Electroplating Lab

Overview

Electroplating is an economically important process, often used to reduce corrosion or improve the appearance of objects. During electroplating a thin layer of a desirable metal is deposited onto another object.

During electroplating, the object to be plated is attached to the negative post of a power source, causing the object to gain a negative charge. This will attract positive metallic cations from the electrolytic solution, or "bath", the object is placed in. In our experiment, positive Cu2+ ions from the bath will become attracted to a nail carrying the negative charge. When the Cu2+ reach the nail they will gain electrons and become reduced to form solid copper:

$$Cu^{2+}\ (aq) + 2\ e- \rightarrow Cu(s)$$

The copper(II) ions removed from the bath must be replenished; this is accomplished at the anode where a solid copper plate undergoes oxidation:

$$Cu(s) \rightarrow Cu^{2+}\ (aq) + 2e-$$

Purpose

- To use electroplating to plate copper onto a metal object such as a nail.

Equipment and Materials

- cathode - an iron nail
- anode - a copper strip
- electrolytic solution - 1.0 M $CuSO_4$
- 9V battery
- 250 mL beaker
- insulated wire leads with alligator clips at both ends
- uninsulated copper wire
- popsicle stick that will cross the top of the beaker - used to suspend the item to be plated

Procedure

1. The nail must be clean for good results. Prepare by polishing with some steel wool.
2. Use the uninsulated copper wire to suspend the item to be plated (the nail) into the empty beaker. Attach one end of the black alligator clip to the copper wire supporting the nail and the other end to the NEGATIVE post of the battery or power source.
3. Place the copper strip, the anode, into the empty beaker. Attach one end of the red alligator clip to the copper strip and attach the other end to the POSITIVE post of the battery or power source.
4. Carefully pour the $CuSO_4$ solution into the beaker until it is about two-thirds full. Make sure the entire nail is submerged.
5. Allow the reaction to continue for a 10 minutes or so. Record your observations while electroplating is continuing.
6. Place the nail into a pre-weighed 50mL beaker. Record the mass of the electroplated nail. The difference between this value and the initial value of the nail is the amount of copper that came out of solution.

Results

1. Mass of nail before electroplating: _________ Mass of nail after electroplating: ___________
   Mass of copper plated: __________ Time of reaction (minutes): ___________
2. Record your observations during and after the electroplating procedure.

Questions and Conclusions

1. Write the half-reaction that occurs at the anode of the electrolytic cell. Is it oxidation or reduction?

2. Write the half-reaction that occurs at the cathode of the electrolytic cell. Is is oxidation or reduction?

3. Write a descriptive paragraph or two that explains both the flow of copper ions and electrons through the system.

4. How many amperes were flowing through the electrolytic cell? Use the mass of copper plated and the time that it took to plate the nail to find this value.