Mahidol University Global Education Office

International Relations Division

Mahidol University

Report for MU Scholarships for Postgraduate Student Exchange Program

Mr. WALEED ALAHMAD

❖ Overview about Okayama University

Okayama University (岡山大学 Okayama Daigaku) is a national universityinJapan. The main campus is located in Tsushima-Naka, Okayama, Okayama Prefecture.The school was founded in 1870 and it was established as a university in 1949. The university's motto is "**Creating and fostering higher knowledge and wisdom**"

- ## Faculties (undergraduate schools)

There are twelve faculties in Okayama University as following:

- Faculty of Letters
- Faculty of Education
- Faculty of Law
- Faculty of Economics
- Faculty of Science
- Medical School
- Dental School
- Faculty of Pharmaceutical Sciences
- Faculty of Engineering
- Faculty of Environomental Science and Technology
- Faculty of Agriculture
- Matching Program Course

- ## Graduate schools

There are seven schools as following:

- Graduate School of Education (Master's courses/Professional Degree Course)
- Graduate School of Humanities and Social Sciences (Master's/Doctoral)
- Graduate School of Natural Science and Technology (Master's/Doctoral)
- Graduate School of Health Sciences (Master's/Doctoral)
- Graduate School of Environmental and Life Science (Master's/Doctoral)
- Graduate School of Medicine, Dentistry and Pharmaceutical Sciences (Master's/Doctoral)
- School of Law

My research lab belongs to Graduate School of Natural Science and Technology.

- ## Campus

There three campuses in Okayama University are Tsushima, Shikata and Misasa campus. Each campus is in the central part of Okayama-city, except the Misasa Campus.

- **Overview about my supervisor in Okayama University**

Takashi Kaneta

Professor

Research field: Analytical Chemistry

Education

B.Sc. (Hokkaido University of Education, Sapporo), M.Sc. (Hokkaido University), D.Sc. (Hokkaido University)

Academic Career

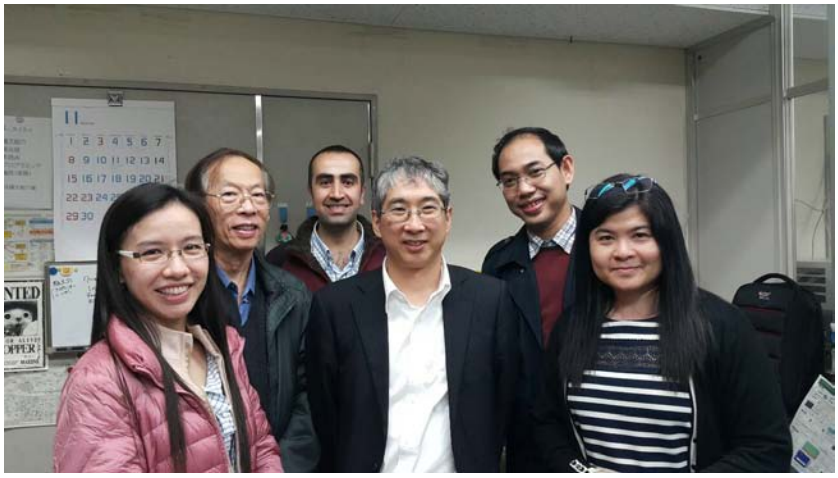
- Assistant Professor, Department of Applied Chemistry, Kyushu University (1992.4-1994.12)
- Associate Professor, Department of Applied Chemistry, Kyushu University (1995.1-2011.3)
- Professor, Department of Chemistry, Okayama University (2011.4-)

Research Interests

- Laser-Induced Fluorometry
- Capillary Electrophoresis
- Single Molecule Detection
- Single Cell Analysis
- Microfluidic Paper-Based Analytical Device.

His lab members

❖ My Thai and Japanese supervisors



My Japanese supervisor Prof. Dr.Kaneta in the middle, my Thai supervisor Assoc. Prof. Dr. DuangjaiNacaprichaon his left-hand side and my Thai co-supervisor Assoc. Prof. Dr. PrapinWilairat on his right-hand side.

❖ **Overview about culture activity**

Visiting Korakuen Garden

Visiting Okayama castle

Hiking stairs at Kagawa prefecture

❖ Overview about my research in Japan

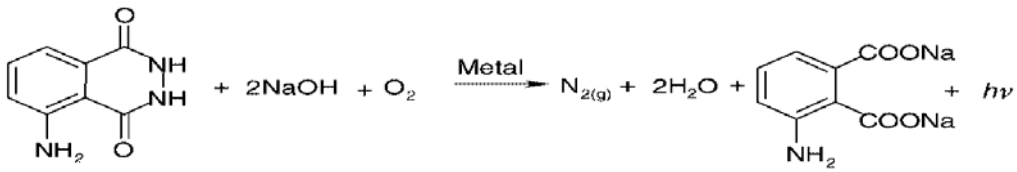
Determination of Chromium (III) in Water Samples by using µPAD and Chemiluminescence Detector

Aim of this work

To determine chromium (III) in water samples by using µPADconsists 6 detection zones, the first five for calibration curve and the last one for sample.

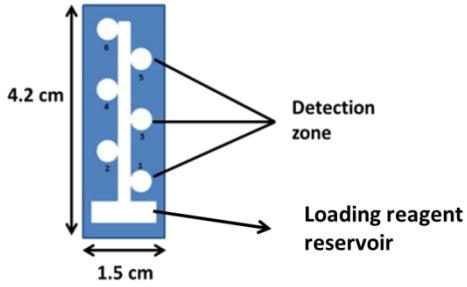
Principle

The CL reaction is based on luminol oxidation by hydrogen peroxide in basic aqueous solution catalyzed by chromium(III).In this case Cr(III) can be determined selectively in the presence of Cr(VI) and other metal ions in the aqueous environment.



Fabrication of the paper device

The µPAD design drew on PowerPoint and printed by wax printer. This µPAD consists 6 circular detection zones (each zone consists 0.20µL standardchromium (III)) and one rectangle reservoir for loading the chemiluminescence (CL)reagent (25µL in this work). The CL reagent will flow sequentially to the detection zones and the signal can record. (The design is able to change according to unexpected problems).

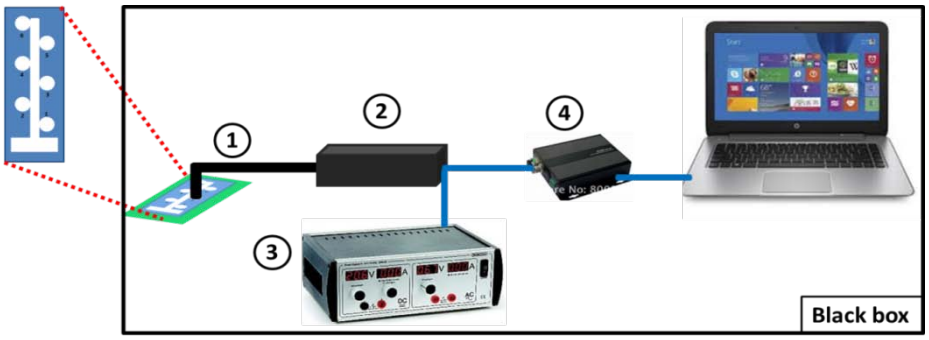


The CL reagent consists:luminol, hydrogen peroxide, NaBrand EDTA in NaHCO3–Na2CO3 buffer. The sodium bromide and carbonate buffer used to enhance the CL signal while EDTA was added to remove the interference of other metal ions. The working standard chromium solutions were prepared in 1.0×10^{-2}mol/L EDTA prior to use.

1. Optimization Study

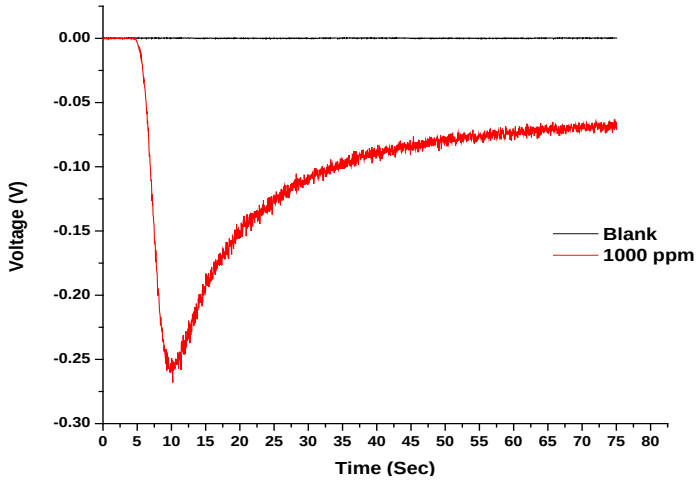
A series of experiments were carried out to establish the optimum conditions by using a Cr(III) concentration of 1000 ppm. In this optimization study, we used only the detection zone number 3.

Manifold



1) Optical fiber. 2) Photomultiplier tube. 3) Voltage power supply. 4) Analog to Digital Voltage converter.

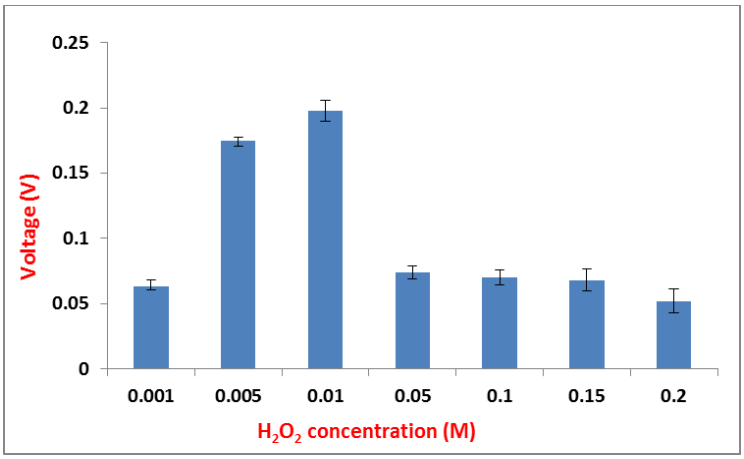
Signal profile:



1.1. Effect of hydrogen peroxide

Optimization range: 1.0×10^{-3} - 2.0×10^{-1} mol/L.

CL reaction solution: 1.0×10^{-3} mol/L luminol, 1.0×10^{-1} mol/L NaBr and 1.0×10^{-2} mol/L EDTA in 5.0×10^{-2} mol/L $NaHCO_3$–Na_2CO_3 buffer, pH of CL reagent 12.1

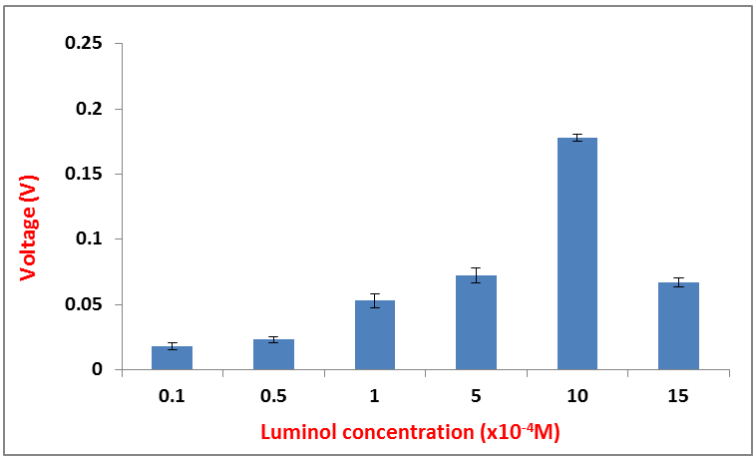


The concentration (0.01M) was chosen for next experiments.

1.2. Effect of luminol concentration

Optimization range: (0.1, 0.5, 1.0, 5.0, 10, 15)$\times 10^{-4}$mol/L.

CL reaction solution:1.0$\times 10^{-2}$mol /L hydrogen peroxide, 1.0$\times 10^{-1}$mol/L NaBr and 1.0$\times 10^{-2}$mol/L EDTA in 5.0$\times 10^{-2}$mol/L $NaHCO_3$–Na_2CO_3buffer, pH 12.1



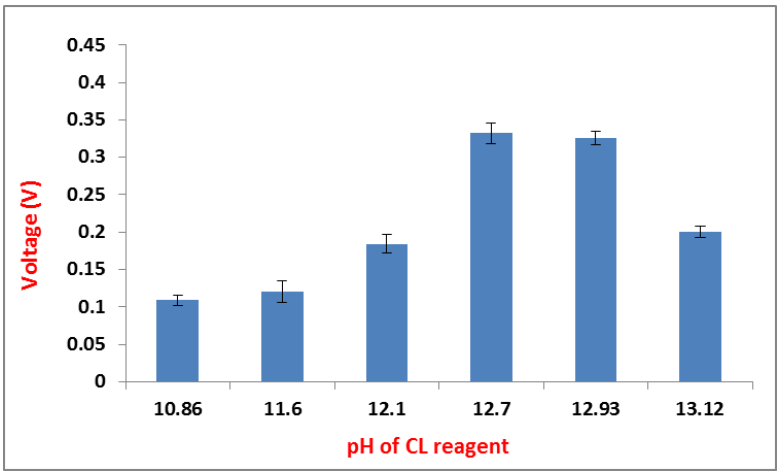
The concentration (10$\times 10^{-4}$ mol/L) was chosen for next experiments.

1.3. Effect of pH CL reagent .

The carbonate buffer which reported to enhance the CL signal in luminol–H_2O_2system was chosen and used in thepreparation of CL solution. Furthermore, luminol–H2O2 system can produce strong CL signal in the alkaline condition, sothe effect of CL reagent pH was needed to investigate by adding NaOH to the reagent solution.

Optimization range: 10.86 – 13.12.

CL reaction solution:1.0×10^{-2}mol/L hydrogen peroxide,1.0×10^{-3} mol/L luminol, 1.0×10^{-1}mol/L NaBr and 1.0×10^{-2}mol/L EDTA in 5.0×10^{-2}mol/L $NaHCO_3$–Na_2CO_3buffer,

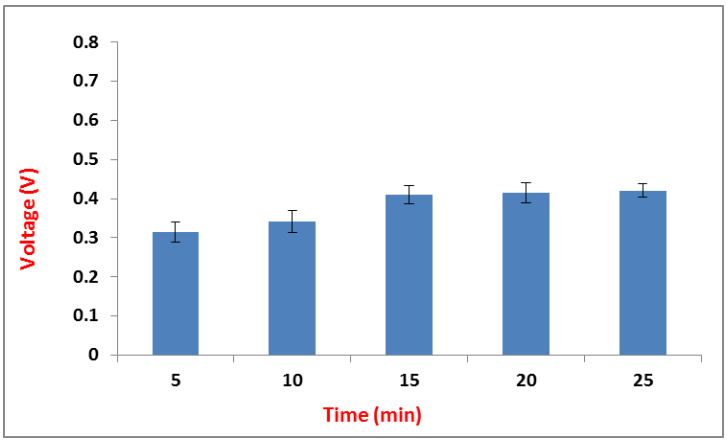


The pH 12.7 was chosen for next experiments. The CL signal started to drop after pH 12.7 because the decomposition of hydrogen peroxide.

1.4. Effect of needed time for stabilizing CL before use.

It was reported in another work [1] that CL reagent was prepared and left to stand for 15 min before used.
From this point, we carry out experiment to investigate the effect of standing time on CL signal, by measure the signal at various times.

Time range: 5-25 minutes
CL reaction solution:1.0×10^{-2}mol/L hydrogen peroxide,1.0×10^{-3} mol/L luminol, 1.0×10^{-1}mol/L NaBr and 1.0×10^{-2}mol/L EDTA in 5.0×10^{-2}mol/L $NaHCO_3$–Na_2CO_3buffer, pH 12.7

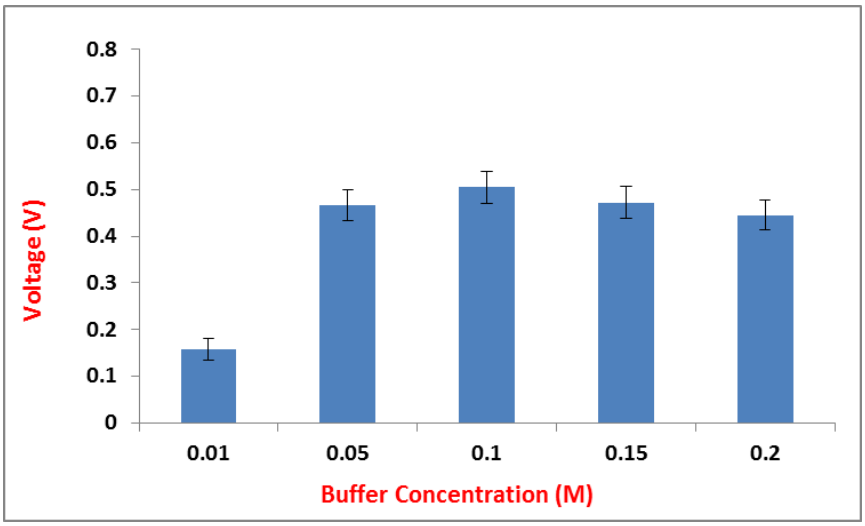


It was able to notice that there is a little difference between 5 to 15 min and the signal is stable after 15. we chose the time (15 min) for next experiments.

1.5. Effect of carbonate buffer concentration

The effect of carbonate buffer concentration was then examined by keeping the pH constant at 12.7.

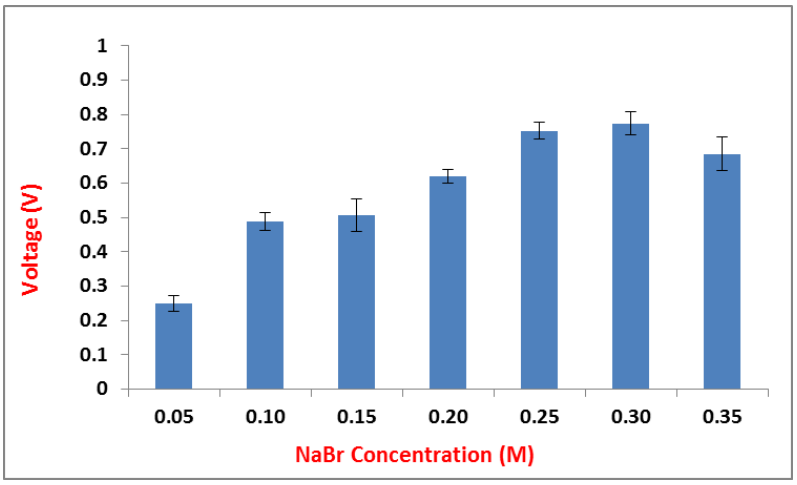
Optimization range: 0.01 – 0.2 M.
CL reaction solution:1.0×10^{-2}mol/L hydrogen peroxide,1.0×10^{-3} mol/L luminol, 1.0×10^{-1}mol/L NaBr and 1.0×10^{-2}mol/L EDTA in ????mol/L $NaHCO_3$–Na_2CO_3buffer,pH 12.7



1.6. Effect of NaBr concentration

NaBrwas added to the luminol solution in carbonate medium in order to enhance the CL signal. In the presence of bromide, the hydroxyl radical is converted into bromide radical with selectively reacts with luminol yielding the luminol radical. Bromide enhances the CL intensity by selectively increasing the steady-state concentration of luminol radical and facilitates its decomposition to give more excited luminol ions.

Optimization range: 0.05 – 0.35 M
CL reaction solution:1.0×10^{-2}mol/L hydrogen peroxide,1.0×10^{-3} mol/L luminol,??????mol/LNaBr and 1.0×10^{-2}mol/L EDTA in 0.1mol/L $NaHCO_3$–Na_2CO_3buffer,pH 12.7



The concentration (0.3M) was chosen for next experiments.

<u>The optimal conditions:</u>

Hydrogen peroxide (0.01M).
Luminol concentration ($10X10^{-4}$M).
Carbonate buffer concentration (0.1M).
NaBr concentration (0.3M).
pH CL reagent (12.7).
required time for stabilizing CL before use (15 min).

2. Analytical features

Analytical parameters	
Limit of detection (ppm)	0.020
Limit of quantitation (ppm)	0.066
Slope of calibration curve	0.350± 0.016
Regression coefficient	0.992 ± 0.014
Linear dynamic range (ppm)	0.05 - 1
RSD (%), (0.5ppm) (n=10)	< 6.5

*** Three injections per sample.**

3. Analysis of real samples.

	This Work			Validation method [a]		
	Added (ppb)	**Found (ppb)**	**Recovery (%)**	**Added (ppb)**	**Found (ppb)**	**Recovery (%)**
Hot Spring	**0**	ND*		**0**	4.69±0.03	
	200	213±0.05	106.38	**200**	199±0.01	96.96
	600	593±0.10	98.82	**600**	576±0.03	95.15
Zasu River	**0**	ND*		**0**	3.74±0.05	
	200	210±0.11	104.96	**200**	206±0.01	101.14
	600	607±0.11	101.18	**600**	594±0.03	98.34
Tap Water	**0**	ND*		**0**	4.16±0.03	
	200	203±0.20	101.65	**200**	201±0.02	98.33
	600	598±0.22	99.61	**600**	604±0.03	99.90

***Not Detected**

[a] **ICP-AES**

❖ Conclusion

I would like to thank the Mahidol University Global Education office, International Relations Division for giving me this great chance to develop my academic skills in research and its related fields. Also, I would like to thank my supervisor Assoc. Prof. Dr. DuangjaiNacapricha for her help and guidance to find the suitable university for my research, and all the thanks for all whose helped me to achieve this research in Japan.