

Investigation into electrolysis of aqueous solutions and electroplating

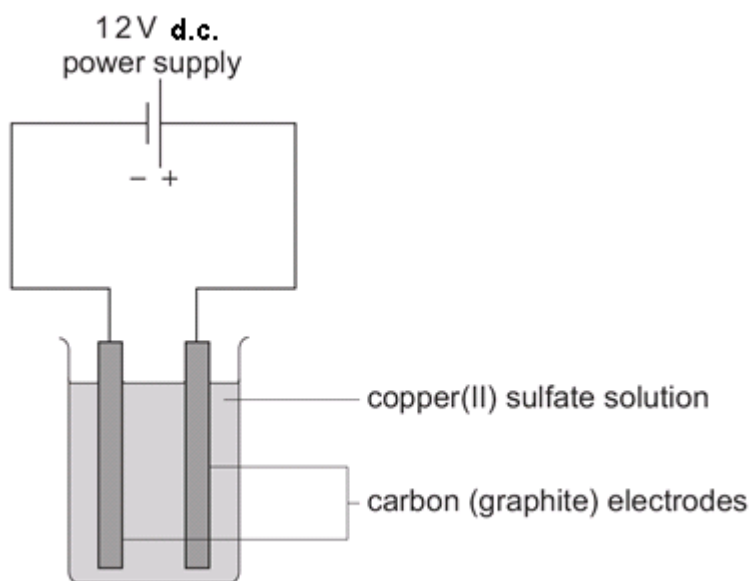
Introduction

In this experiment you will carry out the electrolysis of copper(II) sulfate solution and link your findings to industrial copper purification and copper plating.

Apparatus

250 cm³ beaker
 2 × graphite electrodes (about 5 mm diameter)
 clamp stand, boss and clamp
 12 V d.c. power supply
 leads and crocodile clips
 200 cm³ copper(II) sulfate, about 0.5 mol/dm³

Diagram of Apparatus



Method

1. Measure 200 cm³ of copper(II) sulfate into the beaker.
2. Set up the apparatus as in the diagram.
3. Switch on the power supply.
4. After 2 minutes record any observations seen at the electrodes.

Risk Assessment

Hazard	Risk	Control measure
Copper(II) sulfate is harmful	Copper(II) sulfate splashed onto hands whilst pouring could be transferred to eyes	Wear eye protection Wash hands if copper(II) sulfate spilt on them

Teacher / Technician notes

- Copper(II) sulfate solution - Refer to CLEAPSS hazard card 26

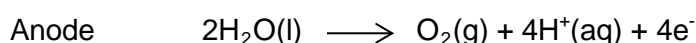
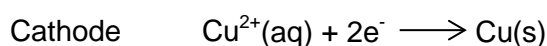
There are several ways of securing the graphite electrodes. Using a clamp stand and clamp is probably the most convenient. They can also be fixed on to a small strip of wood or cardboard resting on the top of the beaker.

A lamp can be included in the circuit to indicate that there is a flow of current.

As an extension to the basic experiment, strips of copper can be used in place of the graphite rods.

After setting up the cell as shown students can observe changes to each of the electrodes. They should see a deposit of copper forming on the cathode. This will often be powdery and uneven. It can be explained that, if the current used is much lower, then the solid coating is shiny, impermeable and very difficult to rub off; this process forms the basis of electroplating.

Bubbles of gas (oxygen) are formed at the anode.

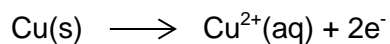


With copper electrodes, the copper anode dissolves. The reaction is the reverse of the cathode reactions.

With graphite electrodes, the oxygen usually reacts with the anode to form CO_2 .

The results can lead to a discussion about electroplating and the electrolytic purification of copper. It is useful to allow students to copperplate metal objects supplied by the school and previously tested for their suitability. Personal items should not be used. In many cases, an alternative redox reaction often takes place before any current is actually passed.

After doing the electrolysis as described above, the electrodes can be interchanged. Students can then see the copper disappearing from the surface of the copper-coated anode.



This leads to a discussion as to why, during electrolysis the:

- anode consists of an unrefined sample of the metal
- cathode is made of pure copper or a support metal such as stainless steel.

Working scientifically skills covered

1. Development of scientific thinking

Explain every day and technological applications of science; evaluate associated personal, social, economic and environmental implications and make decisions based on the evaluation of evidence and arguments.

2. Experimental skills and strategies

Make and record observations and measurements using a range of apparatus and methods.