# Seven kinds of light by chemical reaction chemiluminescence by oxalate ester


**Yumi Sato, Yuri Tokushige, Atsuki Nishikawa[1], Kazuya Sato, Mineki Yamamoto[2]**

Meiwa Senior High School, [1]Gojo Senior High School, [2]Toyota-nishi Senior High School, Tokyo, Japan. E-mail: stuym-16.39@wh.commufa.jp

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**ABSTRACT**

This group became interested in the light that is given off in chemiluminescent reactions and by chlorophyll. The intensity, wavelength, and quantity of light was measured from several chemical reactions and compared with the light given off by chlorophyll. They found that the properties of the emitted lights are different for each fluorescer. Fluorescers which can emit light have several aromatic rings such as chlorophyll.

## Introduction

The reaction of oxalate ester with hydrogen peroxide makes peroxyoxalate, which contains a lot of potential chemical energy. A fluorescer converts this chemical energy to visible light.[1] Our interest was in the properties of this light. First, different kinds of fluorescer were used for this study and the properties of the light given off examined. Next, we assumed that chlorophyll emits light as a fluorescer – to release excess chemical energy from photosynthetic inefficiencies in the form of light.[1] Red light emitted by chlorophyll has been so far observed.

## Materials and Methods

### Experiment with different fluorescers

A solution was made from bis (2,4,6-trichlorophenol) oxalate (TCPO) and fluorescer and was added to a solution composed of hydrogen peroxide and sodium salicylate. Dimethyl phthalate and tert-butyl alcohol were used as solvents. The temperature of solution was approximately 30 degrees Celsius. Then we took measurements of the intensity and the quantity of light with an optical sensor. The maximum wavelength was measured by means of a spectrophotometer.

### Experiment with chlorophyll

We employed chlorophyll as a fluorescer extracted by tert-butyl alcohol from dogwood leaves, measuring the maximum wavelength of the emitted light with a spectrophotometer.

## Results and Discussion

Table 1 shows that the intensity, the quantity of light,

**Table 1: Experiment 2.1**

| Fluorescer | Intensity [lx=lm·m$^{-2}$] | Quantity of light [10$^{2}$·lm·s·m$^{-2}$] | Max wavelength [nm] |
|---|---|---|---|
| Anthracene | –* | –* | 408 |
| 9,10-Diphenylanthracene | 6 | 0.53 | 438 |
| Perylene | 102 | 21.00 | 477 |
| Naphthacene | 48 | 5.70 | 520 |
| 9,10-Bis (phenylethynyl) Anthracene | 28 | 2.70 | 512 |
| Rubrene | 134 | 27.00 | 564 |
| Rhodamine 6G | 4 | 0.26 | 579 |
| Rhodamine B | 7 | 1.30 | 592 |

*Impossible to measure

and the maximum wavelength of light are different from fluorecser. Figure 1 shows that chlorophyll emits red light.

## Conclusion

Properties of the emitted lights are different for each fluorescer. Fluorescers which can emit light have several aromatic rings and chlorophyll has rings including a metal atom. In future experiments, we will try to find natural dyes that emit light and the optimal conditions for the maximum intensity and quantity of light.

## Acknowledgment

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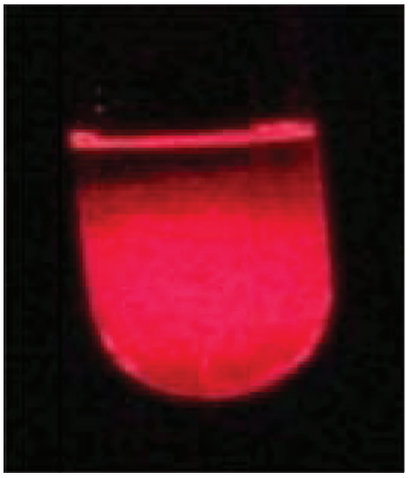

**Figure 1: (Experiment 2.2) The maximum wavelength was 678nm**

## Reference

1. Maxwell K, Johnson GN. Chlorophyll fluorescence: A practical guide. J Exp Bot 2000;51:659-68.

## About the Authors

Everyone in this group is studying Chemistry, Physics, English, Japanese classical literature, modern Japanese, and Maths. Since it is compulsory, they study these at their School.

**Mineki Yamamoto** hopes to be a Japan Air Self Defense Force pilot and enjoys bicycling, reading books, and star gazing.

**Kazuya Sato** also hopes to be a pilot but for an international airline and plays billiards and golf.

**Yuri Tokushige** is interested in Biology, Chemistry, and Nutrition and would love to study Lye. Yuri would like to work in Science. Her hobbies include reading and making sweets.

**Yumi Sato** wants to be a doctor and enjoys reading, listening to music, watching movies, and cooking.

**Atsuki Nishikawa** likes cooking and reading detective stories and science fiction. “I’d like to major in Chemistry at University,” says Atsuki. His dream is to be a professor of Chemistry.