Make Your Own Battery: Guided Inquiry Lab

Overview

Assemble two cells with this student lab kit and identify each as galvanic or electrolytic! Batteries have tremendous impacts in our everyday lives. A few simple materials are provided in order to successfully complete the lab and the procedure guides you to ensure success. Enjoy this fun learning experience!

Focus on Science Practices

SEP 1 Asking Questions and Defining Problems
SEP 2 Developing and Using Models

Materials Per Group

- Copper(II) sulfate solution, $CuSO_4$, 1.0 M, 5 mL
- Paper towels
- Sodium sulfate solution, Na_2SO_4, 1.0 M, 50 mL
- Pipet
- Copper foil conductive adhesive, Cu, 2 cm piece, 2
- Ruler
- Deionized or distilled water
- Universal indicator solution, 10 mL
- Battery clip with alligator ends
- Sandpaper
- Filter paper, 1
- Scissors
- Graduated cylinder, 10 mL, 1
- Tweezers
- LEDs, clear, red, 2
- Weigh boats, medium, 2
- Magnesium ribbon, Mg, 2 cm piece, 2
- Pencil leads
- Battery, 9-V
- Petri dish, disposable

Safety

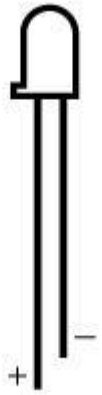
The copper(II) sulfate solution is harmful if swallowed and causes serious skin and eye irritation. The sodium sulfate solution may be harmful if in contact with skin. Magnesium ribbon is a flammable solid. To extend the life of the battery, avoid touching the positive and negative terminals to each other. Universal indicator is an alcohol-based solution and is flammable; do not use near an open flame. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Please follow all laboratory safety guidelines.

Procedure

Part I. Battery Materials Preparation

1. Gently polish both negative and positive terminals on the LEDs with the sandpaper (Figure 1)

Figure 1

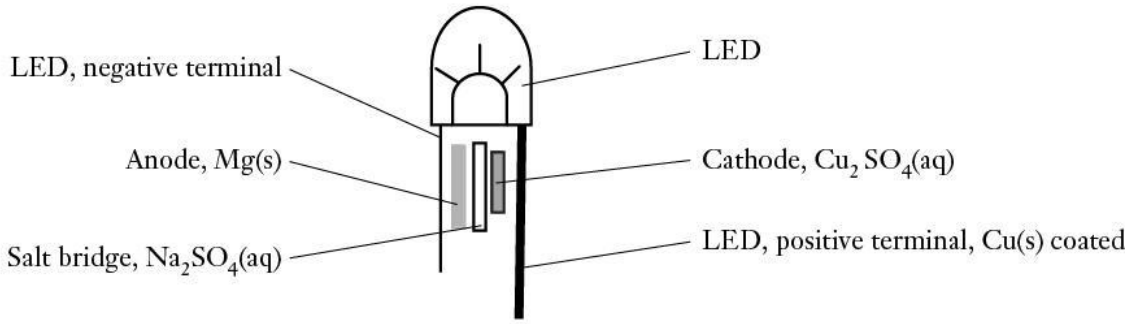


2. Make sure the copper conductive adhesive tape pieces and magnesium metal pieces are 2 cm in length. Cut the pieces with scissors if necessary.
3. Cover the positive terminal of each LED (Figure 3) with the 2 cm piece of the adhesive conductive tape. Sticky side should come in contact with positive terminal.
4. Cut square-shaped filter paper in the sizes below:
   a. Cut 2 pieces of the blue copper(II) sulfate filter paper in about ½ cm^2 in size.
   b. Cut 2 pieces of the white sodium sulfate filter paper in about 1 cm^2 in size.

Part II. Battery Assembly

5. Place all of the materials on the lab bench top. Materials include: prepped LEDs, magnesium metal pieces, and 2 each of copper(II) sulfate and sodium sulfate filter paper squares.
6. Arrange the parts according to the diagram below (Figure 2).

Figure 2

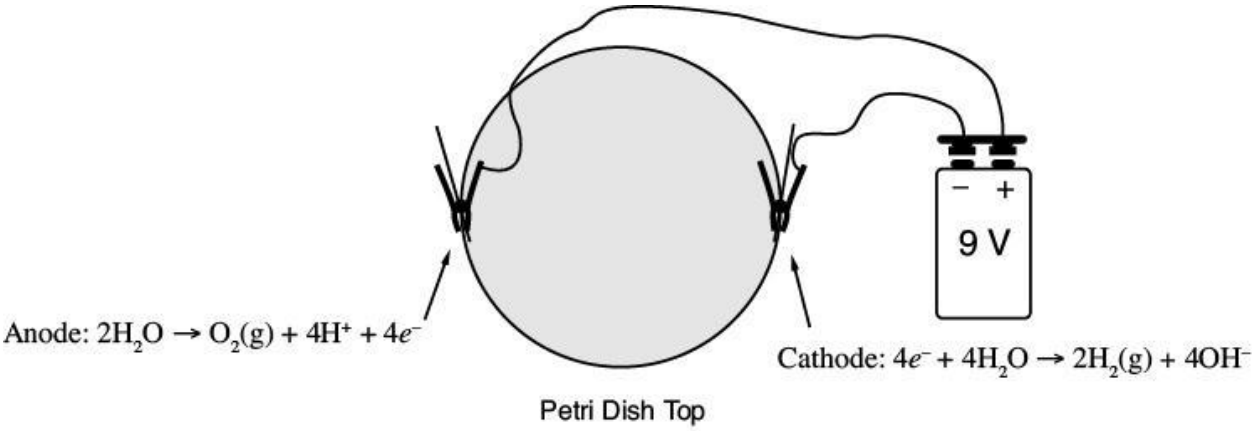


7. Squeeze the positive and negative lead with your thumb and index finger to create a "sandwich".
8. Add one drop of water to the filter papers and watch the LED illuminate red.

Part III. Colorful Electrolysis

9. Pour enough sodium sulfate solution into each half of the Petri dish to just cover the bottom of each half dish.
10. Break a pencil lead in half. Attach the leads to opposite sides of the Petri dish with the alligator clips. Make sure the tip of each lead is submerged in the solution and the alligator clips remain out of the solution.
11. To start the experiment, clip the 9-volt battery into the snaps on the battery clip. See Figure 3 below.

Figure 3



Analyze and Interpret

1. **SEP Define Problems** Define the terms *oxidation* and *reduction*, and identify the oxidation reaction and the reduction reaction below.

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

2. **SEP Identify Knowns** Describe the similarities and differences between galvanic cells and electrolytic cells. Identify Parts II and III as galvanic or electrolytic.

3. **SEP Identify Unknowns** What type of cell did you build in Parts I and II? Galvanic or electrolytic? Explain.

4. **SEP Make Observations** What reaction is occurring at the cathode? At the anode?