ELECTROPLATING

Introduction

To **electroplate** an object means to coat the surface of an object with a thin metal layer. This is done for artistic purposes but is also an important process for industries when it comes to reducing **corrosion,** like rusting. To do so, an electric current will pass through a solution to drive the reaction forward.

For electroplating to occur, an **electrolytic cell** is needed in order to plate metal onto the desired object. For the circuit to be complete each **electrode** is placed in the electrolytic solution and connected to a power source, usually something as simple as a battery. When the electricity flows through the circuit, the electrodes gain a charge. The positively charged electrode is called the **anode** and the negatively charged electrode is called the **cathode**. In order to plate metal onto an object, the electrolytic solution must be based in that same metal. For example, to electroplate a ring with gold, the electrolyte used would have to be gold-based salt as well as a gold anode.

In this experiment, you will be electroplating copper onto an iron nail using **copper (II) sulfate** as an electrolytic solution. The metal to be plated is the iron nail, and it is going to be attached to the cathode. To complete the circuit, the copper strip is connected to the anode.

The copper (II) sulfate solution contains positively charged Cu^{2+} ions and negatively charged SO_4^- ions. The positively charged Cu^{2+} ions are attracted to the negatively charged cathode. However, the copper ions in the solution need to be replenished throughout the process to make sure there is enough copper to coat the iron nail.

The current that is passing through the anode causes the copper ions from the copper strip to become **oxidized** and get dissolved into the electrolyte. When electricity passes through the solution, the positively charged copper ions are attracted to the negatively charged iron nail cathode. These copper ions are then deposited onto the iron nail, producing the thin copper layer.

Purpose

To use the process of electroplating in order to plate copper onto a metal object.

Hypothesis

What is your hypothesis concerning what is going to happen to the iron nail?

_____

_____

Materials

- Copper strip (anode)
- Iron nail (cathode)
- $CuSO_4$, 1.0M
- 9V battery
- 2x Alligator clips with insulated wires
- Weighing boat
- Balance
- Sandpaper
- 250mL beaker
- Uninsulated copper wire
- Popsicle stick

Notes on materials:
The cathode does not have to be an iron nail, you can use anything provided it is a metal from pennies to keys.

If it is a black solution that is forming on the iron nail, the solution of copper (II) sulfate is not strong enough. Dissolve more solid $CuSO_4$ to make it stronger.

In the procedure, the amount of copper (II) sulfate used will need to be adjusted depending on how large the copper strip and the iron nail/other object is.

Procedure

1. Clean nail with sandpaper.

2. Determine the mass of the nail and record observations.

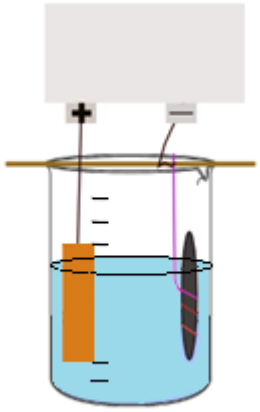
3. Coil the uninsulated copper wire around the iron nail and suspend it from the popsicle stick into the beaker.

4. Attach one end of the alligator clip to the copper wire supporting the nail and the other end to the negative terminal of the battery.

5. Attach one end of the alligator clip to the copper strip and the other end to the positive terminal of the battery.

6. Place the copper strip in beaker being careful to not touch the iron nail.

7. Carefully pour $CuSO_4$ into the beaker. Make sure the cathode and anode are submerged being careful that the alligator clips do not touch the solution.



8. Observe reaction for 10 minutes.

9. Determine the final mass of the nail.

10. Record observations.

Data

Mass of iron nail

Initial: _____

Final: _____

Change in mass: _____

Observations:

Iron nail	Appearance	Texture	Size
Initial			
After 2 minutes			
Final			

Results

1. What does the change in mass indicate?

_____
_____

2. Write the half-reaction equations, indicating which is the oxidation reaction and which is the reduction reaction.

3. Which way were the electrons flowing? Draw a diagram of the electrolytic cell clearly indicating the direction in both wires. Be sure to label the anode and cathode and indicate the direction the ions were moving.

4. Why does it matter which side of the power supply the anode and cathode were connected to? What would have happened if the iron nail was connected to the positive terminal?

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