Removing Silver Tarnish

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Topic

Replacement by more active metals

Time

45 minutes

Safety

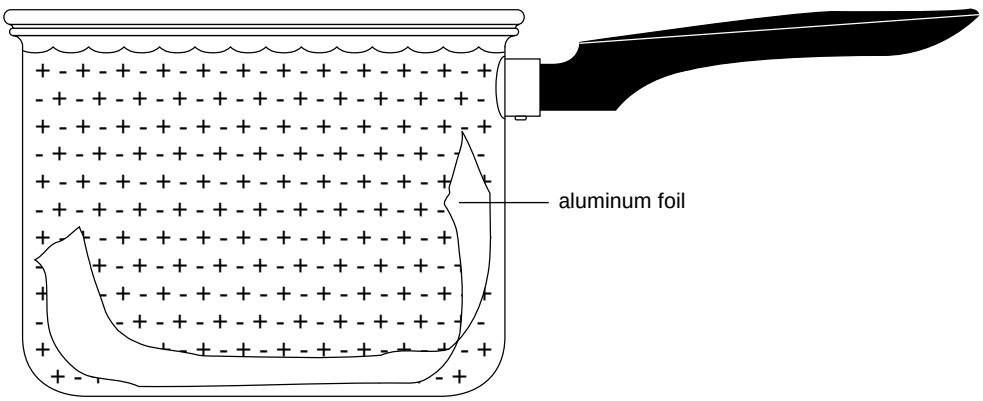
Please click on the safety icon to view the safety precautions. Be careful when using the stove. Use a pot holder when grasping the handles of the hot pot. Do *not* use an aluminum pot for this experiment because it would be destroyed and contaminated by the reaction. Keep table salt away from all silver items.

Materials

tarnished silver or silverplate objects
aluminum foil
tap water
tablespoon
soap
baking soda
iron or stainless steel pot large enough to hold silver items (Do *not* use an aluminum pot.)
kitchen stove or hot plate
stainless-steel tongs
table salt

Procedure

1. Wash the tarnished silver objects with soap and water to clean off any grease, which might interfere with the reaction.
2. Line the stainless-steel pot with a sheet of aluminum foil, and fill the pot with enough water to completely cover any silver item.
3. Add 2 tbs of baking soda to the water and stir. Place the pot on the stove or hot plate, and bring the solution to a boil. (When baking soda dissolves in the water, it breaks up into charged particles, called *ions*, making it a good electrical conductor; see illustration. Boiling the solution provides heat, which speeds up the rate of any chemical reaction.)



4. When the solution comes to a boil, immerse a silver item completely until it contacts the aluminum foil. Use stainless steel tongs to handle the object in the boiling solution, but be careful not to scratch the item.
5. As soon as you observe a change in the silver item, remove it from the pot and wash it off. (It must be washed to remove any baking soda residue.)
6. Repeat the procedure with as many tarnished silver items as desired. If many items are being used, check the aluminum foil periodically, and replace it if crumbling occurs.
7. To determine whether all the silver atoms liberated from the tarnish have returned to the silver object or if any have been lost to the solution, you can perform another test. Silver reacts with sodium chloride (table salt) to form an insoluble solid, silver chloride. (This is why table salt should be kept away from silver as much as possible.) After you have removed the silver items and the aluminum foil from the pot, add a tablespoon of salt to the solution. Observe any reactions.
8. What happened to the aluminum foil? What happened to the silver? Based on these results, which metal tends to lose electrons more readily, making it more chemically active, silver or aluminum?
9. What happened to the stainless-steel or iron pot during the procedure? What can you conclude from this about how chemically active iron or stainless steel is compared to aluminum? Compared to silver?
10. Why would you need to replace the aluminum foil if you were performing the reaction repeatedly with many silver items? Why should you not use an aluminum pot for the reaction?
11. What happened after you added the salt to the solution? Does a white precipitate form? If so, where do you think the silver atoms from the tarnish are? If there is no reaction, where are the silver atoms from the tarnish?

What's Going On

When the tarnished silver is placed in the boiling solution, it instantly loses its dull gray coating and becomes shiny. The aluminum foil loses its shine and becomes brittle and dull gray in color. Aluminum loses electrons, replacing the silver in the tarnish compound and combining with the tarnish anion, sulfide, to form aluminum sulfide. This shows that aluminum is more chemically active than silver. There was no change in the stainless-steel or iron pot. Therefore, iron or steel must be less chemically active than aluminum, otherwise it would have combined with the sulfide, replacing silver and aluminum.

You cannot tell from this procedure whether iron is more or less chemically active than silver, since as long as it is less active than aluminum it will not react. In fact, iron ranks between silver and aluminum in chemical activity. Stainless steel, composed of iron and other alloys, is designed to be resistant to corrosion and is thus relatively inactive. When the aluminum replaces the silver in the tarnish to form aluminum sulfide (the dark coating visible on the aluminum), the aluminum is depleted. With enough reactions, all the aluminum would be used up. For this reason, you must periodically replace the aluminum foil in the procedure, and you should never use an aluminum pot because it would be used up and destroyed by the reaction. There is no reaction to the added salt. All of the silver atoms from the tarnish have remained on the original silver object. Only the sulfide ions have been removed.

Connections

Elements classified as metals have an atomic structure in which free electrons drift between atoms in the substances. The greater a particular metal's tendency to lose electrons, the more chemically active that metal is said to be. Corrosion—for example, iron rusting or silver tarnishing—is a result of this tendency of metals to lose electrons. When two metals are in an environment in which electrons are free to flow between them (conducting electrical current), the more active metal will lose electrons and replace the less-active metal in the compound (tarnish) that is the product of corrosion. Knowing this, you can set up a test of two metals to determine which is more chemically active. In this project you tested aluminum and silver and, in the process, demonstrated a kind of instant silver "polish."

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