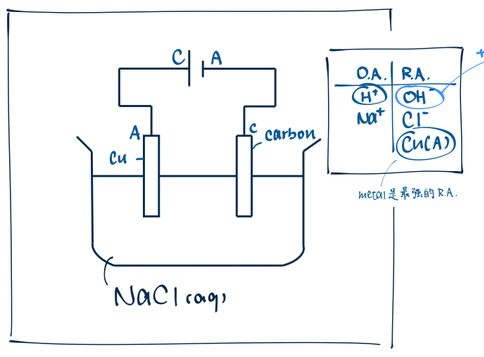
Electrolysis: nature of electrode, electroplating

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: 废的 (O.A. 在 electrolyte 中找)

肥CAT 瘦AN



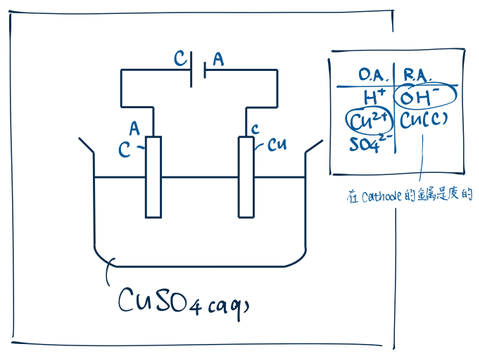
+ Cu^{2+} → form ppt (但不多 ∵ $[OH^-_{(aq)}]$ 低)

C: $2H^+ + 2e^- \rightarrow H_2$
- colourless gas bubbles evolve

H^+ is stronger R.A. than Na^+ → preferentially discharges reduction → H_2

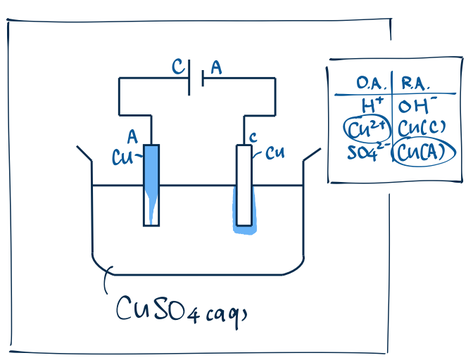
A: $Cu \rightarrow Cu^{2+} + 2e^-$
- anode electrode gets thinner / dissolves
- soln: colourless → blue ↳ 瘦 An

Cu is stronger R.A. than OH^- & Cl^- → preferentially discharges oxidation → Cu^{2+}



C: $Cu^{2+} + 2e^- \rightarrow Cu$
- reddish brown solid deposits ↳ 肥 cat
- soln: blue → colourless

A: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$
- colourless gas bubbles evolve



C: $Cu^{2+} + 2e^- \rightarrow Cu$ ↗ 肥 cat
- cathode electrode gets thicker

A: $Cu \rightarrow Cu^{2+} + 2e^-$ ↗ 瘦 An
- anode electrode gets thinner

→ gain in mass of cathode = loss in mass of anode

soln pH: neutral (H^+, OH^- is not consumed)

soln: remains blue / same blue colour intensity
- rate of production of $[Cu^{2+}_{(aq)}]$ = rate of consumption of $[Cu^{2+}_{(aq)}]$

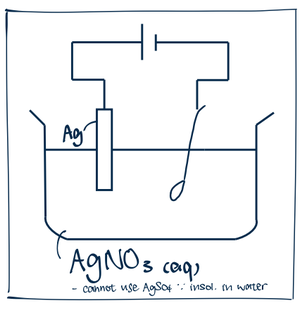
2 Electroplating

DEFINITION, ADVANTAGES

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

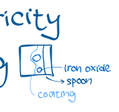
PROCEDURE

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



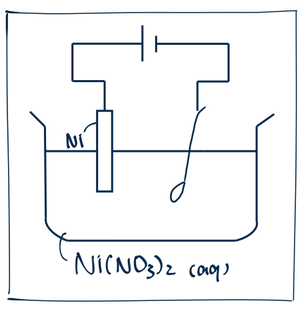
1. use sandpaper / vinegar / tomato (citric acid) to rub iron spoon → remove oxide layer

Fe_2O_3 → ionic bond + solid → ✗ conduct electricity → lead to uneven coating



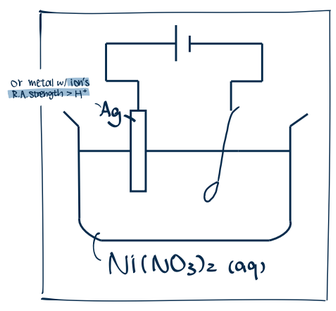
2. dissolve $AgNO_{3(s)}$ in excess distilled water in beaker as electrolyte
3. connect Ag to +ve terminal of battery through connecting wires.
4. connect cleaned Fe spoon to -ve terminal of battery through connecting wires.
5. Immerse electrodes in electrolyte

CHOICE OF ANODE ELECTRODE - ELECTROPLATE Ni ON Fe SPOON



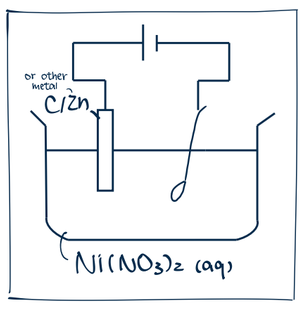
C: $Ni^{2+} + 2e^- \rightarrow Ni$
A: $Ni \rightarrow Ni^{2+} + 2e^-$

$[Ni^{2+}_{(aq)}]$ 不变
- ∵ Ni (A) → oxidation → Ni^{2+}
- provides surplus of Ni^{2+}



C: $Ni^{2+} + 2e^- \rightarrow Ni$
A: $Ag \rightarrow Ag^+ + e^-$

- Ag 变成 Ag^+ 后会被吸引至 cathode
- R.A. strength: $Ag^+ > Ni^{2+}$
- Ag^+ preferentially discharge, reduction → Ag
- Ag 会 coat 在勺子上



C: $Ni^{2+} + 2e^- \rightarrow Ni$
A: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$
$Zn \rightarrow Zn^{2+} + 2e^-$

$[Ni^{2+}_{(aq)}]$ ↓
- 有机会 $[Ni^{2+}_{(aq)}]$ 比 $[H^+_{(aq)}]$ 少很多
  - H^+ preferentially discharge

⇒ bubbles at coated Fe spoon → uneven coating → wear off of coated layer