Reaction of Iodine and Aluminum

Synthesis Reactions

Introduction

Synthesis reaction releases light and heat.

Concepts

- Chemical Reaction
- Synthesis, addition, combination reaction
- Formula and balanced equation writing

Materials

Aluminum, powder, 0.5 g
Iodine crystals, 4 g
Water
Beral pipet
Evaporating dish, borosilicate glass
Mortar and pestle

Safety Precautions

Iodine is toxic by ingestion or inhalation. It reacts violently with reducing materials, sulfur, iron, alkali metals, metal powders and phosphorus. Iodine irritates the skin; and is corrosive to eyes and respiratory tract. Inhalation of vapors or ingestion may be fatal. Fine aluminum powders can form an explosive mixture with air. The reaction product, aluminum iodide reacts violently with water. If heated aluminum iodide produces flammable vapor which may explode if mixed with air and ignited as well as is corrosive to all body tissue. Avoid contact of all chemicals with eyes and skin. Follow all laboratory safety guidelines. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information. Remember to wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

1. Use a mortar and pestle to grind the iodine crystals into a fine powder.
2. In a fume hood, add approximately 4 g of the finely ground iodine crystals and 0.5 g of aluminum powder to the evaporating dish.
3. Mix the two powders well and mound to the middle of the dish. Make a small indentation in the center of the powder.
4. Add 3–4 drops of water to the powders, being careful not to inhale the vapors that will be produced.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines on specific procedures governing the disposal of laboratory waste. The waste aluminum iodide may be disposed of by reacting very small amounts with water over time, neutralizing, decanting and then disposing of the liquid down the drain with plenty of excess water and disposing of the precipitate in the trash, according to Flinn Suggested Disposal Method #1b.

Disposal of Anhydrous Aluminum Iodide

Safety Precautions

Anhydrous aluminum iodide reacts violently with water and is corrosive to body tissue. The solid gives off smoky, irritating fumes of hydrogen iodide upon reaction with moisture in air. Carry out the following procedure in an operating fume hood only. Wear chemical splash goggles, chemical-resistant gloves, and a lab coat or chemical-resistant apron with arm covering.

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Materials

Aluminum iodide, AlI_3, 2 g
Ice
Water
Beaker or large plastic bucket, 1-L
Magnetic stirrer and stir bar or large stirring rod
Spatula or scoop
pH paper
Thermometer
Wash bottle
Weighing dish, large

Procedure

1. Fill a 1-L beaker or large bucket about one-half full with ice water.
2. Add a stir bar to the ice water; place the beaker on a magnetic stirrer, and start stirring.
3. Working in the fume hood, pour the solid aluminum iodide into a large weighing dish.
4. *Carefully* add one very small scoopful of aluminum iodide to the ice water.
5. Smoky white fumes of HI will be released as the AlI_3 reacts with water. Wait 10–30 seconds for the vapor to dissipate before adding additional aluminum iodide.
6. Continue adding solid aluminum iodide in small increments after the white fumes have dissipated. Some spattering of the solid may occur as the aluminum iodide reacts with water. Wear gloves and a lab coat and work slowly and carefully—monitor the temperature as needed to help moderate the reaction of aluminum iodide with water. Add more ice if necessary.
7. Rinse the evaporating dish with ice-cold water and pour the rinse water into the large beaker as well.
8. After all of the aluminum iodide has been added, remove the beaker from the magnetic stirrer. Allow the beaker to stand in the hood for 1–2 hours to allow the HI vapors above the liquid to dissipate. Check the vapor space with moistened pH paper to be sure there are no more HI fumes before going on to the next step.
9. Check the pH of the cloudy, off-white solution. The pH should be between 3 and 4. Neutralize with sodium carbonate, if necessary.
10. Dispose of down the drain with a large excess of cold running water.

Tips

- The iodine from the reaction may stain nearby items. In preparation, please remove all unnecessary items from the demonstration area.
- The reaction can also be done using bromine instead of iodine, please see reference for safety and procedure.

Discussion

Two solid elements react in the presence of water to form aluminum iodide.

$$2Al(s) + 3I_2(s) \rightarrow 2AlI_3(s)$$

The reaction is very exothermic and may burst into flame. The heat of the reaction will sublime the I_2 sending a deep purple plume into the gaseous phase. The aluminum is the reducing agent becoming oxidized by donating electrons and the iodine is the oxidizing agent becoming reduced by accepting electrons.

$$Al \rightarrow Al^{3+} + 3e^-$$

$$I_2 + 2e^- \rightarrow 2I^-$$

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter, transfer of energy
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure of atoms, structure and properties of matter, chemical reactions, motions and forces, conservation of energy and increase in disorder, interactions of energy and matter

References

Shakhashiri, B. Z. *Chemical Demonstrations: A Handbook for Teachers in Chemistry;* University of Wisconsin: Madison, WI; 1983; Vol. 1, p. 68.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Reaction of Iodine and Aluminum* activity, presented by John Mauch, is available in *Synthesis Reactions,* part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Reaction of Iodine and Aluminum* are available from Flinn Scientific, Inc.

Catalog No.	Description
A0021	Aluminum, Powder, 100 g
I0006	Iodine, Reagent, 25 g
AP2253	Beral-Type Pipets, Pkg/20
GP3005	Evaporating Dish, Borosilicate Glass, 90 mL Capacity
AP8258	Mortar, Porcelain, Coors
AP8261	Pestle, Porcelain Coors

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