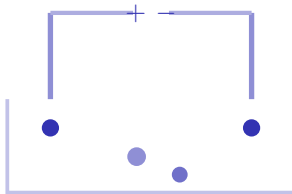


Electrochemistry

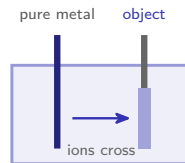
IGCSE Chemistry ■ Topic 4

IGCSE Chemistry



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



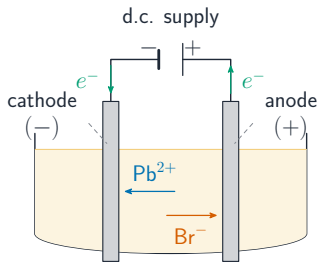
electroplating

What electrolysis is



*Electrolysis
splits compounds with electricity*

The electrolytic cell



molten lead(II) bromide, $PbBr_2$

cathode: $Pb^{2+} + 2e^- \rightarrow Pb$ (silvery lead)

anode: $2Br^- \rightarrow Br_2 + 2e^-$ (red-brown bromine)



*Water can be electrolysed into hydrogen
and oxygen*

Products at each electrode

cathode (−) $\longrightarrow$ metal or hydrogen

anode (+) $\longrightarrow$ non-metal

Cathode: metals & hydrogen. **Anode:** non-metals.

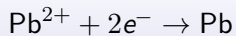
molten PbBr_2 : lead | bromine

conc. NaCl(aq) : hydrogen | chlorine

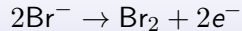
dilute H_2SO_4 : hydrogen | oxygen

Half-equations

cathode – reduction 还原 (gain e^-)

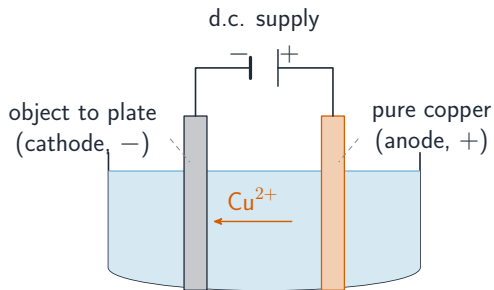


anode – oxidation 氧化 (lose e^-)



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

Electroplating

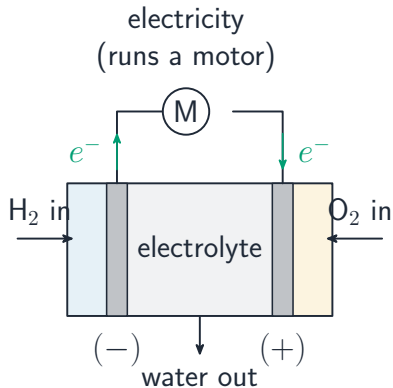


electrolyte: copper(II) sulfate solution
copper coats the object at the
cathode; the copper anode
slowly dissolves to replace it

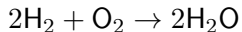
Electroplating 电镀 coats an object to
improve looks & resist **corrosion** 腐蚀.

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

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.

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

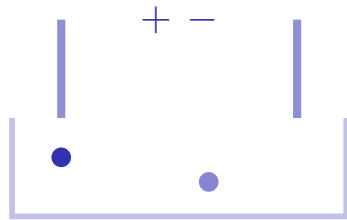
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Fuel cell

$\text{H}_2 + \text{O}_2$; 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