

IGCSE Chemistry: ELECTROCHEMISTRY

Lesson 4.01

Electrolysis (I)

Revision Notes

Cambridge will assess your ability to:

- Define electrolysis as the decomposition of an ionic compound, when molten or in aqueous solution, by the passage of an electric current
- Identify in simple electrolytic cells:
 - the anode as the positive electrode
 - the cathode as the negative electrode
 - the electrolyte as the molten or aqueous substance that undergoes electrolysis
- Identify the products formed at the electrodes and describe the observations made during the electrolysis of:
 - molten lead(II) bromide
 - using inert electrodes made of platinum or carbon / graphite
- State that a hydrogen–oxygen fuel cell uses hydrogen and oxygen to produce electricity with water as the only chemical product
- Describe the advantages and disadvantages of using hydrogen–oxygen fuel cells in comparison with gasoline / petrol engines in vehicles

Hydrogen-oxygen fuel cell



- A **fuel cell** uses **hydrogen** as a fuel, which is **combined** with **oxygen** from the air.
- The hydrogen atoms lose electrons at the negative electrode, and these electrons move around the external circuit to the positive electrode, creating an electric current. This current can be used to power a car or used on any other electrical load.
- Advantages of a hydrogen fuel cell:
 - Water vapour is formed as a byproduct. No harmful pollutants are formed, so this process is environmentally friendly.
 - Hydrogen is a lot more energy dense: 1kg of hydrogen gas gives about 2.5 times more energy than the same mass of methane (natural gas).
- Disadvantages of a hydrogen fuel cell:
 - Hydrogen is highly flammable and can explode if exposed to sparks or a lit match. It must be stored safely.
 - Hydrogen gas is expensive to produce and requires specialised pumps and storage compared to conventional petrol pumps and tanks.

The process of electrolysis

- Electrolysis is defined as the decomposition of an ionic compound, when molten or in aqueous solution, by the passage of an electric current.
- This is a technique that uses a **direct electric current (DC)** to drive an otherwise non-spontaneous chemical reaction.
- E.g. Electrolysis of water to form hydrogen gas and oxygen gas:



• **Electrolysis** can only occur when the compound is either **molten** or in an **aqueous solution**, as the charges must be able to **freely move**.



• Parts of a simple electrolytic cell



- The positive terminal is termed the anode, and the negatively charged anions are attracted to it. This terminal would also repel the positively charged cations away. (Like charges repel, opposite charges attract)
- Similarly, the negative terminal is termed the cathode, and the positively charged cations are attracted to it. This terminal would also repel the negatively charged anions away.
- The molten or aqueous substance that electrolysis is performed on is termed the electrolyte.

• Electrolysis of molten lead(II) bromide



- Lead ions are positively charged and move towards the cathode, thus being reduced to lead metal and we see shiny gray molten lead metal at the bottom of the container below the cathode.
- Bromide ions are negatively charged and move towards the anode, thus it gets oxidised to form gaseous bromine. We see an effervescence of red-brown bromine gas at the anode.
- For this electrolysis process, we use an inert electrode, such as graphite or platinum, as we don't want the electrodes to react with or dissolve in the electrolyte.

