Magical Cyalume

～changing luminescent's color～

Kobe High School science course
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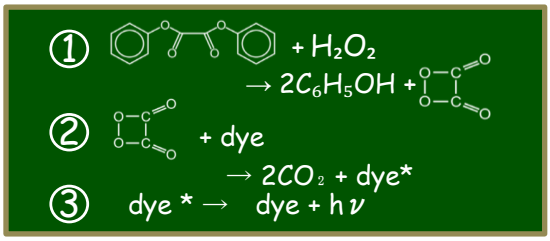
1.What's cyalume?

Cyalume emits light by a chemical reaction without heat.
Cyalume needs an oxalic ester and hydrogen peroxide.
We used diphenyl oxalate as the oxalic ester.



dye…fluorescent substance dye*…excited dye hν…light

2.How to change the luminescent's color

We payed attention to the phenol formed ①.
Phenols turn purple/violet when combined with Fe(Ⅲ) ion.
→We try to change the color of the solution and luminescent's color gradually by this chemical reaction.

3.Method

Experiment Ⅰ

In the reference ,bis oxalate was used in cyalume, but we use diphenyl oxalate to generate phenol.
We mix A in 50mL beaker and B in 100mL beaker.

A

(from right to left)	
dibutyl phthalate	25mL
diphenyl oxalate	75mg
rhodamine-B	25mg

B

(from right to left)	
sodium salicylate	4mg
t-butyl alcohol	10mL
dimethyl phthalate	40mL
35%hydrogen peroxide	2.5mL

Experiment Ⅱ

To check these things, we do experiment Ⅱ.
ⅰ）Fe(Ⅲ) ions turn purple.
ⅱ）Diphenyl oxalate doesn`t allow for the chemical reaction of cyalume.

α1

(from right to left)	
dibutyl phthalate	25mL
diphenyl oxalate	75mL

α2

(from right to left)	
dibutyl phthalate	25mL
bis oxalate	250mL

β

(from right to left)	
sodium salicylate	4mg
t-butyl alcohol	10mL
dimethyl phthalate	40mL
35%hydrogen peroxide	2.5mL
0.1mol/L iron(Ⅲ) chloride aq	1mL

4.Result

Experiment Ⅰ

figure 1

figure 2

We mixed A and B, but the solution didn't emit light. (figure 1)
However, when we added bis oxalate to the solution, the solution emitted light. (figure 2)

Experiment Ⅱ

figure 3 α1 and β

figure 4 α2 and β

We thought that both solutions would turn purple.
But neither solution turned purple.

5.Consideration

Experiment Ⅰ

We think that these things are why the solution didn't emit light.
①Diphenyl oxalate didn't dissolve.
②Diphenyl oxalate can't be used in cyalume.

Experiment Ⅱ

We think that these things are why the color of the solutions didn't turn purple.
①Fe(Ⅲ) ions don't turn purple in an organic solvent.
②Fe(Ⅲ) ions prevent the chemical reaction of cyalume.

Reference
Ayaka Ohhata Rio Kawakami Tsugumi Yano
「新しいケミカルライトの開発」(2015)
第32回高等学校・中学校化学研究発表会