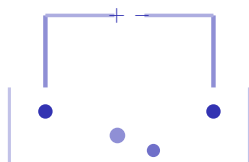


Electrochemistry

IGCSE Chemistry ■ Topic 4

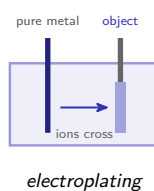
IGCSE Chemistry



Electrochemistry

What we will cover

- 1 What electrolysis is
- 2 The electrolytic cell
- 3 Products at each electrode
- 4 Half-equations
- 5 Electroplating
- 6 Hydrogen fuel cells



1 Electrolysis

What electrolysis is

Electrolysis 电解 splits an ionic compound by passing a current through it when molten or in solution. Ions must be free to move.

The electrolytic cell

Two electrodes in an **electrolyte** 电解质. The **cathode** 阴极 is negative (cations go there and gain electrons – reduction). The **anode** 阳极 is positive (anions lose electrons – oxidation).

Products at each electrode

cathode (–) → metal or hydrogen

anode (+) → non-metal

Cathode: metals & **hydrogen** 氢气.

Anode: **non-metals** 非金属.

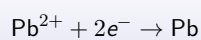
molten PbBr_2 : lead | bromine

conc. NaCl(aq) : hydrogen |
chlorine 氯气

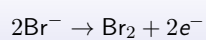
dilute H_2SO_4 : hydrogen | oxy-
gen

Half-equations

cathode – reduction 还原 (gain e^-)

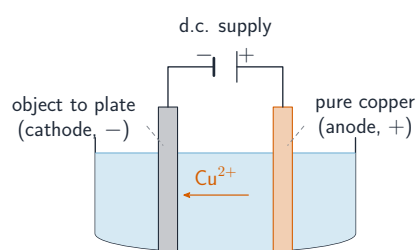


anode – oxidation 氧化 (lose e^-)



Electrons travel the **wires**; ions travel the **electrolyte** – positive to the cathode, negative to the anode.

Electroplating



electrolyte: copper(II) sulfate solution
copper coats the object at the cathode; the copper anode slowly dissolves to replace it

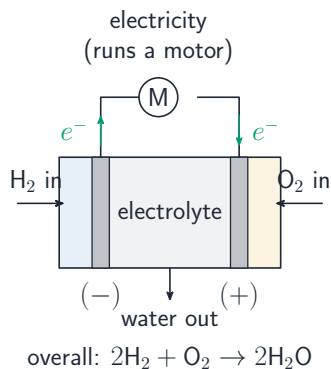
Electroplating 电镀 coats an object to improve looks & resist **corrosion 腐蚀**.

- object = the **cathode**
- plating metal = the **anode**
- electrolyte = that metal's ions

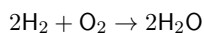
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Fuel cells

Hydrogen–oxygen fuel cells



A **fuel cell** 燃料电池 makes electricity directly; the only product is water.



Clean, but hydrogen is hard to store safely.

3

Recap

Worked example – predicting electrolysis products

Give the products of electrolysis of concentrated aqueous sodium chloride with inert electrodes.

- Ions present: Na^+ , H^+ (cations) and Cl^- , OH^- (anions).
- Cathode (-): the **less reactive** cation is discharged. Na is more reactive than H $\Rightarrow$ **hydrogen**.
- Anode (+): the halide is **concentrated**, so it wins over $\text{OH}^- \Rightarrow$ **chlorine**.
- Na^+ and OH^- stay behind as sodium hydroxide solution.

Cathode = **reduction** (gain electrons), anode = **oxidation**. Dilute halide $\Rightarrow$ oxygen at the anode; concentrated $\Rightarrow$ the halogen.

Topic 4 – key takeaways

1 Electrolysis

splits ionic compounds; needs free ions

2 Electrodes

anode + (oxidation), cathode – (reduction)

3 Products

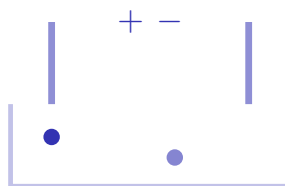
cathode: metals/H; anode: non-metals

4 Fuel cell

$\text{H}_2 + \text{O}_2$; water is the only product

Check yourself

- 1 Why must an electrolyte be molten or aqueous?
- 2 Which electrode is the anode: + or –?
- 3 What forms at the cathode in molten PbBr_2 ?
- 4 What is the only product of a hydrogen fuel cell?



Answers 1. so the ions are free to move 2. the positive (+) 3. lead 4. water