Research Experience for Teachers (SRET)

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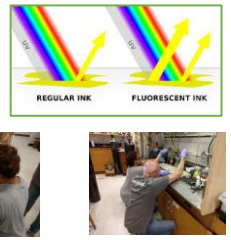
Introduction

Human eyes can interpret only a narrow range of wavelengths of electromagnetic waves known as visible light (390 nm – 700 nm). Different of wavelength within that range are perceived as different colors. Light is a form of energy emitted by the sun as well as light-producing objects on Earth. Light can be absorbed, transmitted, refracted, and/or reflected (scattered) by objects depending on their properties, the type and angle of light that hits the object. Some materials can absorb high energy light (ultraviolet light) known as visible light and emit lower energy light (visible light) such as when your neon clothes "glow" under black light. "

In the case of this research experience the fluorescence properties were explored using a particular wavelength (365 nm) of light that is being absorbed and the visible light that is being emitted.

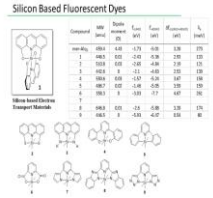



$$2\,C_{19}H_{13}N_5 + 4\,C_6H_{15}N + SiCl_4 \longrightarrow C_{38}H_{22}N_{10}Si + 4\,C_6H_{16}NCl$$
Si(Bzimpy)$_2$

$$2\,C_{17}H_{13}NO_2 + 4\,C_6H_{15}N + SiCl_4 \longrightarrow C_{34}H_{22}N_2O_4Si + 4\,C_6H_{16}NCl$$
Si(BHPP)$_2$

Research Goals

- To characterize fluorescent dyes that can be used in Light Emitting Diodes (LED)
- To learn how to use the Flourolog Instrument for characterization of fluorescence properties of various dyes

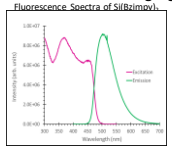


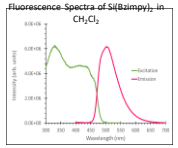
- **Nanometers** and **Nanoseconds** are tiny measurements that scientist use.
- **Nao** means 1 billionth of a meter or second, which written in exponents is 1×10^{-9} m or s.
- **Absorption**: how much light a substance takes in (Absorb)
- **Emissions**: how much light a substance gives off (Emit)
- **Excitation**: when light energy is applied to a molecule it is excited
- **Photons**: light
- **Lifetime**: A measure of the time a fluorophore spends in the excited state before falling back to the ground state by **emitting** a **photon**. The **lifetime** of fluorophores are measured in units ranging from picoseconds to of **nano**seconds.

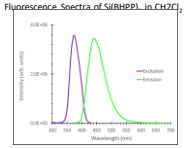
Data

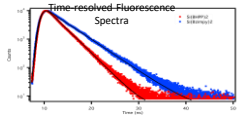
Fluorescence occurs when a source of energy excites **molecules**, making them release packets of light called **photons**. When **ultraviolet light** is absorbed into the sample solution the absorbed energy causes the **molecules** to become excited. When energy is being released in the form of visible light, the **molecules** return to their initial relaxed state.

In the case stated above, the **molecules** are excited via light but there are other ways to excite molecules. For example via heat such as burning fire wood or fireworks or as a result of a **chemical reaction** like breaking a glow stick.

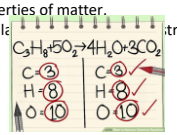






Standards

6.P.1.2 Explain the relationship among visible light, the electromagnetic spectrum, and sight.
6.P.3.2 Explain the effects of electromagnetic waves on various materials to include absorption, scattering, and change in temperature.
8.P.1.1. Classify elements, compounds and mixtures based on atom arrangement.
8.P.1.2. Use the periodic table to identify elements based on information about physical properties.
8.P.1.2. Use the periodic table to predict chemical reactions.
8.P.1.3 Identify the properties of matter.
8.p.1.4. Explain how a bala[illegible]trates the Law of Conservation of Mass.



Acknowledgments

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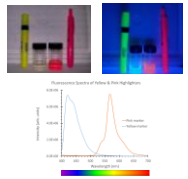
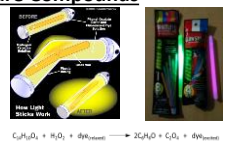
Labs

Mixtures & Pure Compounds

Mixtures

- **Mixtures** are physical combinations of two or more different substances that retain their own individual properties and are combined physically (mixed together).
- **Mixtures** can be separated by physical means (filtration, sifting, or evaporation). Characteristic properties can be used to identify different materials and to separate a mixture into its components.
- **Mixtures** may be heterogeneous or homogeneous.
  - In a heterogeneous mixture, which is not uniform throughout, the component substances can be visibly distinguished. Tossed salad, granite, and iced tea are examples of heterogeneous mixtures.
  - In a homogeneous mixture, which is uniform throughout, the substances are evenly mixed and cannot be visibly distinguished. Air, steel, clear salt-water are examples of homogeneous mixtures.

Compounds

- **Compounds** are pure substances that are composed of two or more types of elements that are chemically combined.
- **Compounds** can only be changed into simpler substances called elements through chemical changes.

Physical vs Chemical Changes

Physical properties can be observed and measured without changing the kind of matter being studied. The following **physical properties** can be used to help identify a substance:

Boiling Point
Melting Point
Density
Color

Chemical Properties can also be used to help identify a substance. **Chemical properties** can be recognized only when substances react or do not react chemically with one another, that is, when they undergo a change in composition.

How to differentiate between physical and chemical changes?

- **Physical changes** do not change the composition of a substance, only the physical properties. Evidences of a physical change include:
  - Change in state of matter
  - Change in size or shape
- **Chemical changes** result in the formation of one or more new substances with new chemical and physical properties. Evidences that a chemical change may have occurred include:
  - Color change
  - Temperature change
  - Formation of a precipitate
  - Formation of a gas


Fluorescence Spectra of Tonic Water