Chemiluminescence

Kitchen Table Demonstration

The Rundown

Time: 10 - 15 minutes
Content: chemiluminescence
Safety Concerns: Heightened safety concerns in darkness
Materials Availability: No common substances, except for sodium bicarbonate (baking soda).

Did you ever wonder how they got those light sabers to glow in the *Star Wars* movies? Or did you ever wonder how the light sticks at a carnival or parade naturally give off light in darkness without a power supply? The answer is chemiluminescence. We see it more often than we think. Chemiluminescence is what we see when a firefly lights up. It is the mechanism of the bright lure of the angler fish in the film *Finding Nemo*. This process is not just something that only can happen in nature. We can produce in a lab too!

Content Application

- Chemiluminescence
- Energy
- Light
- Wavelength
- Frequency

Enduring Understandings

- Chemiluminescence is the generation of electromagnetic radiation in the form of visible light by the release of light from a chemical reaction.

Chemistry

As stated above, **chemiluminescence** is the generation of light by the release of light with limited heat emission through a chemical reaction.

The basic principle behind any type of light-producing reaction involves the excitation of a molecule from its ground state into an excited state. In chemiluminescence, the energy for this excitation is generated through a chemical reaction. Upon returning to ground state, a photon of light is emitted from the molecule with a characteristic wavelength and frequency, and an energy equal to the transition taking place.

In this demonstration, a chemiluminescence reaction occurs between the compound, luminol, and several other chemicals.

Materials

1. Sodium Carbonate 10 hydrate Na_2CO_3•H_2O
2. Sodium Bicarbonate $NaHCO_3$
3. Luminol (3-aminophthalhydrazide)
4. Ammonium Carbonate Monohydrate $(NH_4)_2CO_3$•H_2O
5. Copper (II) Sulfate 5 hydrate $CuSO_4$•$5H_2O$
6. 2 ea. – 1 Liter Erlenmeyer Flasks
7. 2 ea. – 400mL glass beaker

Safety

- Goggles and lab apron are necessary safety gear.

Procedure

1. Add 500mL of deionized water to a 1L Erlenmeyer flask labed solution A.
2. Add 10.7g of sodium carbonate to solution A. Stir.
3. Add 0.2g luminal to solution A. Stir.
4. Add 24.0g of Sodium Bicarbonate to solution A. Stir.
5. Add 0.5g of Ammonium Carbonate to solution A. Stir.
6. Add 0.4g of Copper Sulfate to solution A. Stir.
7. Add Deionized water to Solution A flask to a final volume of 1L.
8. Add 950mL of deionized water to a 1L Erlenmeyer flask labeled solution B.
9. Add 50mL 3% hydrogen peroxide to solution B. Stir.

10. Pour equal amounts (about 100mL) of Solution A and Solution B into separate beakers.
11. Dim the lights and then mix the two solutions in the beakers together.

Disposal

- Dispose of the resulting solution in an organic waste container.

Student Participation and Follow-Up

Questions to ask:

1. Within what region of the electromagnetic spectrum would the light produced in the reaction fall under?

2. Describe what is happening at the molecular level which results in the production of light.

3. Provide other examples of chemiluminescent reactions that you have observed.

Real Life Application:

1. The luminal chemiluminescnce reaction is used by criminalists to detect traces of blood at a crime scene. Luminol powder is mixed with hydrogen peroxide and the mixture is sprayed over the scene. The iron in the hemoglobin protein of in blood serves as a catalyst for the chemiluminescent effect. Using an iron compound, set up a fictitious crime scene in your classroom over which you spray this same type of solution to detect the presence of "blood."