Instant Light Crystals

Chemiluminescence

Introduction

Add several teaspoons of Instant Light crystals to water and watch as the solution instantly produces an eerie blue glow that will last for several minutes.

Concepts

- Chemiluminescence
- Oxidation–Reduction

Materials

Clorox 2,® powder form, 64 g ***or*** Instant Light Kit
Luminol, 0.2 g
Potassium ferricyanide, $K_3Fe(CN)_6$, 4 g
Water, distilled or deionized, 400 mL
Beakers, 400-mL, 2–3
Magnetic stirrer and stir bar

Safety Precautions

Potassium ferricyanide will emit poisonous fumes of hydrogen cyanide if heated or placed in contact with concentrated acids. Clorox 2 powder may be irritating to mucous membranes. 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

Prepare Instant Light crystals: Mix the dry ingredients thoroughly in a 400-mL beaker, but do not grind! Try mixing the luminol and potassium ferricyanide together first and then add the Clorox 2 with frequent stirring. Lastly, pour the dry mixture from one beaker to another beaker to ensure a homogenous mixture. Do this last step in an operating fume hood to reduce airborne dust.

Procedure

1. Fill a beaker with distilled or deionized water, and place the beaker on a magnetic stirrer. The size of the beaker and amount of water is up to you.
2. Turn off the lights in your classroom.
3. Add some Instant Light crystals to the water. About two teaspoons for every 200 mL water works well.
4. The blue chemiluminescent glow will begin instantly and last for several minutes.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Allow the Instant Light solution to fully react (stir for 15 minutes) and then flush down the drain with excess water according to Flinn Suggested Disposal Method #26b.

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Tips

- Clorox 2 is a commercial product. Due to formulation variations of the Clorox 2, actual times of the chemiluminescent glow may vary greatly from one batch to another. The glow should last from 90 seconds to 5 minutes depending on the formulation. To enhance the glow, make sure the room is completely dark.
- Adding a small amount of a fluorescent dye along with the luminol will produce different colors of light. Try small amounts (0.005 g) of disodium fluorescein (yellowish green) or Rhodamine B (red).
- Use hot or cold water to see how temperature affects the kinetics of the chemiluminescent reaction.
- Sprinkle Instant Light crystals on a wet towel; they will light up like stars.

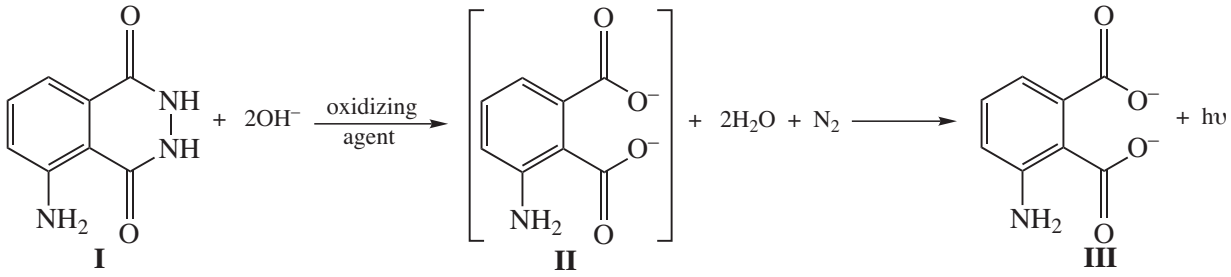
Discussion

Chemiluminescence is defined as the production or emission of light that accompanies a chemical reaction. Light emission results from the conversion of chemical energy into light energy due to changes in the composition of a chemiluminescent material. The "flame test" colors observed when different metal salts are burned in a Bunsen burner flame are examples of a type of chemiluminescence known as pyroluminescence. The oxidation of luminol (3-aminophthalhydrazide) in this demonstration is another well-known example of chemiluminescence.

The light-producing chemical reactions of luminol were discovered by H. O. Albrecht in 1928. Since that time numerous procedures have been developed to produce light using luminol. Experiments have shown that the following "ingredients" are necessary for luminol to exhibit chemiluminescence—a basic (alkaline) pH, an oxidizing agent, and a catalyst. In this demonstration, the oxidizing agent is Clorox 2, which also maintains the basic pH needed, and the catalyst is the iron(III) cation in potassium ferricyanide.

Oxidation of luminol and the resulting chemiluminscence occurs in the following sequence of reactions:

1. Chlorox 2 acts as a base and converts luminol (structure I) into a dianion.
2. Chlorox 2 oxidizes the dianion form of luminol to aminophthalate ion (structure II), which is produced in an excited electronic state (electrons not occupying their lowest energy orbital).
3. The excited aminophthalate ion decays to a lower energy ground state and gives off light in the process (structure III). The emitted light has a wavelength of 425 nm, which is in the blue region of the visible spectrum.



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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, chemical reactions, interactions of energy and matter

Reference

Shakhashiri, B. Z. *Chemical Demonstrations;* University of Wisconsin: Madison, 1992; Vol. 1, pp 156–167.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Instant Light Crystals* activity, presented by Peg Convery, is available in *Chemiluminescence*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

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

Materials required to perform this activity are available in the *Instant Light—An Easy Chemiluminescence Demonstration* available from Flinn Scientific. Materials may also be purchased separately.

Catalog No.	Description
AP9118	Instant Light—An Easy Chemiluminescence Demonstration
L0031	Luminol, 1 g
P0050	Potassium ferricyanide, 100 g
F0043	Fluorescein, 25 g
R0008	Rhodamine B, 25 g

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