

THE SILVER MIRROR REACTION

(Tollen's Test)

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Materials Needed

Solutions:

Silver nitrate, AgNO_3 , 0.10 M (Dissolve 17 g AgNO_3 in distilled water to make 1.0 L of solution.)

Potassium hydroxide, KOH , 0.80 M (Dissolve 22.4 g KOH in distilled water to make 500 mL of solution.)

Dextrose, $\text{C}_6\text{H}_{12}\text{O}_6$, 0.25 M (Dissolve 11.2 g dextrose in distilled water to make 250 mL of solution.)

Ammonia, NH_3 , concentrated (15 M)

Nitric acid, HNO_3 , concentrated (16 M)

Apparatus:

Glass container: Florence or round bottom flask, Erlenmeyer flask, bottle, or other suitable container, one liter or smaller. The container may be precleaned with nitric acid and rinsed with distilled water before the experiment.

Rubber stopper or cork to fit flask or bottle

Beaker, 150 or 250 mL

Graduated cylinders, 10 mL, 25 mL and 50 mL

Medicine dropper

Stirring rod

Safety Precautions

Wear safety goggles at all times in the laboratory.

Mixtures of AgNO_3 , NH_3 , and KOH will form an explosive precipitate (probably silver nitride) if allowed to stand. The Tollen's reagent should be prepared fresh for each procedure. Any unused reagent should be poured into the appropriate waste container in the laboratory and the container rinsed at least four times with large volumes of water.

The silver flask or bottle should be rinsed well with water to prevent formation of explosive silver nitride.

Nitric acid is corrosive. Exercise care in handling and work in a hood to minimize fumes. If any gets on the skin, rinse well with water for 10 to 15 minutes. If reddening or blistering occurs, seek medical assistance. Nitric acid will leave yellow stains on the skin that will persist for several days.

Ammonia fumes are irritating and toxic. Work under a fume hood or in a well ventilated area. If any ammonia solution gets on the skin, rinse well with water.

Disposal

Solutions should be disposed of in the appropriate waste containers in the laboratory.

All glassware must be rinsed at least four times with large volumes of water.

If recovery of the silver is desired, acidify the solution with nitric acid before attempting recovery. The flask, or other glassware, can be cleaned with concentrated nitric acid.

Procedure

NOTE: This procedure is designed for a 125 mL flask (or 4 oz. bottle). Adjust volumes of solutions for larger or smaller flasks according to the *Equivalents* section, at the end of this experiment.

Place 30 mL of silver nitrate solution in a 150-mL or 250-mL beaker. Add concentrated (15 M) ammonia dropwise, with stirring, until the brown precipitate just dissolves. Add 15 mL of potassium hydroxide solution. If the brown precipitate reforms, add additional ammonia solution, dropwise, until it dissolves.

Pour 3 mL of dextrose solution into the flask. Add the contents of the beaker and stopper the flask. Shake the flask so that the liquid comes in contact with the entire inner surface of the flask. The silver film should begin to form within about 1 minute. Continue to shake until the flask has a silver mirror coating (this may take about 5 minutes).

Dispose of the solution and rinse the flask well with water (at least four complete rinsings).

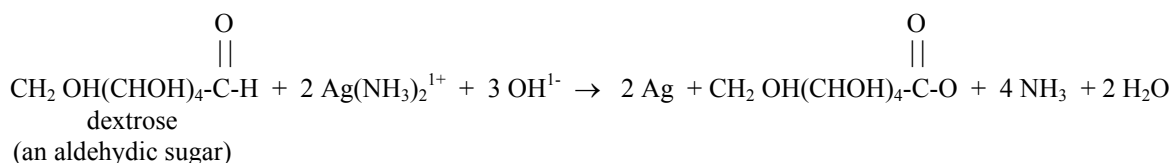
After the flask has dried completely, it may be stoppered with a cork, rubber stopper, or appropriate cap.

The flask may be used as a Christmas tree ornament by attaching a wire tree hanger to the cork or stopper (a screw eyelet may be needed in the cork or stopper.) A drop of super glue placed at top of the flask, at the edge of the stopper, will help to hold the stopper in place.

The coating in the flask or bottle is permanent. Keep the flask or bottle stoppered to prevent oxidation. Do not add any liquids to the container as it will remove the silver from the glass.

Explanation

The Tollen's test is used to detect the presence of aldehyde groups. The reaction that takes place is:



Acknowledgement

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Equivalents for Other Size Containers:

For a **50-mL** flask or container, use:

- 10 mL silver nitrate solution
- 7 mL potassium hydroxide solution
- 2 mL dextrose solution

For a **250-mL** flask or container, use:

- 60 mL silver nitrate solution
- 30 mL potassium hydroxide solution
- 6 mL dextrose solution

For a **500-mL** flask or container, use:

- 120 mL silver nitrate solution
- 60 mL potassium hydroxide solution
- 12 mL dextrose solution