



# ENGINEERING CHEMISTRY

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## Energy storage devices – Fuel cells

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### *Class content:*

- *H<sub>2</sub> – O<sub>2</sub> alkaline fuel cell*
  - *Principle*
  - *Construction and working*
  - *Advantages*
  - *Disadvantages*

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### Alkaline fuel cells

- Aqueous solution of **KOH** is used as electrolyte
- **Low temperature** fuel cell (operates at 100°C)
- Oxygen reduction is **more rapid** in alkaline electrolytes than in acid electrolytes
- Use of **non noble metal electro-catalyst** is feasible
- **Carbon containing fuels cannot be used** as CO<sub>2</sub> is formed as product which reacts with the electrolyte, KOH, to form K<sub>2</sub>CO<sub>3</sub> which reduces efficiency of the cell



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### Construction :

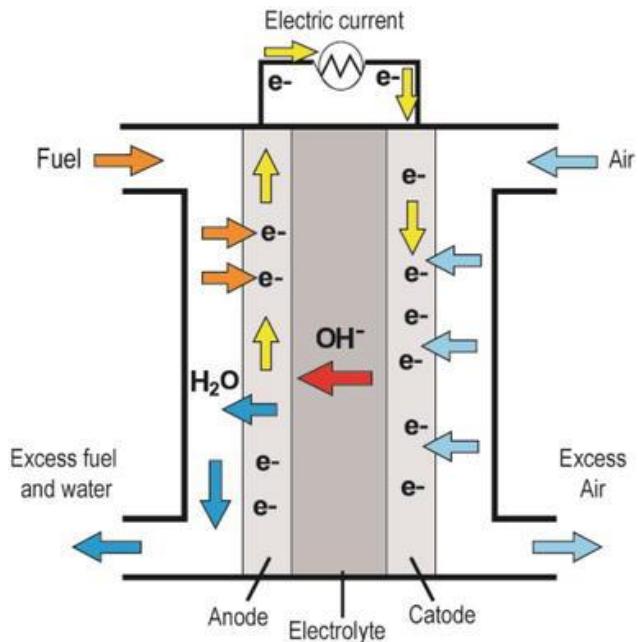
- **Anode** : Porous carbon with Pt catalyst
- **Cathode** : Porous carbon with Ag catalyst
- **Fuel** : Hydrogen gas
- **Oxidant** : Oxygen gas
- **Electrolyte** : 30-45 % KOH(warm)

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Cell representation:

$\text{H}_2 \mid \text{Pt} \mid \text{KOH} \mid \text{Ag} \mid \text{O}_2$

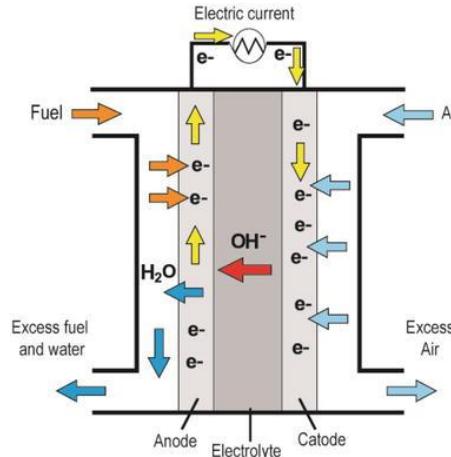
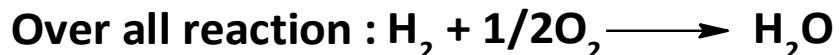
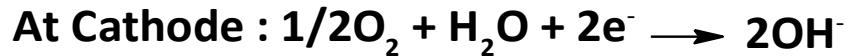
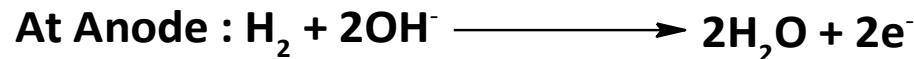


Source:<https://www.intechopen.com/books/new-trends-in-ion-exchange-studies/hydroxide-transport-in-anion-exchange-membranes-for-alkaline-fuel-cells>

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### Working:



- H<sub>2</sub> gas diffuses through anode ,gets adsorbed on the electrode surface ,reacts with OH- to form water
- At cathode O<sub>2</sub> diffuses through electrode, is adsorbed and reduced to OH-
- Product is water which dilutes the KOH
- Cell operates at 100°C, so that water from KOH escapes as steam
- The water was used by astronauts for drinking on Apollo spacecraft

Emf = 1.23 V

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### Advantages:

- Operates at low temperature
- Alkali is used as electrolyte hence non noble metal catalyst can be used so less expensive

### Disadvantages:

- Reactants must be free from C, because on oxidation  $\text{CO}_2$  is formed .The alkali reacts with  $\text{CO}_2$  to form carbonates which reduce efficiency of the cells; pure fuel and oxidant which are free of carbon compounds must be used
- Liquid electrolytes pose handling problems



THANK YOU

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