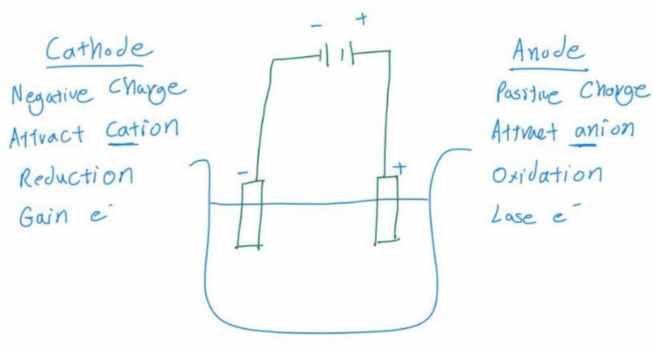
Electrolytic Cells



How to determine reactions at each electrode

Step 1: Look at the ions and molecules in the electrolyte

- This will require looking closely at the state of the electrolyte: molten or aqueous

Step 2: Look at the potential ions/molecules at each electrode, analyse using E°

- Species with higher E° are more readily reduced and less easily oxidised
- Species with lower E° are more readily oxidised and less easily reduced
- It's important to always think about H_2O whenever the electrolyte is in aqueous state

Step 3: Look at concentrations (usually for anions/anode)

- Usually for F^-, Cl^-, Br^-, when they are in higher concentrations, they can oxidise more favourably even when the E° says otherwise.
- For large anions like NO_3^-, a higher concentration usually will not be enough for it to be oxidised

(1) $Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-(aq)$ $E^\circ = +1.36\ V$

$O_2(g) + 4H^+(aq) + 4e^- \rightleftharpoons 2H_2O$ $E^\circ = +1.23\ V$

- E.g. in NaCl (conc) the high [Cl^-] will shift equilibrium I <-, E° decreases, and is lesser than E°($O_2(g)|H_2O(l)$), Cl^- becomes more easily oxidised than H_2O

Step 4: Look at nature of electrode

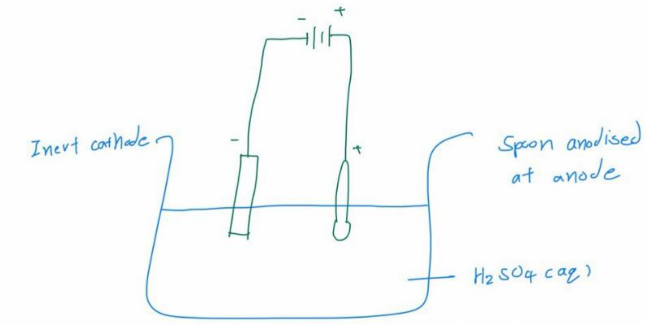
- If it is an inert electrode like Graphite or Platinum, the electrode will not be involved
- If it is an active electrode, they can participate in the reaction (usually favoured to be oxidised)
- Look at E° for oxidation of the active electrode and compare to that of ions and molecules

Calculations in Electrolysis

$Q = It$ — Q: Quantity of Charge (C); I: Current (A); t: time (s)

$Q = nF$ — n: no. of moles of e^-; F: Faraday's = 96500 C mol⁻¹

Anodising Aluminium



Cathode

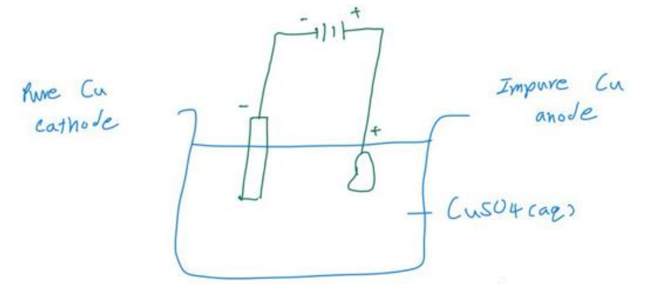
$2H^+(aq) + 2e^- \rightarrow H_2(g)$

Anode

① $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$

② $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$ ⇓ protective oxide layer

Purification of Copper



Cathode

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

Anode

$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$ $E^\circ = +0.34\ V$

$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$ $E^\circ = -0.76\ V$

The Chembridge Institution All Rights Reserved.