

Electroplating

Overview: People use this technique to add material to undersized parts, for placing a protective layer of material on objects, and to add aesthetic qualities to an object.

What to Learn: You're going to use electrolytes to deposit metal ions and make them stick to objects by using by positive and negative electrical charges.

Materials

- one shiny metal key (ask for these at a hardware store that makes keys and keeps a bucket of mistakes)
- copper strip, copper pipe or shiny copper penny (shine it up with ketchup and a toothbrush)
- 2 alligator clips
- 9V battery with clip
- water
- copper sulfate
- disposable cup
- paper towel
- popsicle stick

Lab Time

1. Wipe your key with a few swipes of a wet paper towel to get rid of the oils and dirt from your fingers.
2. Brush up your penny or copper pipe until it's shiny. You can use sandpaper or a clean paper towel.
3. Place a teaspoon of copper sulfate into your container. Don't touch this chemical with your hands. Cap it and set it aside.
4. Add a thin stream of water, just enough so that the bits on the bottom dissolve. Go slowly and stir continuously until all the copper sulfate is dissolved. (Do not heat the solution.)
5. Connect the wires to your battery.
6. Connect one end of an alligator wire to the copper strip and the other end to the positive (red) wire from your battery.
7. Connect the other alligator wire to the key and the negative (black) lead.
8. Place the copper strip and the key in the solution without touching each other. If they touch, you'll short your circuit and blow up your battery. Let this sit for a few minutes... and notice what happens and how long it took to happen (glance at the clock when you put the wires in the solution). Write down your observations.
9. Working with another lab group, use a second battery in your circuit.
 - a. Connect the batteries in series: connect the second battery by removing the wire attached to the positive terminal of the original battery, and attaching a third alligator clip lead. The other end of this alligator clip lead goes to the new battery's negative terminal. Reattach the clip lead to the new positive terminal and perform your experiment. Does the reaction happen faster or slower now?

- b. Connect the batteries in series: twist together the red wires from both batteries. Twist the negative wires from both. Now insert this where the original battery was in your circuit using alligator clip leads. Does the reaction happen faster or slower now?

Electroplating Data Table

[illegible]

12. Cleanup: Clean everything thoroughly after you are finished with the lab. After cleaning with soap and water, rinse thoroughly. Chemists use the rule of “three” in cleaning glassware and tools. After washing, chemists rinse out all visible soap and then rinse three times more.
13. Storage: Place all chemicals, cleaned tools, and glassware in their respective storage places.
14. Disposal: Dispose of all solid waste in the garbage. Strain out the solution through a piece of paper towel and throw the paper towel in the trash. Liquids can be washed down the drain with running water or flushed down the toilet. If using a sink, let the water run awhile to ensure that they have been diluted and sent downstream.

Reading

Electroplating was first figured out by Michael Faraday. The copper dissolves and shoots over to the key and gets stuck as a thin layer onto the metal key. During this process, hydrogen bubbles up and is released as a gas. People use this technique to add material to undersized parts, for placing a protective layer of material on objects, and to add aesthetic qualities to an object.

This experiment can be tricky. The problem areas include:

1. Solution is not saturated, meaning there's too much water mixed in. If this happens, add more copper sulfate.
2. Wires aren't making good contact with the battery or metal pieces.
3. Not enough voltage or amps available to drive the circuit. If this happens, you can add a second battery to your circuit either in series or parallel.
4. No copper sulfate? You can use salt and vinegar, although this is a much slower reaction and you'll probably want to leave it for a couple of hours.

Exercises

1. Look at your key. What color is it?
2. Where did the copper on your key come from?
3. What happened when you added a second battery?
4. Which circuit (series or parallel) did the reaction accelerate faster with?

Answers to Exercises: Electroplating

1. Look at your key. What color is it? (Black until you wipe it off, then copper or dull brown underneath.)
2. Where did the copper on your key come from? (The copper ions in the solution.)
3. What happened when you added a second battery? (The reaction happens much faster.)
4. Which circuit (series or parallel) did the reaction accelerate faster with? (Check data results.)