PURPOSE
To investigate the use of electrolytic cells to cause chemical changes.

DEFINITIONS
Voltaic cell, electrolytic cell, electrolysis.

BACKGROUND
It is common for manufactured products to be coated with a very thin layer of metal. For example, maybe you’ve eaten with silver-plated tableware. Your watchband, belt buckle, or jewelry may be gold-plated. All these plated items were produced using the electroplating process. Electroplating consists of depositing a thin layer of metal on another metal, either to protect the surface from corrosion or for a decorative effect. An electrolytic cell set up to electroplate a fork with a silver coating is shown in Figure 1. When the fork is being silver-plated, the anode metal is silver, the electrolytic solution is aqueous silver nitrate, and the cathode is the fork. The fork becomes silver-plated as a result of the reduction of Ag ions, from the solution, at the cathode.

\[
Ag^+(aq) + e^- \rightarrow Ag(s) \quad \text{reduction}
\]

At the same time, the silver ions are replenished by oxidation of silver atoms at the anode.

\[
Ag(s) \rightarrow Ag^+(aq) + e^- \quad \text{oxidation}
\]

In this experiment, you will electroplate a metal object using a typical electrolytic cell. You will then remove the plating by reversing the direction of flow of electrons in the electrolytic cell.

Figure 1. Silver Electroplating

MATERIALS
1 M copper(II) sulfate
copper strip
silver foil
steel wool
12 V power source

SAFETY
- Wear safety goggles.
ELECTROPLATING: An Example of Electrolysis
EXPERIMENT 25

PROCEDURE
As your instructor performs the experiment, record observations in Data Table 1.
1. Clean a small piece of the object to be plated with steel wool. Attach wire to the object.
2. Clean a small strip of copper with steel wool. Attach a wire to the copper strip.
3. Add 1 M CuSO₄ to a beaker and set up a system as shown in Figure 2.
4. Connect the wire attached to the object to the negative terminal of the power source. Connect the wire attached to the copper strip to the positive terminal. The object and the copper strip should not touch. Record your observations after several minutes have elapsed.

ANALYSIS
1. What is oxidized in this experiment? At which electrode, anode or cathode, does oxidation occur? Write the half-reaction.
2. What is reduced in this experiment? At which electrode, anode or cathode, does reduction occur? Write the half-reaction.
3. Add the two half reactions together to get the overall equation. Is this surprising?
4. To which battery terminal must an object be attached for it to become electroplated? Why?
5. On the diagram above (Figure 2) indicate the direction of electron flow in both wires, and label the anode and cathode on both the battery and the electrolytic cell.

OBSERVATIONS

<table>
<thead>
<tr>
<th>Data Table 1. Observations of Electroplating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of Observation</td>
</tr>
<tr>
<td>After several min. of current flow</td>
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</tbody>
</table>

Figure 2. Experimental Set-up