

Electrolysis: nature of electrode, electroplating

1 Factors affecting preferential discharge: nature of electrode

- Using metal as electrode (vs graphite electrode: inert)
- Anode metal electrode: may preferentially discharge (as R.A.)
- Cathode metal electrode: 度的 CO.A. 在 electrolyte 中找)

肥 CAT 瘦 AN

	<p>OA: H^+ RA: OH^- Cl^- Cu(A)</p> <p>+ $\text{Cu}^{2+} \rightarrow \text{form ppt (但不多 } \because [\text{OH}^+_{\text{aq}}] \text{ 低)}$</p> <p>C: $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ - colourless gas bubbles evolve</p> <p>A: $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ - anode electrode gets thinner/dissolves - solⁿ: colourless \rightarrow blue \rightarrow 瘦 AN</p> <p>metal 是更强的 R.A.</p>	<p>H^+ is stronger R.A. than Na^+ \rightarrow preferentially discharges reduction $\rightarrow \text{H}_2$</p> <p>Cu is stronger R.A. than OH^- & Cl^- \rightarrow preferentially discharges oxidation $\rightarrow \text{Cu}^{2+}$</p>
	<p>OA: H^+ RA: OH^- SO_4^{2-} Cu(C)</p> <p>C: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ - reddish brown solid deposits \rightarrow 肥 cat - solⁿ: blue \rightarrow colourless</p> <p>A: $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$ - colourless gas bubbles evolve</p> <p>在 Cathode 的 金属 是 度的</p>	
	<p>OA: H^+ RA: OH^- Cu^{2+} SO_4^{2-} Cu(C) Cu(A)</p> <p>C: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ \rightarrow 肥 cat - cathode electrode gets thicker</p> <p>A: $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ \rightarrow 瘦 AN - anode electrode gets thinner</p> <p>\rightarrow gain in mass of cathode = loss in mass of anode</p>	<p>solⁿ pH: neutral (H^+, OH^- is not consumed)</p> <p>solⁿ: remains blue / same blue colour intensity - rate of production of $[\text{Cu}^{2+}_{\text{aq}}] =$ rate of consumption of $[\text{Cu}^{2+}_{\text{aq}}]$</p>

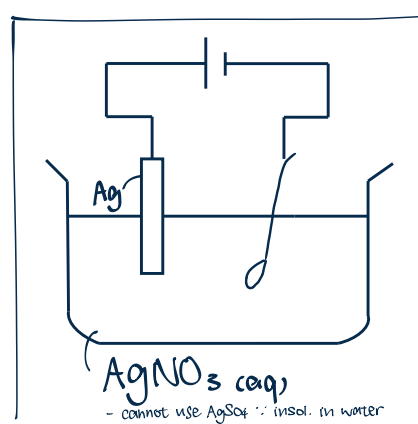
2 Electroplating

DEFINITION, ADVANTAGES

- Electroplating = coat metal layer on top of another substance using electrolysis
- note: can only electroplate w/ ion R.A. strength $> \text{H}^+$ (otherwise H^+ preferentially discharges)
- advantages
 - > provides better appearance for metal
 - > prevents corrosion of metal (provides protective layer of unreactive metal \rightarrow prevent coated metal from contacting O_2 & water vapour in air)

PROCEDURE

- Task: Electroplate Silver on iron spoon.
- Apparatus: sandpaper, rusted iron spoon, Ag foil, beaker, battery, wires



1. Use sandpaper/ vinegar/ tomato (citric acid) to rub iron spoon \rightarrow remove oxide layer
2. dissolve $\text{AgNO}_3(\text{s})$ in excess distilled water in beaker as electrolyte
3. connect Ag to +ve terminal of battery through connecting wires.
4. connect cleaned Fe spoon to -ve terminal of battery through connecting wires.
5. Immerse electrodes in electrolyte

$\text{Fe}_2\text{O}_3 \rightarrow$ ionic bond + solid
 \rightarrow X conduct electricity
 \rightarrow lead to uneven coating

iron oxide
spoon
coating

CHOICE OF ANODE ELECTRODE - ELECTROPLATE Ni ON Fe SPOON

<p>C: $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$ A: $\text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{e}^-$</p>	<p>C: $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$ A: $\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-$</p>	<p>C: $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$ A: $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$ $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$</p>
<p>$[\text{Ni}^{2+}_{\text{aq}}]$ 不变</p> <p>$\therefore \text{Ni(A)} \rightarrow \text{oxidation} \rightarrow \text{Ni}^{2+}$</p> <p>- provides surplus of Ni^{2+}</p>	<p>- Ag 变成 Ag^+ 后会被吸引至 cathode</p> <p>- R.A. strength: $\text{Ag}^+ > \text{Ni}^{2+}$</p> <p>- Ag^+ preferentially discharge, reduction $\rightarrow \text{Ag}$</p> <p>- Ag 会 coat 在勺子上</p>	<p>$[\text{Ni}^{2+}_{\text{aq}}] \downarrow$</p> <p>- 有机会 $[\text{Ni}^{2+}_{\text{aq}}]$ 比 $[\text{H}^+_{\text{aq}}]$ 少很多</p> <p>- H^+ preferentially discharge</p> <p>\Rightarrow bubbles at coated Fe spoon</p> <p>\rightarrow uneven coating</p> <p>\rightarrow wear off of coated layer</p>