

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>NaCl(aq)</p>	<p>OA: H^+ RA: OH^- Cl^- Cu(A)</p> <p>$\text{Cu}^{2+} \rightarrow \text{form ppt (但不多: } [\text{OH}^+_{\text{aq}}] \text{ 低)}$</p> <p>C: $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$</p> <ul style="list-style-type: none"> - colourless gas bubbles evolve <p>A: $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$</p> <ul style="list-style-type: none"> - anode electrode gets thinner/dissolves - solⁿ: colourless \rightarrow blue \rightarrow 瘦 AN 	<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>$\text{CuSO}_4(\text{aq})$</p>	<p>OA: H^+ RA: OH^- Cu(C) SO_4^{2-}</p> <p>C: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$</p> <ul style="list-style-type: none"> - reddish brown solid deposits \rightarrow 肥 cat - solⁿ: blue \rightarrow colourless <p>A: $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$</p> <ul style="list-style-type: none"> - colourless gas bubbles evolve 	
<p>$\text{CuSO}_4(\text{aq})$</p>	<p>OA: H^+ RA: OH^- Cu(C) Cu(A)</p> <p>C: $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$</p> <ul style="list-style-type: none"> - cathode electrode gets thicker \rightarrow 肥 cat <p>A: $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$</p> <ul style="list-style-type: none"> - anode electrode gets thinner \rightarrow 瘦 AN <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</p> <ul style="list-style-type: none"> - rate of production of $[\text{Cu}^{2+}_{\text{aq}}] =$ rate of consumption of $[\text{Cu}^{2+}_{\text{aq}}]$

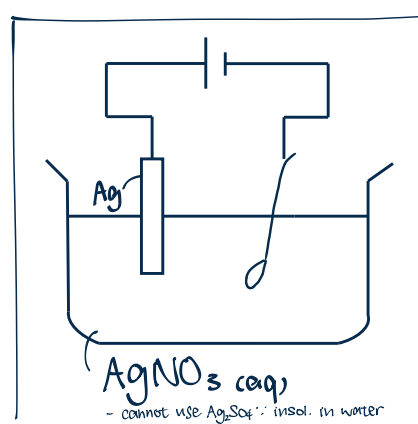
2 Electroplating

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
lead to uneven coating



CHOICE OF ANODE ELECTRODE - ELECTROPLATE Ni ON FE SPOON

<p>$\text{Ni(NO}_3)_2(\text{aq})$</p> <p>C: $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$ A: $\text{Ni} \rightarrow \text{Ni}^{2+} + 2\text{e}^-$</p>	<p>$\text{Ni(NO}_3)_2(\text{aq})$</p> <p>C: $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$ A: $\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-$</p>	<p>$\text{Ni(NO}_3)_2(\text{aq})$</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> <ul style="list-style-type: none"> - $\therefore \text{Ni(A)} \rightarrow \text{oxidation} \rightarrow \text{Ni}^{2+}$ - provides surplus of Ni^{2+} 	<ul style="list-style-type: none"> - Ag 变成 Ag^+ 后会被吸引至 cathode - R.A. strength: $\text{Ag}^+ > \text{Ni}^{2+}$ - Ag^+ preferentially discharge, reduction $\rightarrow \text{Ag}$ - Ag 会 coat 在勺子上 	<p>$[\text{Ni}^{2+}_{\text{aq}}] \downarrow$</p> <ul style="list-style-type: none"> - 有机会 $[\text{Ni}^{2+}_{\text{aq}}]$ 比 $[\text{H}^+_{\text{aq}}]$ 少很多 - H^+ preferentially discharge <p>\Rightarrow bubbles at coated Fe spoon \rightarrow uneven coating \rightarrow wear off of coated layer</p>