{2}O_2 + 2e^- \longrightarrow 2OH^-$



Cathode: ~~$H_2O + \frac{1}{2}O_2 + 2e^- \rightarrow 2OH^-$~~

Total: $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$

ADVANTAGES

- High efficiency
- Silent operation
- Eco-friendly

APPLICATIONS

- Space application
- Electrical vehicles