

The World's Smallest Christmas Tree

Copper, Silver and Gold Redox Reactions

Introduction

Add a drop of clear solution to a microscope slide containing a tiny piece of copper and create a beautiful, silver-branched Christmas tree that grows before your very eyes!

Concepts

- Oxidation–reduction
- Crystallization

Materials

Copper strip, Cu, 2 × 0.5 mm

Silver nitrate solution, AgNO₃, 0.3 M, 1 drop

Eye dropper or Beral pipet

Microscope

Microscope slide and cover slip

Microscope video camera and monitor (optional)

Scissors

Safety Precautions

The silver nitrate solution is moderately toxic by ingestion, irritating to body tissues. Avoid all body tissue contact. Silver nitrate solution will stain skin and clothing. Be careful when cutting and handling the copper sliver; it is very sharp. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

Prepare a 0.3 M AgNO₃ solution by dissolving 5.1 g of AgNO₃ in 100-mL of distilled or deionized water or diluting a more concentrated silver nitrate solution.

Procedure

1. To make the small tree, use scissors to cut out a small triangle, about 2-mm tall and 0.5-mm wide, from the copper strip (see Figure 1).
2. Center the copper tree on a microscope slide and place the cover slip over it (see Figure 2).

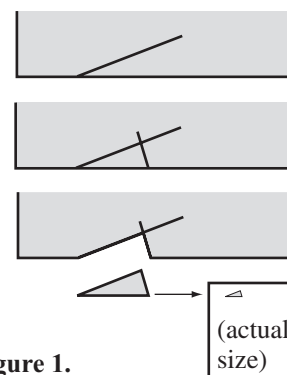


Figure 1.

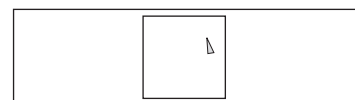


Figure 2.

3. Bring the tree into focus. Set the magnification so that the tree is centered and does not fill the entire field (see Figure 3).
4. Have each student view the tree or optionally, set up the video camera and display the tree on the monitor.
5. Add 1 drop of 0.3 M silver nitrate (AgNO_3) along the side of the cover slip. (see Figure 4). The solution is wicked under the cover slip and when it reaches the copper tree, dendritic silver crystals will start to grow from the edges of the copper.
6. As they grow outward, the silver crystals resemble pine tree branches and needles (see Figure 5).
7. Move the slide slightly and change magnification to follow the growth of these beautiful crystals.

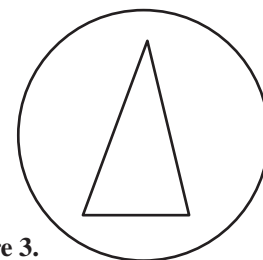


Figure 3.



Figure 4.

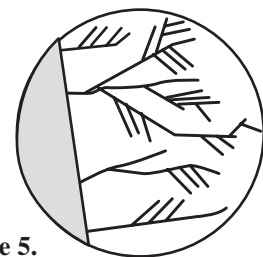


Figure 5.

Disposal

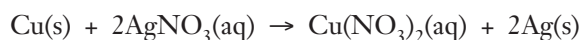
Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Silver nitrate may be disposed of according to Flinn Suggested Disposal Method #26b. The slide and the reaction products may be disposed of according to Flinn Suggested Disposal Method #26a.

Tips

- Use caution when cutting the copper strip to avoid any sharp edges or metal slivers.
- Switching from a back-lit image to a top-lit image will highlight the shiny silver needles.

Discussion

The “Christmas tree” reaction is a single replacement, oxidation–reduction reaction, in which copper metal is oxidized to copper(II) ions and silver ions are reduced to silver metal.



The slide and the cover slip restrict the growth of silver crystals, creating the dendritic patterns. Silver crystals grow in thread-like spikes along the edges of the copper sliver.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School

- MS-PS1 Matter and Its Interactions
 - PS1.A: Structure and Properties of Matter
 - PS1.B: Chemical Reactions

Disciplinary Core Ideas: High School

- HS-PS1 Matter and Its Interactions
 - PS1.A: Structure and Properties of Matter
 - PS1.B: Chemical Reactions

Science and Engineering Practices

- Developing and using models
- Planning and carrying out investigations
- Constructing explanations and designing solutions

Crosscutting Concepts

- Cause and effect
- Energy and matter
- Structure and function

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of *The World's Smallest Christmas Tree* activity, presented by Bob Becker, is available in *Copper, Silver and Gold Redox Reactions* and in *Favorite Holiday Demonstrations*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *The World's Smallest Christmas Tree* are available from Flinn Scientific, Inc.

Catalog No.	Description
C0182	Copper Strips, 1.2 × 15 cm, Pkg. of 6
S0274	Silver Nitrate, AgNO ₃ , 5 g
ML1382	Cover Slips, Glass, 1 oz Pkg.
ML1398	Microscope Slides, Glass, Pkg. of 72
AP8949	Scissors, Heavy-Duty

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.