

Topic 3 - Applications of Electrolysis - pg 646-650

Production of Elements

- Most elements occur naturally combined with other elements in compounds.
- Ex. ionic compounds of sodium, potassium, lithium, magnesium, calcium, and aluminum are abundant, but these reactive metals are not found uncombined in nature
- Some metals can be produced by electrolysis of solutions of their ionic compounds, but two difficulties arise.

1. Many naturally occurring ionic compounds have a low solubility in water
2. Water is a stronger oxidizing agent than many active metal cations

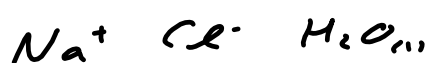
<http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch20/faraday.php#molten>

- To overcome these problems for those metals, we simply melt the ionic compound it is found in and do the electrolysis in the molten compound

- Molten ionic compounds are electrolytes, just like dissolved ionic compounds.
- This eliminates the presence of water and allows the metal ion to be reduced.

- In molten-salt electrolysis, metal cations move to the cathode and are reduced to metals, and nonmetal anions move to the anode and are oxidized to nonmetals.

Ex. Write the cathode, anode and net cell reaction for the electrolysis of aqueous sodium chloride.



Ex. Write the cathode, anode and net cell reaction for the electrolysis of ~~aqueous~~ molten sodium chloride.



Refining of Metals

- In the production of metals, the initial product is usually an impure metal.
- Impurities are often other metals that come from various compounds in the original ore
- A common method of increasing the purity of the metal is known as *electrorefining*
- This process uses an electrolytic cell to obtain high-grade metals at the cathode from an impure metal at the anode

Ex. Refining of Copper

- The presence of impurities in copper lowers its electrical conductivity
- The initial smelting process produces copper that is about 99% pure, containing some silver, gold, platinum, iron, and zinc
- These valuable impurities can be recovered and sold to help pay for the process

Process

- a slab of impure copper is the anode of an electrolytic cell that contains copper(II) sulfate dissolved in sulfuric acid.

- The cathode is a thin sheet of very pure copper.

- As the cell operates, copper and some of the other metals in the anode are oxidized, but only copper is reduced at the cathode

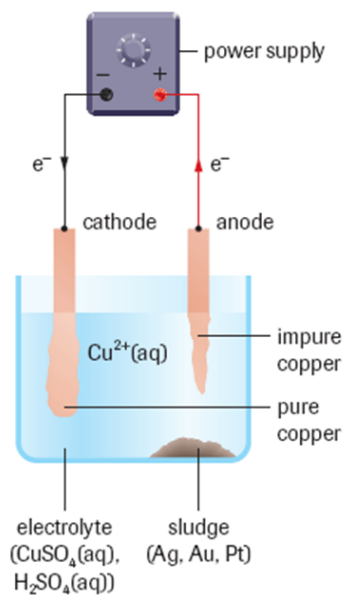
<http://group.chem.iastate.edu/Greenbowe/sections/projectfolder/flashfiles/electroChem/electrolysis10.html>



http://www.yteach.co.uk/page.php/resources/view_all?id=copper_ore_titanium_metal_nugget_electrorefining_patina_t_page_5&from=search



http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/ions/electrolysisrev3.shtml



Electroplating

- Plating of a metal at the cathode of an electrolytic cell is called *electroplating*

- This is a common technology that is used to cover the surface of an object with a thin layer of metal
- The object that is to be plated is made the cathode by hooking it up to the negative terminal of the power supply
- The solution needs to contain the metal ion to be plated onto the object.
- The anode can be inert, or the metal that is being plated onto the object



Figure 12

Chromium is best plated from a solution of chromic acid. A thin layer of chromium metal is very shiny and, like aluminium, protects itself from corrosion by forming a tough oxide layer.

