Glow Light

Chemiluminescence Using Luminol

Introduction

Turn out the lights and watch as two cold chemical solutions are mixed together to produce a glowing iridescent blue color. The solution actually glows in the dark!

Concepts

- Chemiluminescence
- Oxidation–reduction

Materials

Luminol, 0.15 g
Sodium hydroxide solution, NaOH, 1 M, 300 mL
Sodium hypochlorite solution, 0.5% available chlorine*, 300 mL
Balance
Beakers, 400-mL, 2
Beaker, large (at least 600-mL)
Funnel
Graduated cylinder, 250-mL
Graduated cylinder, 500-mL
Ice-water bath
Ring stand setup
Tape, clear
Tubing, clear plastic

**Note:* Standard laundry bleach (a 5% sodium hypochlorite solution) has 5% available chlorine. A 10% bleach solution with 0.5% available chlorine is needed for this demonstration. See *Preparation* instructions below.

Safety Precautions

Luminol/sodium hydroxide solution is corrosive; skin burns are possible; it is very dangerous to eyes. Sodium hypochlorite solution is also a corrosive liquid; causes skin burns; evolves chlorine gas when heated or upon reaction with acid; toxic by ingestion; avoid contact with organic material. 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.

Preparation

To make a 10% bleach solution, measure out 10 mL of standard laundry bleach. Dilute to 100 mL with distilled or deionized water.

Procedure

1. Mass out 0.15 g of luminol. Add it to 300 mL of 1 M NaOH solution in a 400-mL beaker.
2. Pour 300 mL of 10% bleach solution into another 400-mL beaker.
3. Chill both solutions in an ice-water bath. The solutions should be as cold as possible to produce a longer reaction.
4. Coil a piece of clear plastic tubing around a 500-mL graduated cylinder, taping it in place with clear tape. Place a funnel at the top using a ring stand setup (see Figure 1).

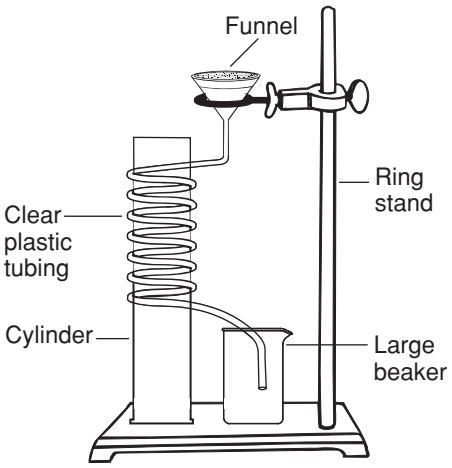

Figure 1.

5. Darken the room completely to best view the chemiluminescence reaction.
6. Gradually add the two solutions to the funnel simultaneously. The glowing solution will move down through the coiled tube and can be collected in a large beaker (at least 600-mL), where it continues to glow.
7. Observe the blue glow-in-the-dark solution.

Publication No. 463
032317

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The resulting solution may be rinsed down the drain with excess water according to Flinn Suggested Disposal Method #26b.

Connecting to the National Standards

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

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
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 and properties of matter, chemical reactions, interactions of energy and matter

Tip

- The colder the solutions, the slower the reaction and the longer lasting the chemiluminescence. For best results, the solutions should be chilled in an ice bath or freezer for at least an hour.

Discussion

Chemiluminescence is the emission of energy in the form of light due to a chemical reaction. Chemical energy is converted into light energy, which is seen as a blue glow.

In this demonstration, the sodium hypochlorite (bleach) solution acts as an oxidizing agent to convert luminol to an excited-state intermediate. The decay of the excited-state intermediate to the ground state occurs with the emission of light (see Figure 2).

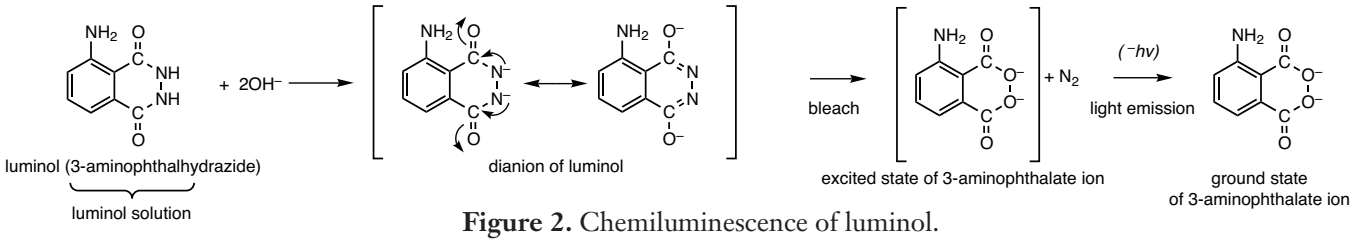

Figure 2. Chemiluminescence of luminol.

Acknowledgment

Special thanks to Jim and Julie Ealy, The Peddie School, Hightstown, NJ, who provided us with the instructions for this activity.

References

Alyea, Hubert N. and Dutton, F. B., *Tested Demonstrations in Chemistry*, Chemical Education Publishing Company, 1965, pp. 18, 81, 130, 186.

Fieser, L. F. and Williamson, K. L., *Organic Experiments*, 3rd ed., Heath; Lexington, MA, 1975; p 256.

Fuchsman, W. H. and Young, W. G., *J. Chem. Ed.*, 1976, 53, 548.

Materials for *Glow Light* are available from Flinn Scientific, Inc.

Catalog No.	Description
L0031	Luminol, 1 g
S0148	Sodium Hydroxide Solution, 1 M, 500 mL
S0079	Sodium Hypochlorite Solution, 500 mL

Consult the Flinn Scientific website for current prices.