Electrolysis

Electrolysis is a process during which electricity is passed through an ionic compound and a chemical change takes place. An **electrode** is a conductor in which electricity enters or exits in a substance. The **electrolyte** is an ionic salt solution. The **cathode** is the negative electrode, to which cations are attracted to. The **anode** is the positive electrode, to which anions are attracted to.

General principle: metals or hydrogen are formed at the cathode and non-metals are formed at the anode. At the anode, it is always OH- unless it is a chloride, bromide or iodide. Then you have to look if the solution is dilute or concentrated. At the cathode, it is usually Hydrogen, unless it is a less reactive metal. The less reactive the metal is, the more likely it is to undergo reduction.

During the electrolysis of a molten ionic compound, metal is deposited at the cathode and non-metal is evolved as a gas at the anode.

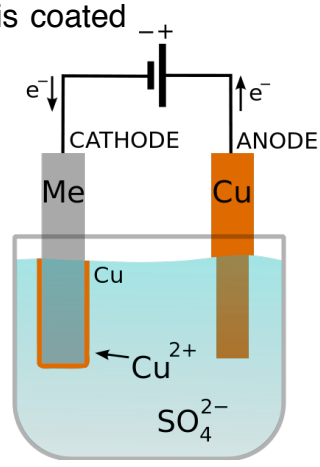
!Always anodeic oxidation and cathodeic reduction!

- Molten lead(II) bromide –> Lead **(Cathode)** + bromide^{-} ion **(Anode)**
- Concentrated hydrochloric acid --> Hydrogen (cathode) + chlorine (anode)
- Concentrated aqueous sodium chloride (a.k.a. **Brine**) --> Hydrogen (cathode) + chlorine (anode). This is a very useful reaction because it produces chlorine, hydrogen and sodiumhydroxide. **Chlorine** is used to make bleach, dyes, drugs and used in swimming pools. **Hydrogen** is used as a very important fuel, used in the conversion from oil to water. **Sodiumhydroxide** is used in the manifacture of soap and to make drugs.

1) When **aqueous copper sulphate** is electrolysed using carbon electrodes, copper is deposited at the cathode and oxygen forms as a gas at the anode. The observations are **bubbles of oxygen** at the anode (relight a glowing splint), **pink brown deposit of copper** at the cathode, solution turns **acidic** (sulphuric acid) and the **blue** colour of the solution gradually **fades**, because the cupric ions are being removed from the solution.

2) When aqueous copper sulphate is electrolysed using **copper** electrodes, copper undergoes oxidation at the anode and then reduction at the cathode. This done for **refining** the copper, as the impure substances (gold, silver etc) form a sludge at the bottom of the beaker. The observations are **pink brown** deposit of copper at the cathode, **increase** in size of **cathode**, **decrease** in size of **anode**, and no colour change in the solution.

3) This reaction can also be done for **electroplating**. Electroplating is the coating of one metal on another by electrolysis. It is done to prevent the metal that is coated from rusting and to make it look nice. Metal that will coat is taken as the anode. Metal to be coated is taken as the cathode. Electrolyte is a soluble salt solution of the anode.



The ore of aluminium is called **bauxite.** Bauxite contains **alumina** and **iron (III) oxide**. The two are first separated using NaOH (aq) because it is a base. Iron (III) oxide is a **basic oxide**, so it does not react and remains insoluble. Alumina is an **amphoteric oxide** and dissolves. The two are then separated by filtration.

In the electrolysis of **alumina** (Al_2O_3), carbon rods are taken as the anode and steel with carbon lining is taken as the cathode. The electrolyte is molten Al_2O_3 but since it has a very high melting point (2045 degrees celsius), it is mixed with cryolite (Na_3AlF_6) which brings the melting point down to 950 degrees celsius. ~to reach the high melting point, there would be a large energy cost, thus not being very economical~ Aluminium forms at the cathode and oxygen gas forms at the anode. **Carbon dioxide** is also formed when oxygen reaches the carbon rods. Therefore, the carbon rods have to be replaced from time to time as they are being eaten away by the oxygen.

Aluminium is used in **cables** because it is a very **light metal**. Unfortunately, it doesn't keep it's shape easily, so the cables are **copper** on the **outside** and aluminium in the interior. Plastics and ceramics are used as insulators because they **do not conduct electricity** and can maintain their shape and function despite hard conditions.

Colours
Bromine gas ---> redish brown vapours
Carbon (graphite) rods are black
$CuSO_4$ (aq) is a blue solution
Copper is pink brown