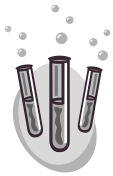


Electrographic Metal Detection

Mary Ethel Parrott

Topic

Electrographic identification of iron, copper, and lead

Time

2 hours

Safety

***This experiment must be supervised by a chemistry teacher*. Please click on the safety icon to view the safety precautions. The solutions must be prepared by a teacher. Solutions should be treated as poisonous and corrosive. Wear safety goggles, lab apron, and gloves. Wash your hands when you finish the experiment. If any of the solution contacts your skin or clothing, immediately wash with plenty of water. Clean up all residue, and containerize the residue for proper disposal.**
Dispose of all chemicals in accordance with local, state, and federal laws.

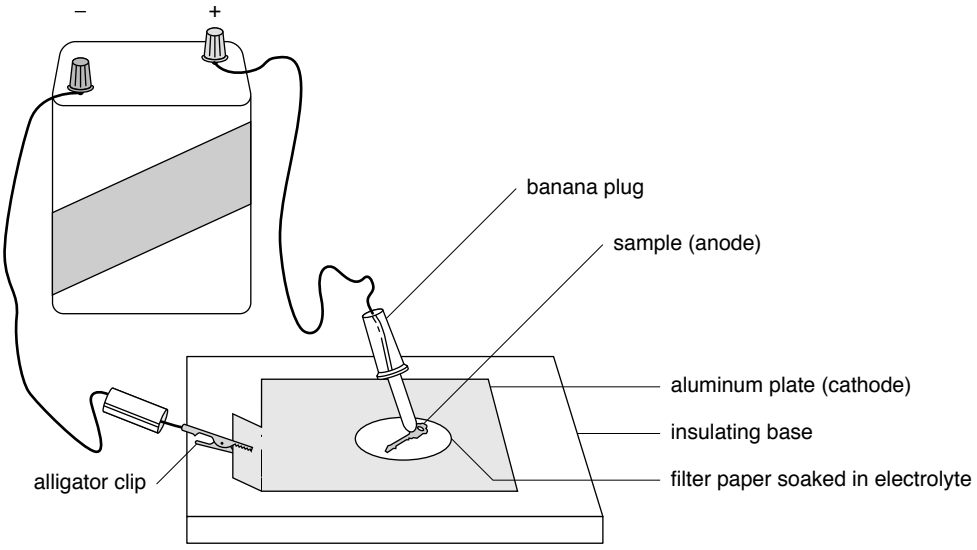
Materials

small, flat samples of iron, copper, and lead
small, flat sample of galena
small, flat samples of one or more of iron sulfide, chalcocite, and magnetite
small, flat samples of your choice; include coins, small pieces of hardware, bits of minerals found in your area, etc.
aluminum sheet
insulator base (e.g., sheet of plastic or wood)
6-V lantern battery
alligator clip
banana plug
two pieces of electrical wire, each 15 cm long
razor knife
tweezers
filter paper
2% potassium chromate solution
10% potassium ferrocyanide solution
10% potassium ferricyanide solution

Procedure

1. Set up the electrographic apparatus as shown in the illustration. First, strip about 1 in. off each end of both wires. Attach the banana plug to one wire and the alligator clip to the other. Attach the other end of the banana plug wire to the positive pole of the battery and the alligator clip wire to the negative pole. Test the connections to see that they are firm. Place the aluminum sheet on top of the insulating base, and attach the alligator clip to one edge.
2. Holding it with the tweezers, soak a piece of filter paper in potassium ferrocyanide solution. Gently wave the wet paper in the air for about 30 sec so that

excess liquid evaporates. Place it on the aluminum sheet. Then place the copper sample on top of the filter paper, and hold the banana plug against the copper sample. Apply pressure to make good contact for 30 sec. Break the contact and remove the sample. Remove the paper carefully with the tweezers, and rinse in gently running water until all of the color from the electrolyte solution has been washed out. Examine the filter paper for a colored precipitate, indicating the presence of copper. Record the color on the data table.



DATA TABLE

Material tested	Solution on filter paper	Color of precipitate
Copper	potassium ferrocyanide	
Iron	potassium ferrocyanide	
Iron	potassium ferricyanide	
Lead	potassium chromate	
Galena	potassium chromate	
Your choice:		
Your choice:		
Your choice:		

3. Repeat the test with iron, again using potassium ferrocyanide solution on the filter paper. Wipe off any excess solution that has accumulated on the aluminum sheet, and test iron again, this time using potassium ferricyanide. Then

test a lead sample, moistening the filter paper with potassium chromate solution. Each time you change solutions, wipe off the aluminum sheet.

4. Test the sample of galena in place of a metal sample. Look for an indication of the presence of lead in the sample. Record your results on the data table.
5. Test the other mineral samples or metallic items you have chosen for the presence of copper, lead, and iron. Record your results on the data table.
6. What color indicated the presence of copper? What color indicated the presence of iron? What color indicated the presence of lead?
7. Is there lead in galena? How do you know?
8. What metals, if any, were present in the sample(s) you tested of iron sulfide, chalcocite, and magnetite? How do you know?
9. Were you able to identify metals present in any of your other samples? What were they, and how did you find them?

What's Going On

Copper with ferrocyanide forms a red precipitate. Iron forms blue precipitates with both ferrocyanide and ferricyanide. Lead forms a bright yellow precipitate with chromate. Galena contains lead. It forms a yellow precipitate with chromate. Iron sulfide and magnetite contain iron. They form blue precipitates with both ferrocyanide and ferricyanide. Chalcocite contains copper; it forms a red precipitate with ferrocyanide. Results with other samples will vary.

In each case, soak the filter paper in the solution you originally used to test for the metal you are seeking. If the unknown sample delivers the same colored precipitate as the known metal sample did, the unknown contains that metal. In some cases, the precipitate that forms before the paper is rinsed will be a different color than expected. Only precipitates that remain in the paper after it is washed should be used as indicators of the metals in question.

Connections

Electrography is a method of qualitative analysis employed by chemists and forensic scientists. An electrical current is passed through a sample in contact with an electrolyte. The original sample dissociates and reacts with the electrolyte to form an insoluble compound, visible as a colored precipitate. A classic example of the forensic use of electrography was the investigation of a crime during which a copper electrical wire had been severed. Electrographic analysis revealed traces of copper on a hatchet in a suspect's possession. In this project, you used electrography to identify the presence of different metals in known and unknown samples.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say "be careful with hot liquids" or "don't cut yourself with the knife" does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don't use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES