

Project Notes:

Project Title: Using Acid Red 94 to Detect & Quantify Pb²⁺ Ion Concentration in Water

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Note Well: There are NO SHORT-cuts to reading journal articles and taking notes from them. Comprehension is paramount. You will most likely need to read it several times so set aside enough time in your schedule.

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Knowledge Gaps:

This list provides a brief overview of the major knowledge gaps for this project, how they were resolved and where to find the information.

Knowledge Gap	Resolved By	Information is located	Date resolved
How does the dye Acid Red 94 (AR94 also known as rose bengal) bond to lead(II) ions in aqueous solution?	Research	Research articles either online or in pdf format	10/12/19
What is the optimum wavelength for spectroscopy performed on AR94?	Research	Research articles either online or in pdf format	10/12/19
What is the optimum wavelength for spectroscopy performed on complexes of AR94 with lead(II) ions in aqueous solution?	Research	Research articles either online or in pdf format	10/12/19
How does the fluorescence of AR94 change when it bonds to lead(II) ions in aqueous solution?	Research	Research articles either online or in pdf format	10/12/19
What is the ideal concentration of AR94 for detecting and quantifying lead(II) ions in aqueous solution?	Research	Research articles either online or in pdf format	10/12/19
What range of lead(II) ion concentrations in aqueous solution can AR94 detect?	Research	Research articles either online or in pdf format	10/12/19

Literature Search Parameters:

These searches were performed between (Start Date of reading) and 10/11/2019.

List of keywords and databases used during this project.

Database/search engine	Keywords	Summary of search
ScienceDirect	Fluorescence, AR94, concentration	<ul style="list-style-type: none">• Research has been done on the relationships between viscosity, fluorescence, and other properties.• Some include AR94 and/or lead while others have different material fulfilling similar roles.
PubChem	Fluorescence, AR94, concentration	<ul style="list-style-type: none">• The chemical structure for AR94 contains rings.
Royal Society of Chemistry	Fluorescence, AR94, concentration	<ul style="list-style-type: none">• A study has been done relating the fluorescence of AR94 to Ag⁺ ion concentration

Article #1 Notes: **Simple, selective detection and efficient removal of toxic lead and silver metal ions using Acid Red 94**

Source Title	Royal Society of Chemistry
Source Author	Mohamed E. El-Khouly
Source citation	Kamel, G. M., El-Nahass, M. N., El-Khouly, M. E., Fayed, T. A., & El-Kemary, M. (2019, March 13). Simple, selective detection and efficient removal of toxic lead and silver metal ions using Acid Red 94. Retrieved from https://pubs.rsc.org/en/content/articlelanding/2019/ra/c9ra00464e#!divAbstract
Original URL	https://pubs.rsc.org/en/content/articlelanding/2019/ra/c9ra00464e#!divAbstract
Source type	Online scholarly article
Keywords	Acid Red 94, metal ions, lead, silver, dye-metal complex, fluorescence, chemical sensor, nanoparticles
Summary of key points	<ul style="list-style-type: none"> • The interaction between AR94 and both metal ions was proved quantitatively by the absorption and fluorescence spectral changes, and qualitatively by the rapid color change from a pink color (for AR94) to a violet color (for the AR94–Ag complex). • The removal of the accumulated complex (AR94–Ag) was successfully performed using safe and harmless mesoporous titanium dioxide with an adsorption capacity of 91% at 30 min. • The high and fast efficiency of mesoporous TiO₂ was due the generation of radicals which usually react with the free dye particles followed by the formation of several intermediates which are finally mineralized into carbon dioxide and water. • From the notable spectral changes and fast color changes of AR94 with the addition of silver, lead and their nanoparticles, it can be concluded that AR94 can potentially become a sensitive and selective sensor for the qualitative and quantitative detection of the used metal ions and could be used as a visual indicator.

Important Figures

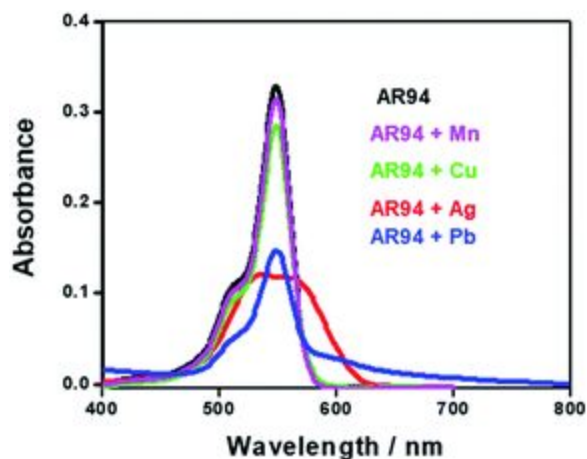


Fig. 1 UV-visible absorption spectra of AR94 in the absence and presence of lead and silver metal ions in water.

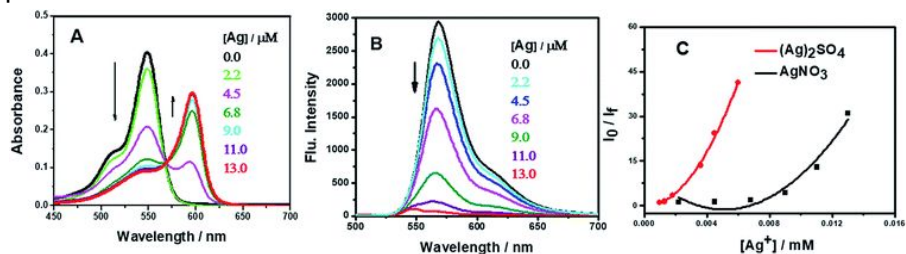


Fig. 2 (A) UV-visible absorption spectra and (B) emission spectra of AR94 with the addition of different concentrations of AgNO_3 ; $\lambda_{\text{ex}} = 460$ nm. (C) Stern–Volmer plots for the fluorescence quenching of AR94 in the presence of Ag metal ions in water.

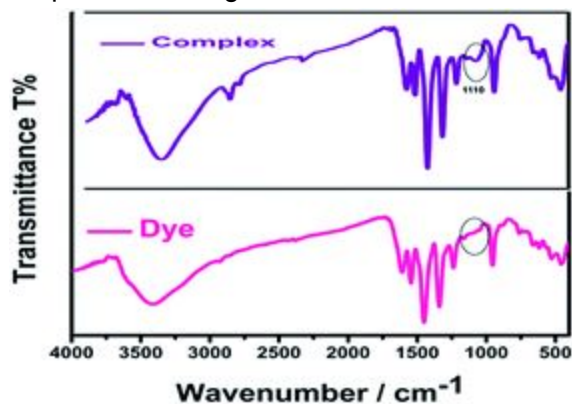


Fig. 5 FTIR spectra of AR94 (lower panel) and the AR94–Ag complex (upper panel).



Scheme 1 Suggested binding mode of AR94 with AgNO_3

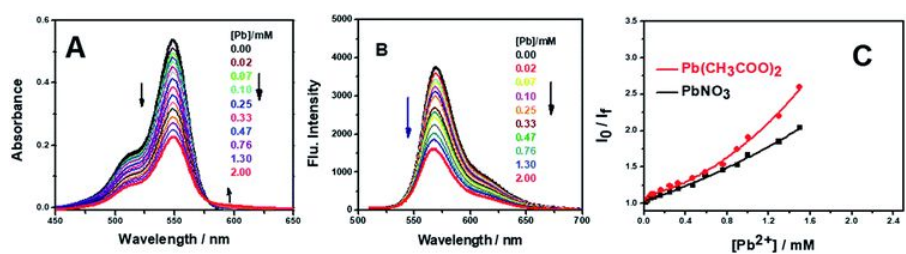


Fig. 6 (A) UV-visible absorption spectra and (B) emission spectra of AR94 in the absence and presence of Pb^{2+} metal ions in water. (C) Stern–Volmer plots for the fluorescence quenching of the singlet AR94 in the presence of lead metal nitrate and lead acetate in water.

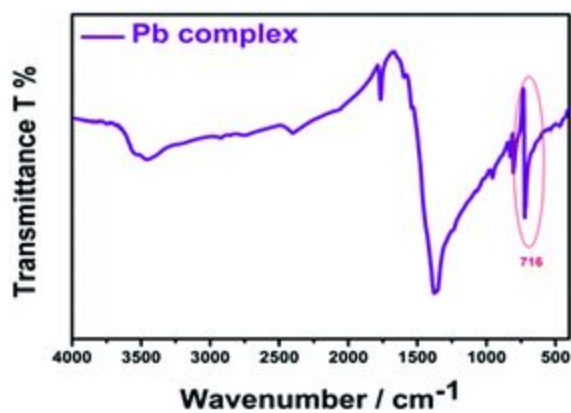


Fig. 7 FTIR spectra of the AR94–Pb complex.

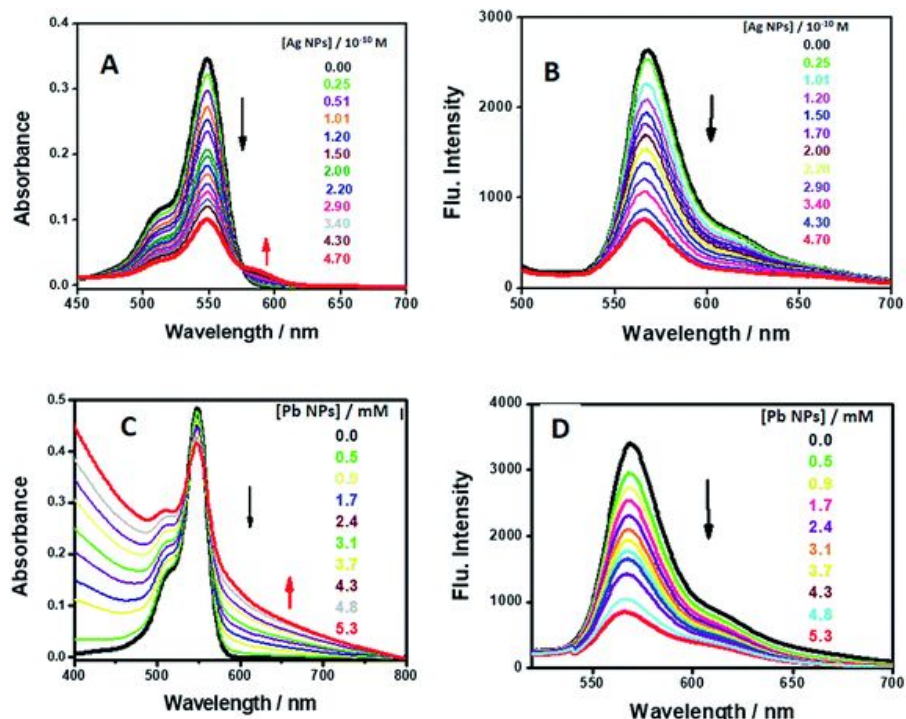


Fig. 9 UV-visible absorption spectra and emission spectra of AR94 in the absence and presence of different concentrations of the synthesized AgNPs (A and B) and PbNPs (C and D).

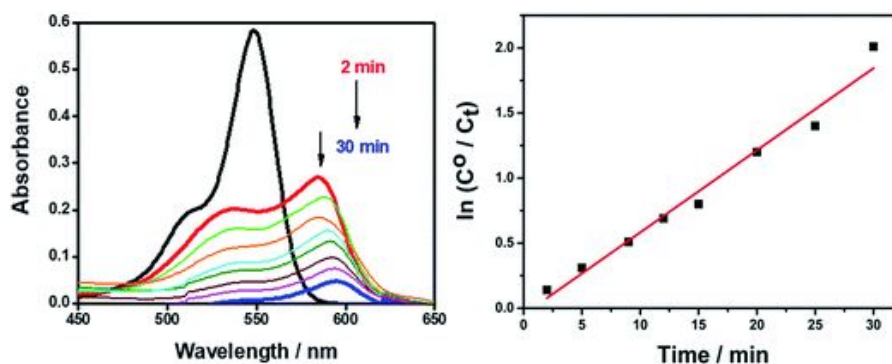


Fig. 11 UV-visible absorption spectra of removing AR94-Ag⁺ complexes using mesoporous TiO₂ under continuous UV radiation.

Reason for interest

I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.

Notes	<ul style="list-style-type: none"> ○ Chemical sensors are becoming more and more important in our life due to their use in several fields including; chemistry, medicine, the environment, food, and agriculture.^{1,2} As is well known, metal ions cause many problems in the human body if they are found in large amounts. ○ Herein, we report the selective and sensitive detection of silver and lead as hazard metal ions using a cheap and easily prepared Acid Red (AR94) dye. To our knowledge, utilizing AR94 as a sensitive chemosensor is rarely reported in the literature. ○ Furthermore, our main goal aimed at studying the ability to use Acid Red 94 dye as a fluorescent chemosensor for the detection of metal ions such as lead and silver qualitatively (using naked eye detection) and quantitatively (using spectroscopic techniques at low concentration levels). ○ We have also examined the electronic interactions of AR94 with silver and lead nanoparticles (NPs). ○ Finally, TiO₂ mesoporous materials have been used as safe and harmless materials for the removal of the accumulated AR94–Ag⁺ complexes from the water under UV radiation in a fast and efficient way.
Follow up Questions	<ul style="list-style-type: none"> ● Are there other chemicals that act similar to AR94? ● Are there other chemicals can be used to detect heavy metal ions more efficiently?. ● Why does AR94 behave the way it does in relation to heavy metals in water? ● What concentration of AR94 was used in this paper?

Article #2 Notes: **Dithizone functionalized CdSe/CdS quantum dots as turn-on fluorescent probe for ultrasensitive detection of lead ion**

Source Title	Dithizone functionalized CdSe/CdS quantum dots as turn-on fluorescent probe for ultrasensitive detection of lead ion
Source Authors	Qin Zhao, Xiaolong Rong, Hongbing Ma, and Guanhong Taoa
Source citation	Dithizone. (2013, February 4). Dithizone functionalized CdSe/CdS quantum dots as turn-on fluorescent probe for ultrasensitive detection of lead ion. Retrieved from https://www.sciencedirect.com/science/article/pii/S0304389413000885?via=ihub#
Original URL	https://www.sciencedirect.com/science/article/pii/S0304389413000885?via=ihub#
Source type	Online Scholarly Article
Keywords	Lead determination, Quantum dots, Dithizone, Turn-on fluorescent probe
Summary of key points	<ul style="list-style-type: none"> • A turn-on probe for lead based on dithizone functionalized QDs was constructed. • Unique properties of QDs were combined with specific Pb²⁺ affinity of dithizone. • High sensitivity and selectivity were achieved by combination of QDs with dithizone. • The fluorescent probe was applied to environmental samples with satisfactory results.

Important Figures

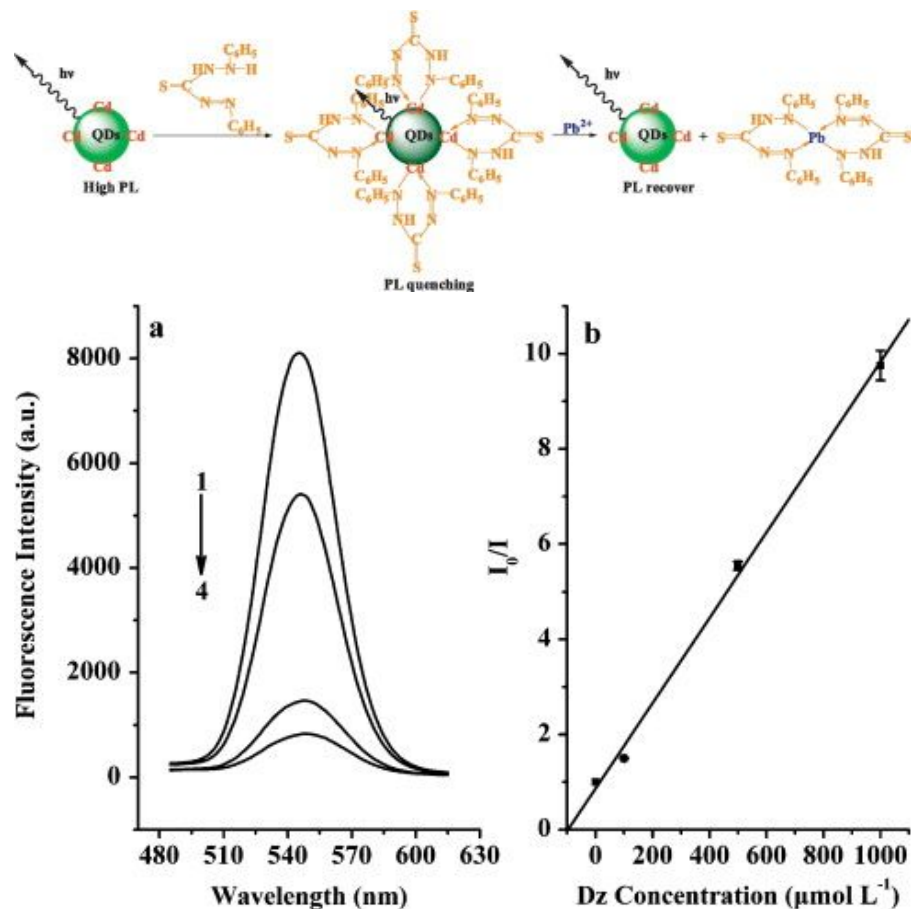


Fig. 1. (a) Fluorescence spectra of Dz-functionalized QDs with the addition of different dithizone concentrations. The dithizone concentrations added for spectrum (1) to (4) were 0, 100, 500 and 1000 $\mu\text{mol L}^{-1}$, respectively. (b) Stern–Volmer relationship between relative fluorescence intensity and dithizone concentration.

Reason for interest

I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver). Dyes from textile industry waste can contain such heavy metals and pollute the environment. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.

Notes

N/A

Follow up Questions	<ul style="list-style-type: none"> • Who is the intended audience? • Are there other substances or materials that behave similar to the quantum dots?
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Article #3 Notes: **Fluorescent sensor based models for the detection of environmentally-related toxic heavy metals**

Source Title	<i>Science of the Total Environment</i>
Source Author	Tahir Rasheed
Source citation	M.N.Iqbal, H., & YongfengZhoua. (2017, October 5). Fluorescent sensor based models for the detection of environmentally-related toxic heavy metals. Retrieved from https://www.sciencedirect.com/science/article/pii/S0048969717324683#f0035 .
Original URL	https://www.sciencedirect.com/science/article/pii/S0048969717324683#f0035
Source type	Online Scholarly Article
Keywords	Fluorescent sensor, Heavy metals, Environmental pollutants, Rhodamine, Detection, Colorimetric
Summary of key points	<ul style="list-style-type: none"> • The controlled or uncontrolled release of hazardous pollutants from various industrial sectors is one of the key problems facing humanity. • Besides their presence at lower concentrations, most of these toxic heavy metals are posing noteworthy toxicological concerns. • In this context, notable efforts from various regulatory authorities, the increase in the concentration of these toxic heavy metals in the environment is of serious concern, so real-time monitoring is urgently required. • This necessitates the exploration for novel and efficient probes for recognition of these toxic agents.

- Among various methodologies adopted for tailoring such probes, generally the methodologies, in which changes associated with spectral properties, are preferred for the deceptive ease in the recognition process.
- Accordingly, a promising modality has emerged in the form of radiometric and colorimetric monitoring of these toxic agents.
- Second, recent advances regarding small molecule and rhodamine-based fluorescent sensors, radiometric and colorimetric probes are discussed.

Important Figures

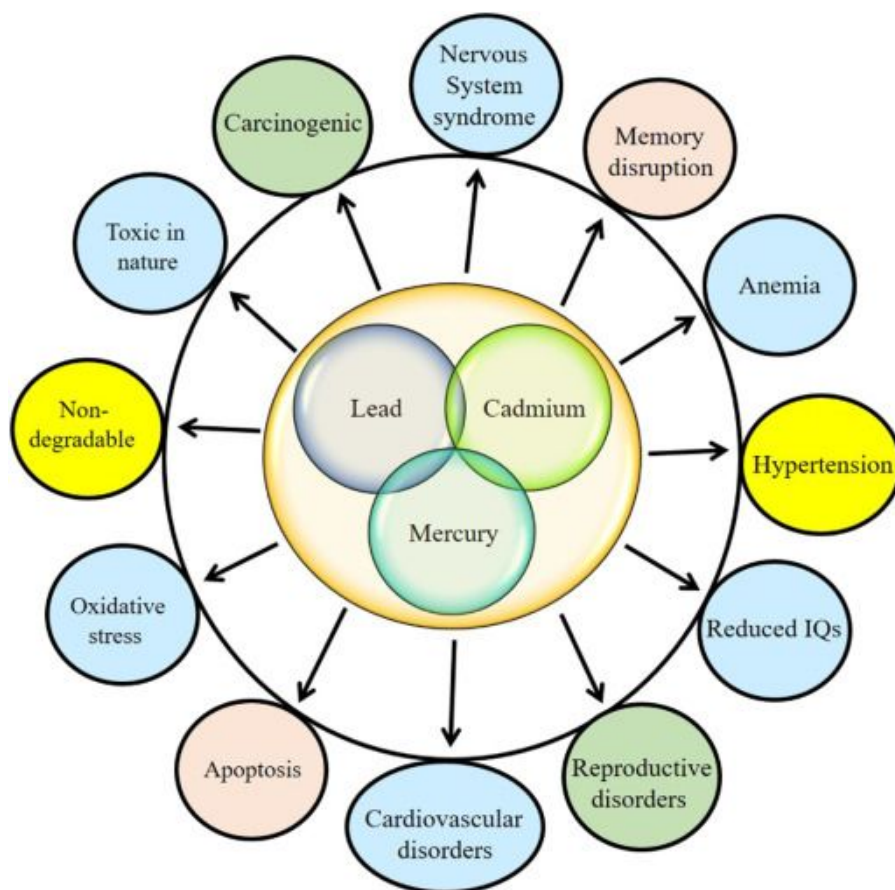


Fig. 1. Major consequences and adverse health effects of lead, cadmium, and mercury.

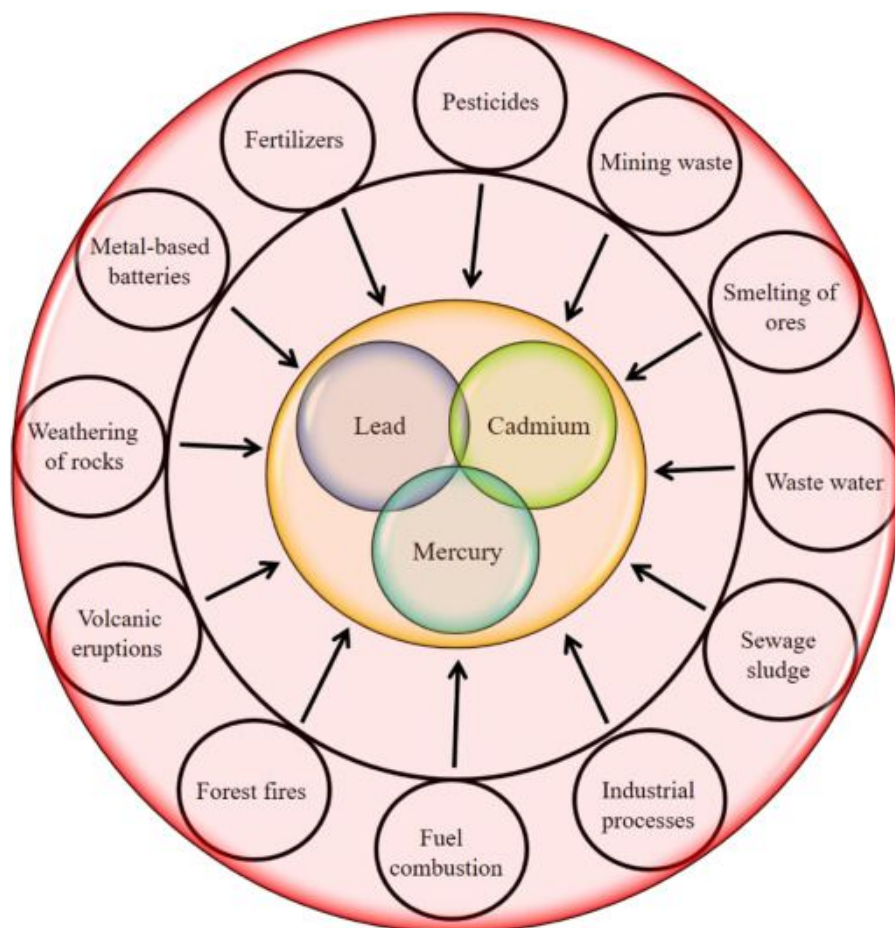


Fig. 2. Various sources of lead, cadmium, and mercury.

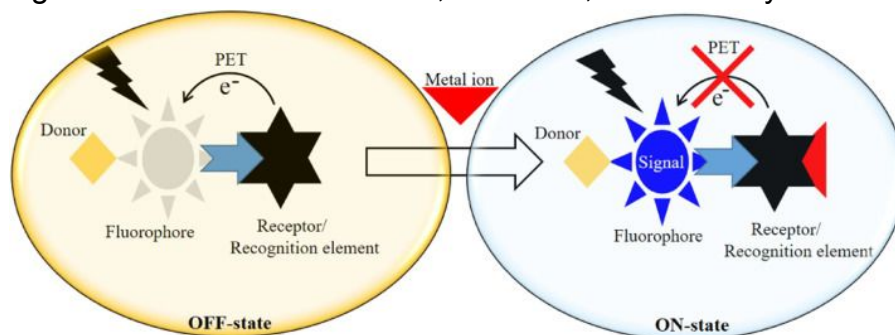


Fig. 3. A schematic representation of fluorescent sensor and tentative work mode following a photoinduced electron transfer (PET) mechanism.

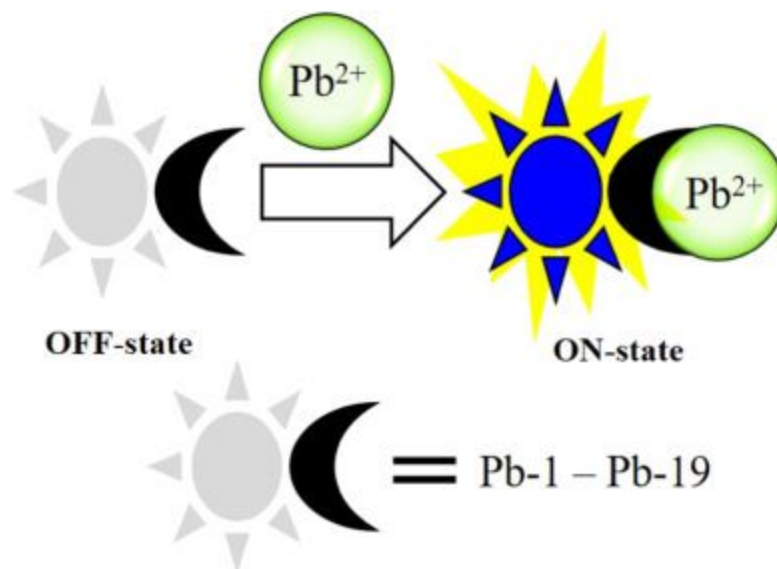


Fig. 4. A simplified scheme of Pb-based fluorescent sensor for the detection of Pb^{2+} .

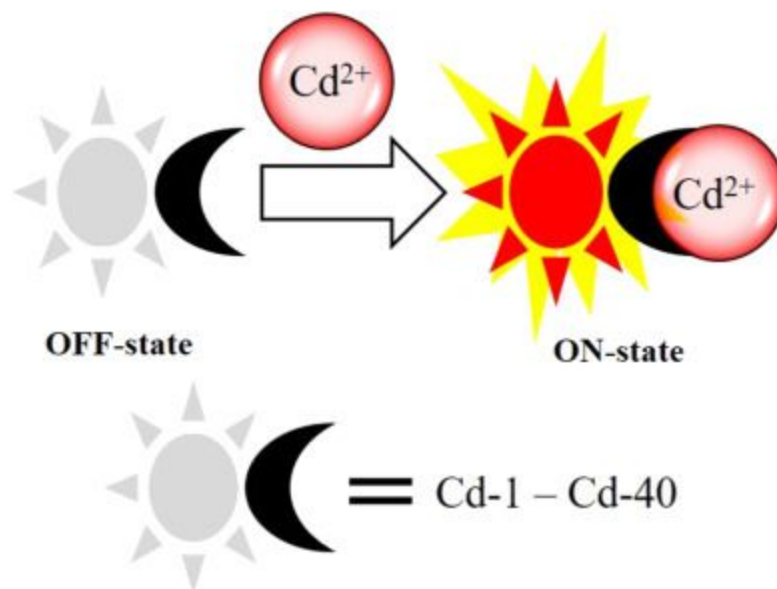


Fig. 5. A simplified scheme of Cd-based fluorescent sensor for the detection of Cd^{2+} .

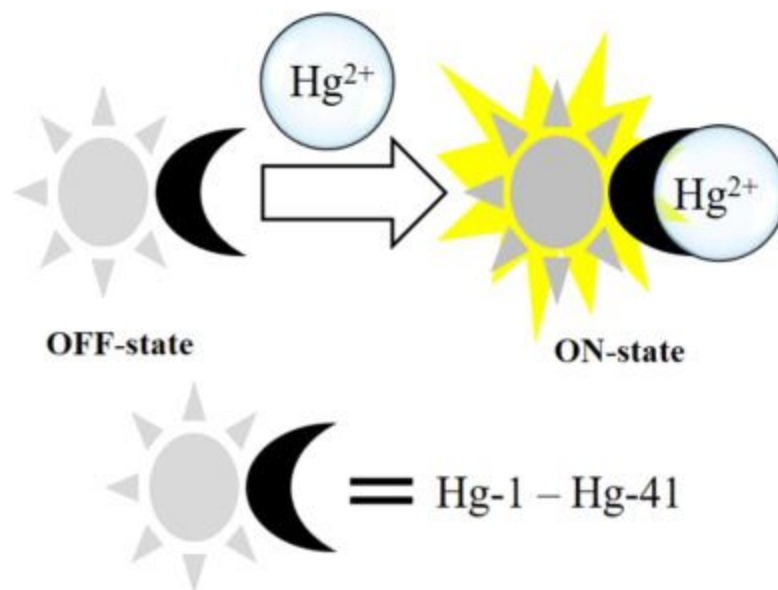
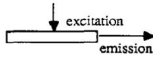
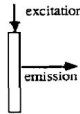
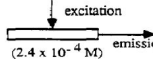
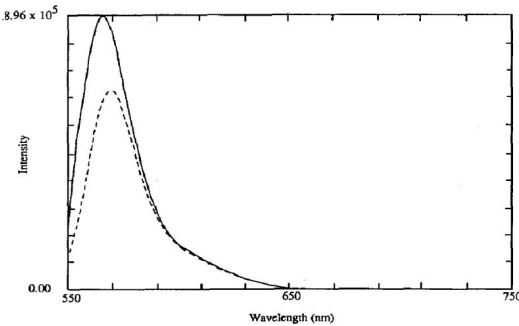
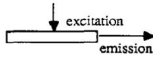
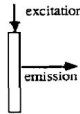
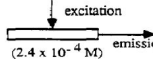
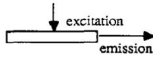
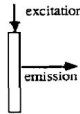
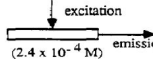


Fig. 6. A simplified scheme of Hg-based fluorescent sensor for the detection of Hg^{2+} .

Reason for interest	I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver). It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.
Notes	N/A
Follow up Questions	<ul style="list-style-type: none"> • What simplifications were made to obtain the simplified schemes? • What is the photoinduced electron transfer (PET) mechanism and how does it work?

Article #4 Notes: **Aggregation of Rose Bengal Molecules in Solution**

Source Title	<i>Journal of Photochemistry and Photobiology</i>
Source Author	Danian Xu and D. C. Neckerst
Source citation	Xu, D., & Neckers, D. (1987). Aggregation of rose bengal molecules in solution. <i>Journal of Photochemistry and Photobiology A: Chemistry</i> , 40(2-3), 361–370. doi: 10.1016/1010-6030(87)85013-x
Original URL	N/A
Source type	Scholarly Article Pdf file
Keywords	Rose bengal, concentration
Summary of key points	<ul style="list-style-type: none"> • Previous workers have improperly attributed artifactual spectroscopic observations to the dimer. In fact, with fluorescein, concentration quenching completely alters the fluorescence spectrum and dramatically alters the observed emission. • The emission spectrum changes to an exact replica of that at lower concentration. • These data provide unambiguous evidence for concentration quenching by the rose bengal solution * [Multimer] * f multimer hv' In region 2 of the A 1/k2 us. • The ratio 1,12 derived from the fluorescence spectrum rises as the concentration decreases. • In concentration region 3 of the 1,12 plot, that is, the very low concentration region, surprisingly the I1/r2 ratio goes down. • Based on the information above, we conclude that rose bengal aggregates are of the H type and that they begin to form in solutions of water or methanol at concentrations above 2.0×10^{-6} M. H-type aggregates are layered aggregates and they absorb at shorter wavelengths while

	<p>emitting at longer wavelengths than the monomer.</p> <ul style="list-style-type: none">• Above concentrations of low4 M the dimers accumulate even more rose bengal molecules into higher aggregates.																
Important Figures	<p>TABLE 2 Fluorescence of rose bengal in methanol (4.88×10^{-5} M) as a function of path length</p> <table><thead><tr><th></th><th>Measuring Mode</th><th>Excitation (nm)</th><th>Emission (nm)</th></tr></thead><tbody><tr><td>1</td><td></td><td>518,557</td><td>584</td></tr><tr><td>2</td><td></td><td>504,528</td><td>576</td></tr><tr><td>3</td><td></td><td>504,528</td><td>-----</td></tr></tbody></table>  <p>Fig. 6. Fluorescent emissions of rose bengal in methanol (5.35×10^{-4} M): —, excited at 549 nm, maximum 565 nm; ---, excited at 510 nm, maximum 570 nm.</p>		Measuring Mode	Excitation (nm)	Emission (nm)	1		518,557	584	2		504,528	576	3		504,528	-----
	Measuring Mode	Excitation (nm)	Emission (nm)														
1		518,557	584														
2		504,528	576														
3		504,528	-----														
Reason for interest	<p>I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.</p>																
Notes	N/A																
Follow up Questions	<ul style="list-style-type: none">• Why does RB form H type aggregates at high concentrations?• Why does the absorption spectrum of RB change when such aggregate form?																

Article #5 Notes: **A new silver (I) ions optical sensor based on nanoporous thin films of sol–gel by rose bengal dye**

Source Title	Sensors and Actuators B: Chemical
Source Author	Seyed Alireza Shahamirifard, Mehrorang Ghaedi, and Shaaker Hajati
Source citation	Shahamirifard, S. A., Ghaedi, M., & Hajati, S. (2018). A new silver (I) ions optical sensor based on nanoporous thin films of sol–gel by rose bengal dye. <i>Sensors and Actuators B: Chemical</i> , 259, 20–29. doi: 10.1016/j.snb.2017.12.030
Original URL	N/A
Source type	Scholarly Article Pdf file
Keywords	Sensor, ion, film
Summary of key points	<ul style="list-style-type: none"> • After the membrane was immersed in buffer solution containing Ag ions, the membrane color changed which was studied by UV-vis spectra of the proposed optical sensor. • The presence of an isobestic point in spectra shows that the RB and its complex with Ag are in equilibrium, which proves that the working principle of the optical sensor is based on an interaction between Ag ion and the RB. As it was validated by XPS analysis, it was suggested that the interaction between Ag ions and Cl groups of RB occurs that is the reason for the complex formation and color change. • In present work, the response time is considered to be the time required for 95% of total signal change and the membrane achieves a stable absorbance in certain concentration of ion solution as well as the sensor membrane gains equilibrium with the sample solution.

- At pHs greater than 7, silver ions as hydroxide complex deposit and thus An important factor that should be tested is the regeneration of sensor after which the sensor would get ready for the next analytical measurements.
- To investigate the sensor selectivity, the response of optode was measured in a solution including $2.6 \times 10^{-6} \text{ mol L}^{-1}$ of Ag ions in absence and presence of interfering ions under the optimum conditions followed by the comparison of two responses the calculation of relative error.
- The results showed that the variations in the absorbances are not more than 5% and therefore the sensors are satisfactorily reproducible with relative standard deviation of 1.8%. In addition, the repeatability of this sensor was investigated by measuring its absorbance at 519 nm in optimal condition for several times.
- Y. Bae, An improved measurement method for the strength of radiation of reflective beam in an industrial optical sensor based on laser displacement meter, Sensors 16 752.

Important Figures

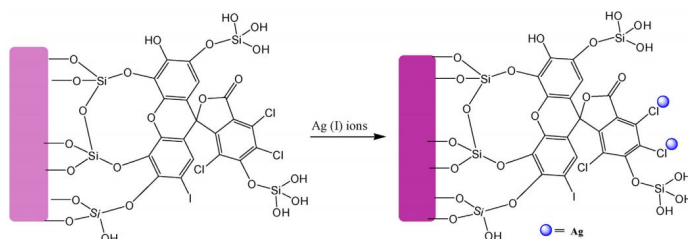


Fig. 4. A suggestion for the mechanism of silver (I) ions detection by the prepared sensor.

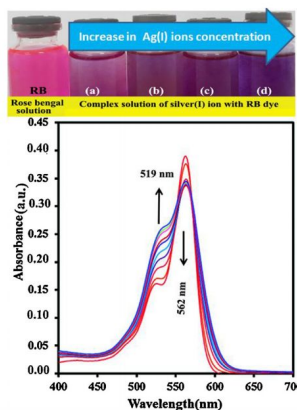


Fig. 5. Absorbance spectra of the proposed optical sensor in the presence of Ag⁺ ions at different concentrations. The Ag⁺ ion concentrations are increased from bottom (1.48×10^{-6}) to top (2.0×10^{-6}) in a phosphate buffer solution of pH 7. (519 nm is related to

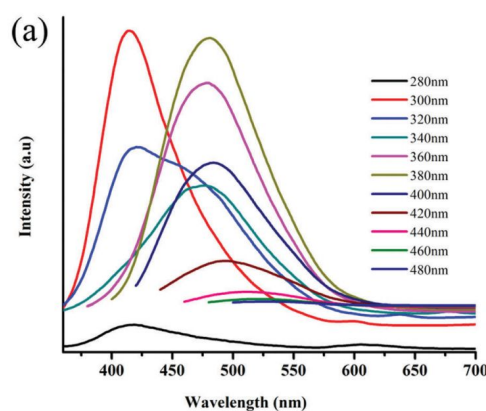
	complex formation between Ag^+ and RB dye. 562 nm corresponds to max of RB dye).
Reason for interest	I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.
Notes	N/A
Follow up Questions	<ul style="list-style-type: none">• Does this sensor work as well for other heavy metals as it does for silver (I) ions?• How would this sensor be best used in the real world?

Article #6 Notes: **Fluorescent carbon quantum dots chemosensor for selective turn-on sensing of Zn²⁺ and turn-off sensing of Pb²⁺ in aqueous medium and zebrafish eggs**

Source Title	Royal Society of Chemistry
Source Author	Vadivel Vinod Kumar, Thiagarajan Ramanb, and Savarimuthu Philip Anthony
Source citation	<p>Kumar, V. V., Raman, T., & Anthony, S. P. (2017).</p> <p>Fluorescent carbon quantum dots chemosensor for selective turn-on sensing of Zn²⁺ and turn-off sensing of Pb²⁺ in aqueous medium and zebrafish eggs. <i>New Journal of Chemistry</i>, 41(24), 15157–15164. doi: 10.1039/c7nj02831h</p>
Original URL	N/A
Source type	Scholarly Article Pdf file
Keywords	Carbon quantum dots (cqds),fluorescence,zn ²⁺ ,ions,pb ²⁺
Summary of key points	<ul style="list-style-type: none"> • The method of synthesis, precursors and surface decoration play crucial roles in determining the fluorescence properties of CQDs. For example, CQDs synthesized using laser ablation show strong fluorescence after only surface passivation. • 17 CQDs synthesized using cheap sources such as carbohydrates and natural gas via thermal decomposition exhibited 15% fluorescence efficiency, whereas CQDs produced using citric acid as a precursor gave the highest quantum yield.

- 21-24 The reactive/guest interacting hydroxyl and carboxyl functional groups of CQDs offer an opportunity to use CQDs as fluorescence sensors.
- 25 One of the first applications demonstrated using CQDs was the selective fluorescence sensing of metal ions.26-30 Green synthesized CQDs using pomelo peel showed selective fluorescence quenching for Hg²⁺ ions, whereas CQDs produced from roseheart radish exhibited Fe³⁺ sensing.
- 34,35 Except for a few CQDs, the majority of CQDs fabricated from different precursors/methods showed the selective fluorescence sensing of Fe³⁺, Cu²⁺ and Hg²⁺ metal ions.36-43 Phosphorus/nitrogen co-doped CQDs obtained from an ethylene diamine-glucose precursor and nitrogen/sulfur co-doped CQDs synthesized using pomelo exhibited selective sensing of Cr(VI) ions.44,45 Fluorescence sensing of Pb²⁺ ions was demonstrated using green synthesized CQDs from *Ocimum sanctum*.
- 59,60 The TEM analysis of the CQDs revealed the uniform dispersion of spherical CQDs in the size range between 2-6 nm without aggregation.
- The selective fluorescence sensing response of the CQDs was investigated by adding different metal ions: Ca²⁺, Mg²⁺, Al³⁺, Cr³⁺, Mn²⁺, Fe²⁺, Co²⁺, Ni²⁺, Cu²⁺, Zn²⁺, Cd²⁺, Hg²⁺ and Pb²⁺. Interestingly, the CQDs showed selective fluorescence changes in the presence of Zn²⁺ and Pb²⁺ ions.

Important Figures



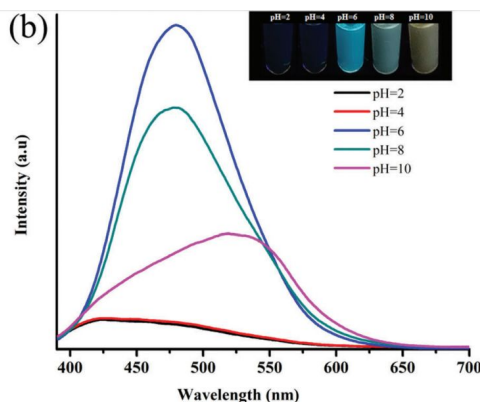


Fig. 4 CQD fluorescence intensity as a function of excitation wavelength (a) and pH (b). The inset in (b) shows digital images of solution fluorescence at different pH ($\lambda_{exc} = 365$ nm).

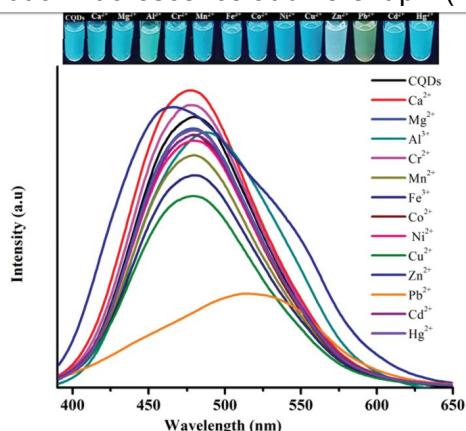


Fig. 5 Fluorescence sensing of CQDs towards metal cations (103 M). The inset shows digital images of fluorescence response towards different metal cations ($\lambda_{exc} = 365$ nm).

Reason for interest	I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.
Notes	N/A
Follow up Questions	<ul style="list-style-type: none"> Does this sensor work as well for other heavy metals as it does for lead (II) ions and zinc ions? How would this sensor be best used in the real world?

Article #7 Notes: **The role of viscosity in the fluorescence behavior of the diesel/biodiesel blends**

Source Title	<i>Renewable Energy</i>
Source Author	Anderson R.L. Caires, et al.
Source citation	<p>Caires, A. R. L., Scherer, M. D., Souza, J. E. D., Oliveira, S. L., & M'Peko, J.-C. (2013, October 18). The role of viscosity in the fluorescence behavior of the diesel/biodiesel blends. Retrieved from</p> <p>https://www.sciencedirect.com/science/article/pii/S096014811300520X.</p>
Original URL	https://www.sciencedirect.com/science/article/pii/S096014811300520X
Source type	Online Scholarly Article
Keywords	Diesel, Biodiesel Blend, Fluorescence, Viscosity
Summary of key points	<ul style="list-style-type: none"> • Fluorescence behavior of diesel/biodiesel blend was performed. • The fluorescence intensity as a function of the biodiesel content was evaluated. • The fluorescence behavior may be explained by taking into account viscosity changes. • The proposed explanation presented a good agreement with experimental data.

Important Figures

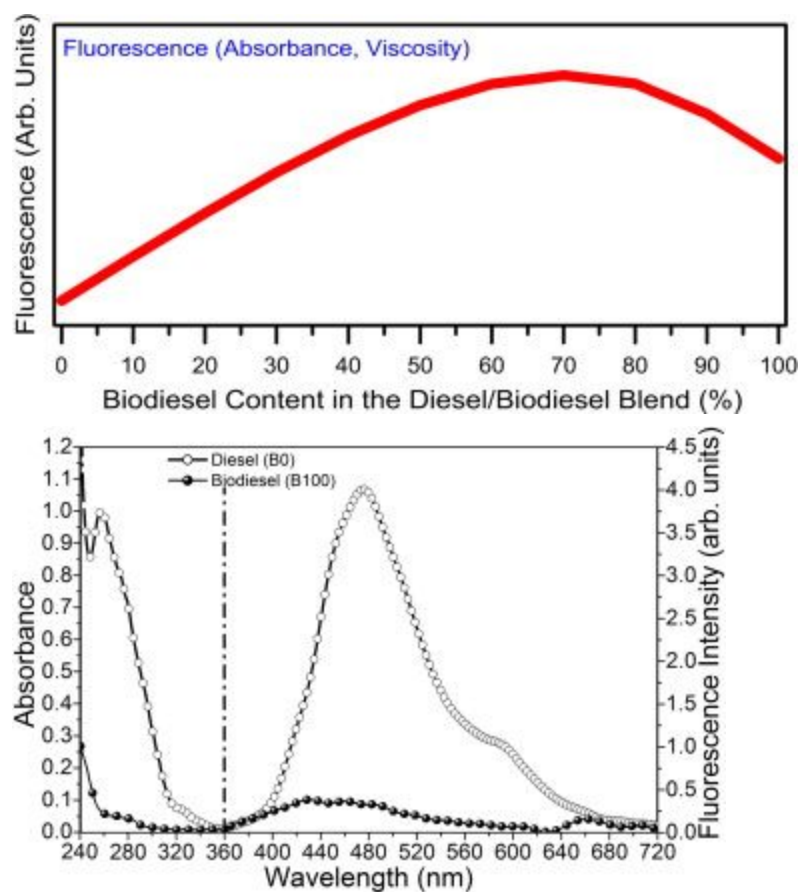


Fig. 1. Diesel and biodiesel absorbance between 240 and 360 nm; diesel and biodiesel fluorescence in the 360–720 nm region when excited at 260 nm.

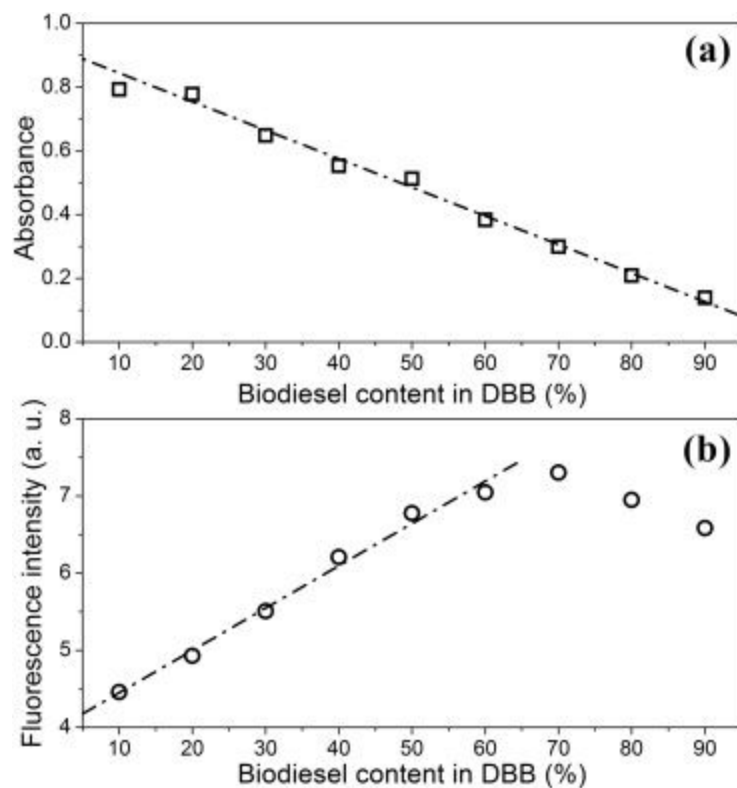


Fig. 2. Absorbance at 260 nm (a) and fluorescence at 475 nm (b) as a function of the biodiesel content in diesel/biodiesel blend.

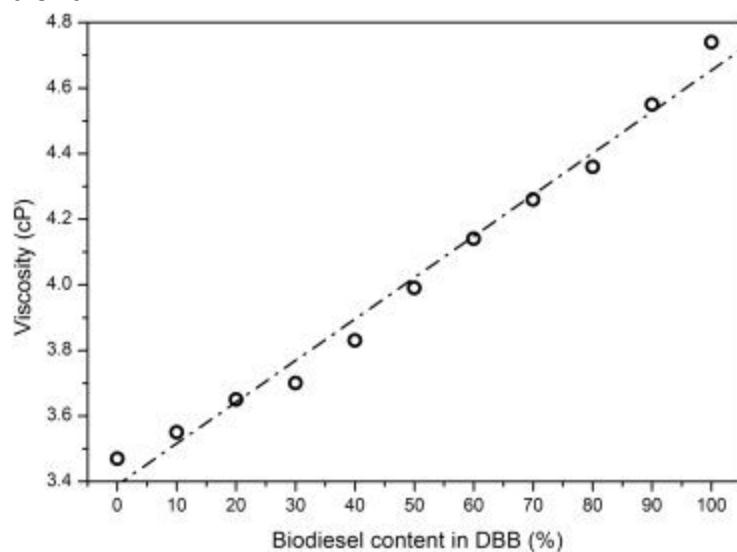


Fig. 3. Changes on the blend viscosity with respect of the biodiesel concentration.

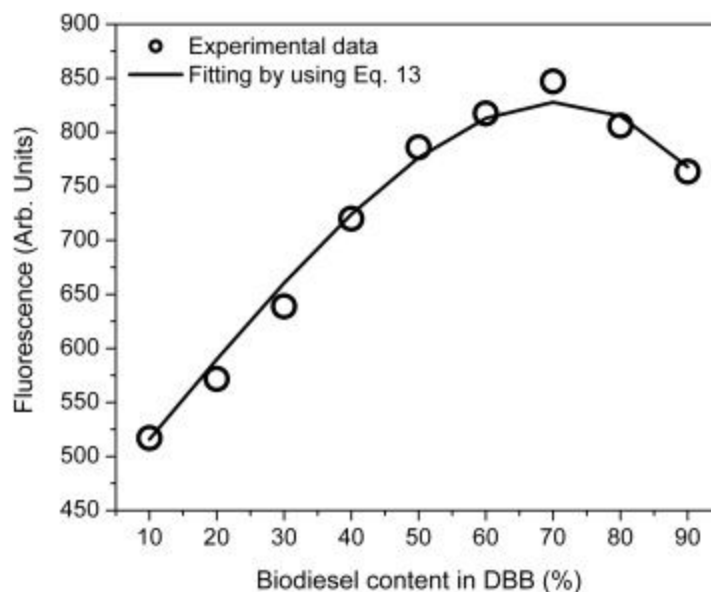


Fig. 4. Fluorescence of the diesel/biodiesel blend as a function of the biodiesel content.

Reason for interest	I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.
Additional Notes	N/A
Follow up Questions	N/A

Article #8 Notes: **Heterogeneous photocatalytic degradation of rose bengal: Effect of operational parameters**

Source Title	Physica B: Condensed Matter
Source Author	Japinder Kaur, Sonal Singhal
Source citation	<p>Kaur, J., & Singhal, S. (2014, June 11). Heterogeneous photocatalytic degradation of rose bengal: Effect of operational parameters. Retrieved from</p> <p>https://www.sciencedirect.com/science/article/pii/S0921452614004682.</p>
Original URL	https://www.sciencedirect.com/science/article/pii/S0921452614004682
Source type	Online Scholarly Article
Keywords	Photodegradation of rose bengal, Photocatalysis, Dye degradation, Rose bengal
Summary of key points	<ul style="list-style-type: none"> • The photocatalytic degradation of rose bengal dye has been investigated using ZnO nanoparticles as photocatalyst. ZnO nanoparticles were found to be efficient catalyst for the degradation of dye and 98% degradation was observed in 90 min. • Effect of various operational parameters such as amount of catalyst (0.25–2.00 g/L), concentration of dye (0.01–0.05 mM) and pH (3–11) of dye solution on the rate of dye degradation was studied. • The most favorable results for the degradation of rose bengal were observed at pH 5 at a catalyst loading of

1 g/L. Moreover, hydroxyl radicals have been detected in the photocatalytic reaction mixture by using terephthalic acid photoluminescence probing technique. The reusability of the catalyst has also been studied and catalyst was found to be active even after being used for 5 times.

Important Figures

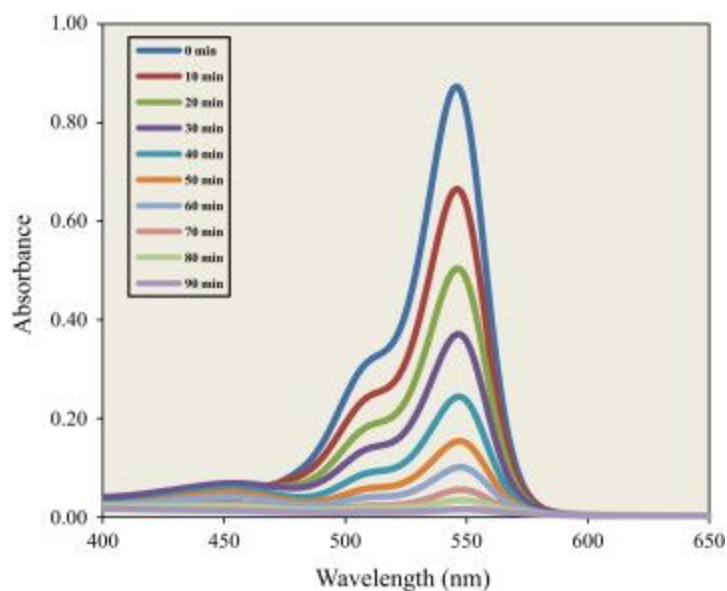


Fig. 1. Time dependent UV-vis spectra of rose bengal.

Reason for interest

I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.

Additional Notes

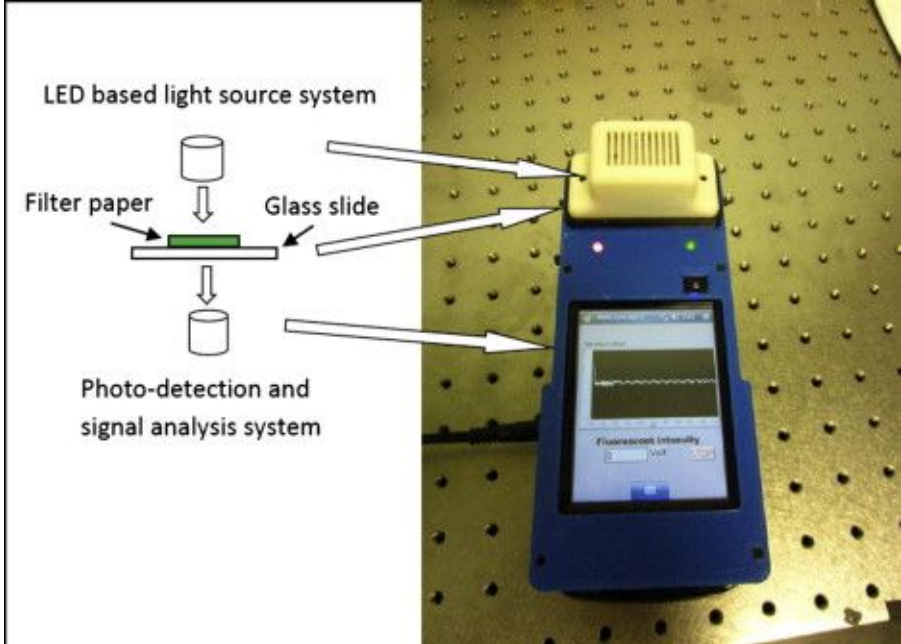
N/A

Follow up Questions

N/A

Article #9 Notes: **Miniature fluorescent sensor for chloride ion concentration determination based on modified Stern–Volmer Equation**

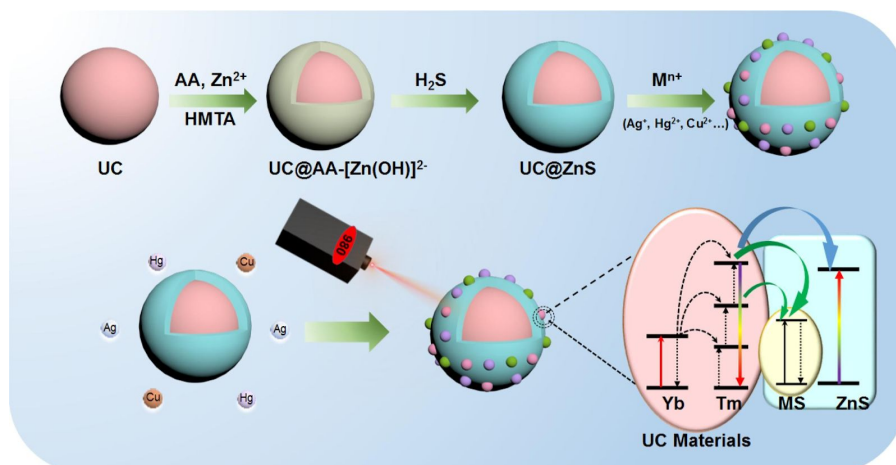
Source Title	<i>Measurement</i>
Source Author	Junsheng Wang et. al
Source citation	<p>Wang, J., Song, Y., Jinyang, S., Wu, X., Sun, Y., Pan, X., & Li, D. (2013, July 20). Miniature fluorescent sensor for chloride ion concentration determination based on modified Stern–Volmer Equation. Retrieved from</p> <p>https://www.sciencedirect.com/science/article/pii/S0263224113003199.</p>
Original URL	https://www.sciencedirect.com/science/article/pii/S0263224113003199
Source type	Online Scholarly Article
Keywords	Stern-volmer equation
Summary of key points	<p>A novel sensor of detecting Cl⁻ accurately from a very small amount of sample.</p> <ul style="list-style-type: none"> • A modified Stern–Volmer Equation for using the miniature fluorescent sensor system. • The predictability of this modified Stern–Volmer Equation is verified. • The novel sensor based on modified equation is of great potential for CF diagnosis.

Important Figures	 <p>Fig. 1. A portable device for measuring chloride ion concentration with a miniature fluorescent detection system.</p>
Reason for interest	<p>I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.</p>
Additional Notes	N/A
Follow up Questions	N/A

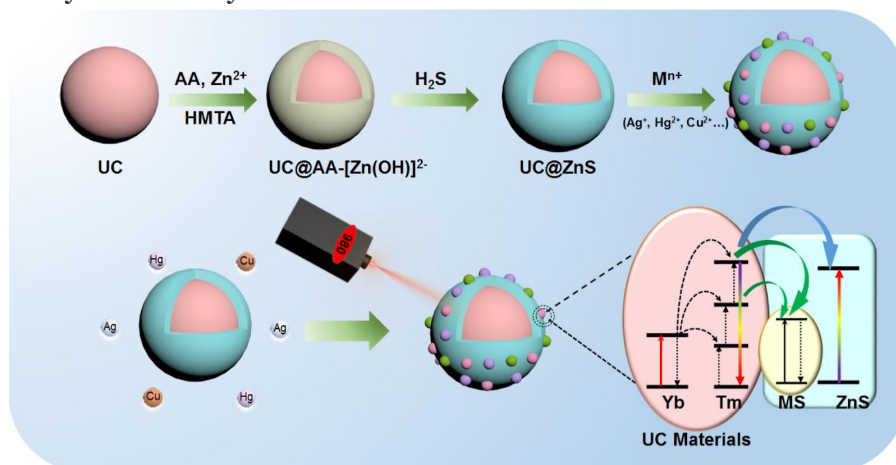
Article #10 Notes: **Monitoring and removal of trace heavy metal ions via fluorescence resonance energy transfer mechanism: In case of silver ions**

Source Title	<i>Chemical Engineering Journal</i>
Source Author	Zhao-You Chu et. al
Source citation	<p>Chu, Z.-Y., Wang, W.-N., Zhang, C.-Y., Ruan, J., Chen, B.-J., Xu, H.-M., & Qian, H.-S. (2019, June 13). Monitoring and removal of trace heavy metal ions via fluorescence resonance energy transfer mechanism: In case of silver ions. Retrieved from https://www.sciencedirect.com/science/article/pii/S138589471931321X.</p>
Original URL	https://www.sciencedirect.com/science/article/pii/S138589471931321X
Source type	Online Scholarly Article
Keywords	Fluorescence mechanism
Summary of key points	<p>UCNPs@ZnS nanoparticles was used to monitor and removal of some heavy metal ions.</p> <ul style="list-style-type: none"> • The upconversion fluorescence was greatly quenched with the addition of Ag⁺. • 3.98 μmol Ag⁺ can be removed completely in the presence of 1 mg UCNPs@ZnS nanoparticles.

Important Figures



Scheme 1. Schematic illustration the removal and optical analysis of heavy metal ions.



Scheme 2. Illustration of the mechanism under irradiation of NIR light.

Reason for interest

I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.

Additional Notes

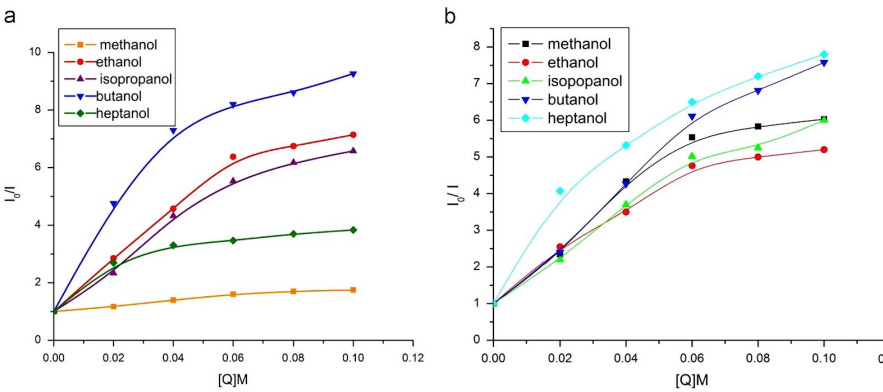
N/A

Follow up Questions

N/A

Article #11 Notes: **Fluorescence quenching of boronic acid derivatives by aniline in alcohols – A Negative deviation from Stern–Volmer equation**

Source Title	<i>Journal of Luminescence</i>
Source Author	H. S. Geethanjali
Source citation	Geethanjali, H. S., Nagaraja, D., Melavanki, R. M., & Kusanur, R. A. (2015, July 2). Fluorescence quenching of boronic acid derivatives by aniline in alcohols – A Negative deviation from Stern–Volmer equation. Retrieved from https://www.sciencedirect.com/science/article/pii/S0022231315003580 .
Original URL	https://www.sciencedirect.com/science/article/pii/S0022231315003580
Source type	Online Scholarly Article
Keywords	Boronic acid derivatives, Fluorescence quenching, Modified Stern–Volmer (Lehrer) equations, and hydrogen bond
Summary of key points	<ul style="list-style-type: none"> • Fluorescence quenching of two boronic acid derivatives by aniline in alcohols is carried out at room temperature. • A negative deviation is observed in Stern-Volmer(S-V) plots and it is explained using S-V kinetics and Lehrer equation. • The negative deviation observed in the S–V plot is explained in terms of intramolecular and intermolecular hydrogen bond formations.

Important Figures	 <p>Fig. 6. Stern–Volmer plots of I_0 / I versus $[Q]$ exhibiting negative deviation in different solvents (a) 5CMPBA (b) 4FMPBA.</p>
Reason for interest	<p>I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.</p>
Additional Notes	N/A
Follow up Questions	N/A

Article #12 Notes: Investigating interactions of phenanthrene with dissolved organic matter: Limitations of Stern–Volmer plot

Source Title	<i>Chemosphere</i>
Source Author	Bo Pan et. al
Source citation	<p>Pan, B., Xing, B., Liu, W., Xing, G., & Tao, S. (2007, July 6). Investigating interactions of phenanthrene with dissolved organic matter: Limitations of Stern–Volmer plot. Retrieved from https://www.sciencedirect.com/science/article/pii/S0045653507007175.</p>
Original URL	https://www.sciencedirect.com/science/article/pii/S0045653507007175
Source type	Online Scholarly Article
Keywords	Dissolved organic matter, Nonlinear binding, Fluorescence quenching, Stern–Volmer equation, Freundlich equation
Summary of key points	<ul style="list-style-type: none"> • Although linear binding isotherms of hydrophobic organic chemicals (HOCs) with dissolved organic matter (DOM) are widely reported, several studies showed nonlinear HOC–DOM interactions. • This study pointed out that fluorescence static quenching modeling (FSQM), which often uses a Stern–Volmer type plot to process the data from fluorescence quenching experiments, is conceptually different from the classic Stern–Volmer equation.

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| | <ul style="list-style-type: none">• We also emphasized that although linear Stern–Volmer plots are generally observed in literature, it does not necessarily indicate a linear HOC–DOM interaction.• According to both mathematical simulation and laboratory sorption experiments in this study, nonlinear interactions could be concealed by the use of Stern–Volmer plot. Moreover, this study tested the two assumptions for applying FSQM to process binding data.• Our results showed that binding coefficient (KDOC) for phenanthrene is neither independent of free solute concentration, nor DOM concentration, which is a critical limitation for using FSQM in a form of Stern–Volmer equation to examine HOC–DOM interactions.• Therefore, the true characteristics of HOC–DOM interactions need to be examined using different ways of experimental design and data processing. |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Important Figures

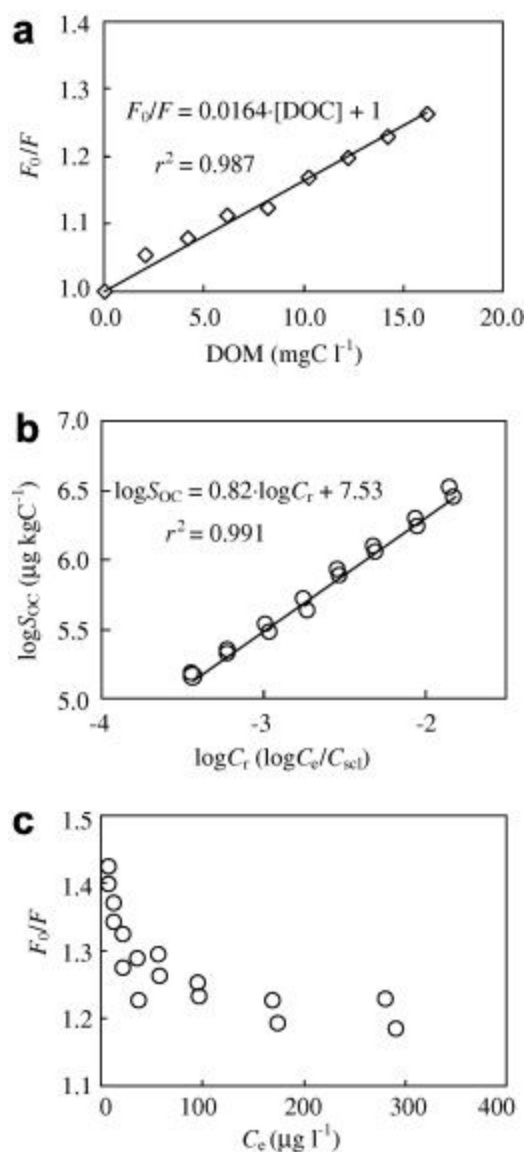


Fig. 2. Experimental results of Fluka DHA and PHE binding using traditional fluorescence quenching experiment followed by FSQM (a), and using the batch fluorescence quenching experiment followed by Freundlich modeling (b). The F_0/F decreased with free phenanthrene concentration (c). The Stern–Volmer modeling was conducted with a fixed intercept of 1. C_e is the aqueous-phase concentration of PHE ($\mu\text{g l}^{-1}$), and C_{scl} is the super-cool solubility of PHE at 25 °C ($5970 \mu\text{g l}^{-1}$).

Reason for interest

I am interested in either finding or improving a solution to combat water pollution, specifically from industrial waste such as toxic heavy metals (like mercury, lead, and silver) or dyes from textile industry waste. It is especially important to be able to test water to detect

	contaminants. Furthermore, if contaminants are found, it is important to be able to test the water again after any purification process to ensure the contaminants were removed as much as possible and more were not added.
Additional Notes	N/A
Follow up Questions	N/A

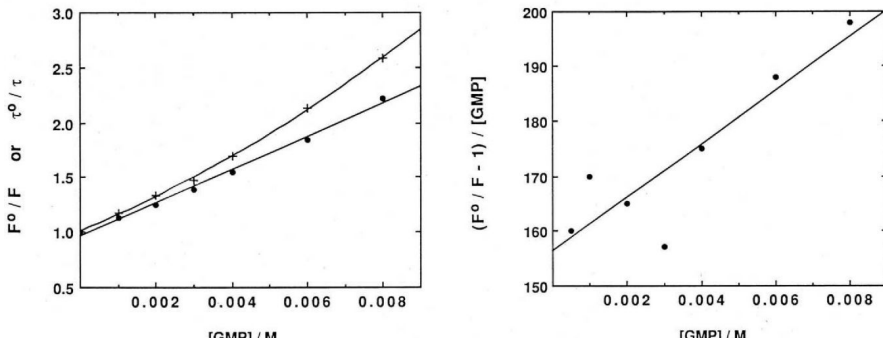
Article #13 Notes: **Study of the interaction between indole-based compounds and biologically relevant G-quadruplexes**

Source Title	<i>Biochimie</i>
Source Author	Josue Carvalho, et. al
Source citation	Carvalho, J., Nottelet, P., Mergny, J.-L., Queiroz, J. A., Salgado, G. F., & Cruz, C. (2017). Study of the interaction between indole-based compounds and biologically relevant G-quadruplexes. <i>Biochimie</i> , 135, 186–195. doi: 10.1016/j.biochi.2017.02.005
Original URL	N/A
Source type	Scholarly Article pdf
Keywords	Fluorescence, complex, concentration
Summary of key points	<ul style="list-style-type: none"> G-quadruplexes (G4s) are high-order secondary structures that modulate several key cell processes such as telomere function, gene expression and DNA replication. In the past years G4s have emerged as promising targets for drug development due to the discovery of small molecules which

	<p>bind and stabilize these structures. In this work, we report the synthesis of indole-based compounds and the study of their interaction with the biological relevant G4s c-MYC and human telomeric repeat 22AG using several biophysical techniques.</p> <ul style="list-style-type: none"> • The ligands are G4 specific and they can discriminate different G4 structures namely parallel and hybrid-1 topologies. The NMR study of interaction between the most promising indole-derivative (compound 3) and c-MYC quadruplex suggests that the ligand binds on the external tetrads with additional actions in the loops/grooves in a 2:1 ratio. • The molecular docking calculations of compound 3 to c-MYC quadruplex corroborates with the ^1H and NOESY NMR studies. Overall, the results suggest that indole-based ligands are promising candidates for future lead optimizations in drug development.
Important Figures	<p style="text-align: center;"><i>J. Carvalho et al. / Biochimie 135 (2017) 186–195</i></p> <p>Fig. 3. Fluorescence emission spectra of compound 3 with successive additions of (A) c-MYC and (B) hybrid-1 22AG. Insets: Stern-Volmer plots obtained by plotting F_0/F as a function of DNA concentration and fitting to the adequate equation</p>
Reason for interest	<ul style="list-style-type: none"> • This article shows examples of Stern-Volmer plots being fitted with linear and nonlinear models.
Additional Notes	N/A
Follow up Questions	N/A

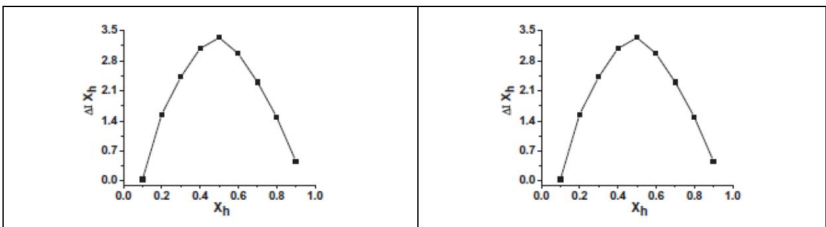
Article #14 Notes: Static and Dynamic Fluorescence Quenching Experiments for the Physical Chemistry Laboratory

Source Title	<i>Journal of Chemical Education</i>
Source Authors	Lee K. Fraiji, David M. Hayes, and T. C. Werner
Source citation	Fraiji, L. K., Hayes, D. M., & Werner, T. C. (1992). Static and dynamic fluorescence quenching experiments for the physical chemistry laboratory. <i>Journal of Chemical Education</i> , 69(5), 424. doi: 10.1021/ed069p424
Original URL	N/A
Source type	Scholarly Article pdf
Keywords	Fluorescence, quenching, static, dynamic
Summary of key points	<ul style="list-style-type: none"> • Fluorescence spectroscopy is a technique that is ideally suited for the undergraduate laboratory curriculum. Several workers have published experiments designed for the undergraduate lab employing fluorescence measurements (1-5). In all of these cases, the measurement of the steady state fluorescence signal has been emphasized to extract information on analyte level or identity and on the efficiency of fluorescence quenching by an external quencher. • The time-dependent nature of fluorescence can also be exploited if the lifetime of fluorescence can be measured. • This information is especially useful in evaluating the mechanism and efficiency of fluorescence quenching, especially when time-dependent data are combined with steady-state fluorescence measurements on the same fluorophore—quencher system. • These data can often be used to determine whether the quenching mechanism is static (occurs because of a ground

	<p>state complex between fluorophore and quencher), dynamic (occurs from diffusion of quencher to fluorophore while the latter is in its excited state) or if both mechanisms are occurring. Moreover, the binding constant for the ground-state quenching complex (K) and the rate constant for dynamic quenching (k_q) can often be calculated from these results. As a consequence, such measurements constitute an excellent experiment for the physical chemistry laboratory</p>
Important Figures	 <p>Figure 1. Fluorescence intensity and lifetime of W-MEAI plotted against the concentration of GMP quencher. The excitation wavelengths for the fluorescence intensity and lifetime determinations were 380 and 358 nm, respectively. In both experiments the fluorescence emission was monitored at 485 nm. The solid circles correspond to x^0/x and the crosses to F^0/F.</p>
Reason for interest	<ul style="list-style-type: none"> It provides details on static and dynamic quenching mechanisms.
Additional Notes	N/A
Follow up Questions	N/A

Article #15 Notes: A new pyrene based highly sensitive fluorescence probe for copper(II) and fluoride with living cell application

Source Title	<i>Organic and Biomolecular Chemistry</i>
Source Author	Shyamaprosad Goswami, et. al.
Source citation	Goswami, S., Chakraborty, S., Paul, S., Halder, S., Panja, S., & Mukhopadhyay, S. K. (2014). A new pyrene based highly sensitive fluorescence probe for copper(ii) and fluoride with living cell application. <i>Organic & Biomolecular Chemistry</i> , 12(19), 3037. doi: 10.1039/c4ob00067f
Original URL	N/A
Source type	Scholarly Article pdf
Keywords	fluorescence
Summary of key points	<ul style="list-style-type: none"> • A new pyrene based fluorescence probe has been synthesized for fluorogenic detection of Cu²⁺ in acetonitrile–aqueous media (7 : 3 CH₃CN–HEPES buffer, v/v, at pH 7.5) with bioimaging in both prokaryotic (<i>Candida albicans</i> cells) and eukaryotic (<i>Tecoma stans</i> pollen cells) living cells. The anion recognition properties of the sensor have also been studied in acetonitrile by fluorescence methods which show remarkable sensitivity toward fluoride over other anions examined.

Important Figures	<div data-bbox="544 226 1365 489">  <div data-bbox="711 457 792 483">Figure (a)</div> <div data-bbox="1117 457 1198 483">Figure (b)</div> </div> <p data-bbox="522 531 1404 678">Figure S1: Job's plot diagram of the (a): Cu²⁺-complex for BMPA; (b): F⁻-complex for BMPA determined by fluorescence method in CH₃CN (where X_h is the mole fraction of the host and DI is the change of emission intensity).</p>
Reason for interest	<ul style="list-style-type: none"> The supporting information includes Job Plot construction and analysis.
Additional Notes	N/A
Follow up Questions	N/A