INSTITUT KIMIA MALAYSIA

Certificate of Participation

This is to certify that

Dr. Hendrik Oktendy Lintang

has participated as an Oral Presenter in the

16th Asia Pacific International Symposium on Microscale Separations and Analysis

APCE 2016

7th to 10th November 2016

Johor Bahru, Johor, Malaysia

Organized By
INSTITUT KIMIA MALAYSIA Southern Branch
UNIVERSITI TEKNOLOGI MALAYSIA

Cawangan Selatan
INSTITUT KIMIA MALAYSIA

Prof Dr Mohd Marsin
Organizing Chairman
APCE 2016

Soh Song Chaw
Chairman
IKM (Southern Branch)

UNIVERSITAS
MA CHUNG

LETTER OF ASSIGNMENT

No: 366/MACHUNG/ST/X/2016

The Rector of Universitas Ma Chung hereby assigns:

Name	:	Dr. Hendrik Oktendy Lintang
Employee's Number	:	20160017
Position	:	Principal Investigator of MRCPP

to participate in the **16th Asia-Pacific International Symposium on Microscale Separations and Analysis (APCE) 2016 as Oral Presenter** with paper title "**Phosphorescent Chemical Sensors of Alcohol Derivatives using Single Crystals of Copper(I) Pyrazolate Complexes**" organized by Institut Kimia Malaysia (IKM) and Universiti Teknologi Malaysia (UTM) which is held on 7-10 November 2016 in KSL Hotels & Resort, Johor Bahru, Johor, Malaysia,

He has to submit an official report when returns to work.

Please be informed.

Malang, 21 October 2016
Rector,

MA CHUNG

Dr. Chatief Kunjaya

Acknowledged by,

INSTITUT KIMIA MALAYSIA
(Cawangan Selatan)
, Jalan Bakawali 68, Taman Johor Jaya
81100 Johor Bahru, Johor, Malaysia.
Tel: 607-352 8227 Fax: 607 351 8227

(Name) POOSHER LIN
Hon. Treasurer - IKM(S).

CC:

1. Vice Rectors
2. Ma Chung Research Center for Photosynthetic Pigments (MRCPP)
3. Human Resource Management

APCE 2016

16th Asia Pacific International Symposium on Microscale Separations and Analysis

SOUVENIR PROGRAM AND EXHIBITION DIRECTORY

Incorporating
LabAsia Southern 2016

7th–10th November 2016
Johor Bahru, Johor, Malaysia

In Collaboration with

with the support of
Lee Foundation

PAPERS & AUTHORS

1040 – 1100	Refreshments

Technical Session 6B: Forensic and others **Venue: Ledang Room** **Chairperson: Dato' Dr Yew Chong Hooi** **Forensic Science Society of Malaysia (FSSM)**	
1100 – 1130	V14 Invited Lecture Behaviour of low levels of pseudoephderine on surfaces upon deposition during clandestine laboratory remediation Dr. Ahmad Fahmi Lim Abdullah Universiti Sains Malaysia, Malaysia
1130 – 1200	V15 Invited Lecture Differentiation and identification of isobaric compounds in drug abuse cases Pn. Zaiton Ariffin Department of Chemistry, Malaysia
1200 – 1230	V16 Invited Lecture Graphene and graphene nanospheres for biosensor applications Prof. Dr. Yook Heng Lee Universiti Kebangsaan Malaysia, Malaysia
1230 – 1250	C24 Contributed Lecture Phosphorescent chemical sensors of alcohol derivatives using single crystals of copper(I) pyrazolate complexes Dr. Hendrik Oktendy Lintang Universitas Ma Chung, Indonesia
1250 – 1310	C25 Contributed Lecture In-syringe dispersive micro-solid phase extraction method for the HPLC fluorescence determination of aflatoxins in peanut Mr. Nor Shifa bin Shuib Department of Chemistry, Malaysia
1310 – 1400	Lunch
1400 – 1500	Poster Session (Group B)

Venue: Grand Ballroom 1	
1500 – 1540	Plenary Lecture 3 Chairperson: Prof. Dr. Sam Fong Yau Li National University of Singapore, Singapore Purpose made capillary electrophoresis instruments Prof. Dr. Peter C. Hauser University of Basel, Switzerland
1540 – 1630	Award presentations/Closing ceremony/Announcement of APCE 2017
1630 – 1700	Refreshments

Thursday, November 10, 2016

0900 – 1500	Social event

C24

PHOSPHORESCENT CHEMICAL SENSORS OF ALCOHOL DERIVATIVES USING SINGLE CRYSTALS OF COPPER(I) PYRAZOLATE COMPLEXES

Hendrik O. Lintang[1,2] , Leny Yuliati[1,2] , Nur Fatiha Ghazalli[3,4]

[1]Ma Chung Research Center for Photosynthetic Pigments, Universitas Ma Chung, 65151 Malang, East Java, Indonesia
[2]Centre for Sustainable Nanomaterials, Ibnu Sina Insititute for Scientific and Industrial Research, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.
[3]Department of Chemistry, Faculty of Science, Universiti Teknologi Malaysia, 81030 UTM Johor Bahru, Johor, Malaysia
[4]School of Fundamental Science, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

Chemical sensors (chemosensors) at molecular level with changes in luminescent color and emission have been utilized using single crystals of phosphorescent metal complexes for detection of volatile organic compounds (VOCs). However, effect of molecular structures on sensing capabilities has not been addressed. Therefore, we report the systematic study on vapochromic phosphorescent sensing of alcohol derivatives using trinuclear copper(I) pyrazolate complexes ($\mathbf{2}_{\mathbf{A-E}}$) synthesized from non-side chain, 3,5-dimethyl, 3,5-bis(trifluoromethyl), 3,5-diphenyl and 4-(3,5-dimethoxybenzyl)-3,5-dimethyl pyrazole ligands ($\mathbf{1}_{\mathbf{A-E}}$). All complexes showed emission bands centered at 553, 584, 570 and 616 nm (λ_{ext} = 280 nm) for complexes $\mathbf{2}_{\mathbf{A-C,E}}$, respectively and 642 nm (λ_{ext} = 321 nm) for complex $\mathbf{2}_{\mathbf{D}}$ with lifetime in microseconds, indicating a large Stoke shift for phosphorescent compounds with green to red emission in the dark room. Upon exposure to ethanol in 5 mins, chemosensors $\mathbf{2}_{\mathbf{A-C}}$ showed quenching of its intensities to 34%, 15% and 100% with color changes to less emissive, suggesting insertion of the vapors to the weak non-covalent Cu(I)-Cu(I) interactions. In particular, the best chemosensor $\mathbf{2}_{\mathbf{C}}$ with color OFF gave only reusability using external stimuli. Otherwise, chemosensor $\mathbf{2}_{\mathbf{D}}$ showed photoinduced energy transfer from 642 to 636 and 460 nm with 87% decreasing in intensity. Interestingly, chemosensor $\mathbf{2}_{\mathbf{E}}$ revealed blue-shifting of its emission intensity to 556 nm ($\Delta\lambda$ = 60 nm, orange to green) where its original emission band was completely and autonomously recovered in 15 mins. When alcohol derivatives were used, chemosensors $\mathbf{2}_{\mathbf{E}}$ only showed good sensing capability for detection of methanol ($\Delta\lambda$ = 60 nm) to propanol ($\Delta\lambda$ = 22 nm) due to a weak intermolecular hydrogen bonding interaction of alcohol (methanol to propanol) to the oxygen atoms at dimethoxybenzyl side-chains of the pyrazole ring. By increasing hydrophobicity of alcohols (butanol to hexanol), it will reduce the electronegativity of alcohols for the interaction and have lower vaporation rate.

7-10 November 2016, Johor, Malaysia

C24

Phosphorescent Chemical Sensors of Alcohol Derivatives using Single Crystals of Copper(I) Pyrazolate Complexes

Hendrik. O. LINTANG,[1,2]
Leny Yuliati,[1,2] and Nur Fatiha Ghazalli[3,4]

[1]Ma Chung Research Center for Photosynthetic Pigments (MRCPP), Universities Ma Chung, Indonesia
[2]Centre for Sustainable Nanomaterials, Universiti Teknologi Malaysia, Malaysia
[3]Department of Chemistry, Faculty of Science, Universiti Teknologi Malaysia, Malaysia
[4]Department of Chemistry, Faculty of Science, Universiti Malaysia Terengganu, Malaysia

1

Volatile Organic Compounds (VOCs)

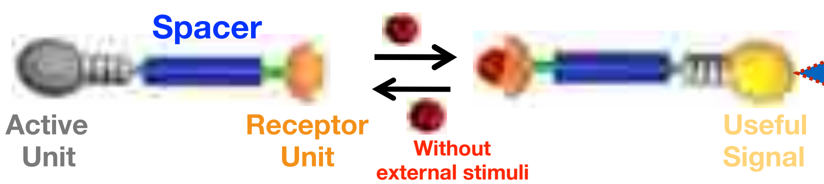
VOCs are commonly used as ingredients in household products or in industrial processes where they normally get vaporize at room temperature as toxic and organic vapors as well as non-organic vapor

Elosua, C, *et al*., *Sensors* **2006**, *6*, 1440

2

Luminescence Chemosensors

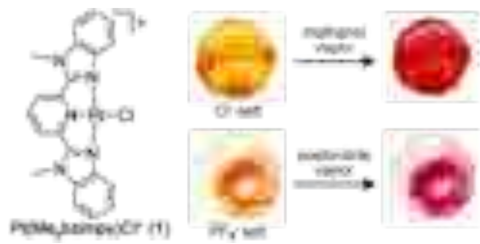
Chemical sensors (chemosensors) are a molecule, when receptor unit interact with analytes, transform specific information through spacer to the active unit to give analytical useful signals



Changes in Properties
- Absorption
- Permittivity
- Swelling
- Mass
- Refractive index
- Thermal resistivity
- Luminescence

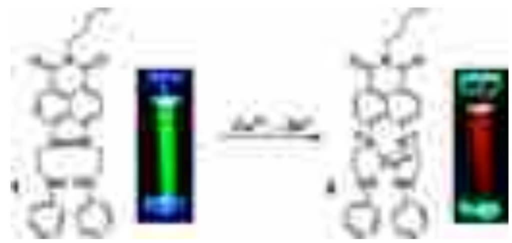
Example of Luminescence Chemosensors

Pt Complex Salt for Chemosensor of Vapors



Grove, L.J., *et al*., *Journal of the American Chemical Society* **2004**, *126*, 1594

Naphthalimide for Chemosensor of Metal Ions



Xu, Z., *et al*., *Organic Letters* **2005**, *7*, 3029

Ma Chung Research Center for Photosynthetic Pigments 3

Luminescent Copper Complexes with Phosphorescent Properties

Good Phosphorescent Properties, Less Toxicity, and Cheaper Precursors

Chair-Like Coordination Geometry with Cu(I)–Cu(I) Distance 3.1-3.9 A

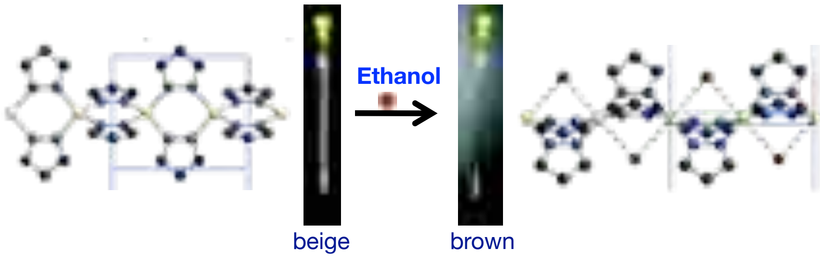
Properties
- Strong Emission
- Microsecond Lifetime
- Large Stokes Shift
- Thermochromics
- Emission Dependent on Alkyl Side Chains

Dias, H.V.R., *et al*., *Journal of the American Chemical Society* **2005**, *127*, 7489

Ma Chung Research Center for Photosynthetic Pigments 4

Copper Complexes as Vapochromic Chemosensors

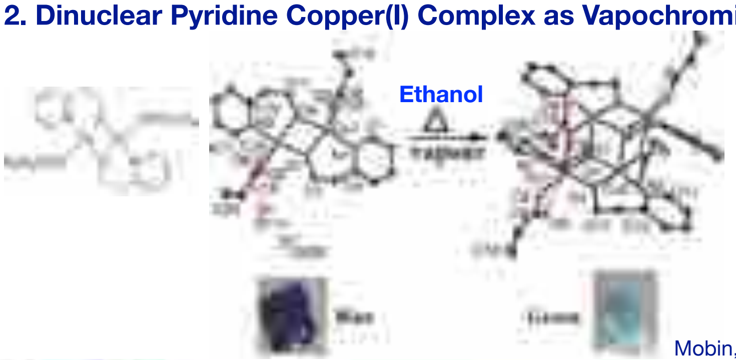
1. Dinuclear Bispyrazolate Copper(II) Complex as Vapochromic Chemosensors



- **Response time: 2 days**
- **Reusability: irreversible**

Cingolani, A., *et al.*, *Journal of the American Chemical Society* **2005**, *127*, 6144

2. Dinuclear Pyridine Copper(I) Complex as Vapochromic Chemosensors



- **Response time: 2 hours**
- **Reusability: irreversible**

Mobin, S.M., *et al.*, *Dalton Transaction* **2010**, *39*, 1447

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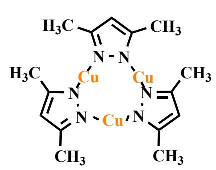
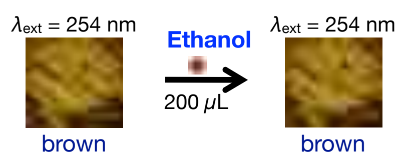
Copper Complexes as Vapochromic Chemosensors

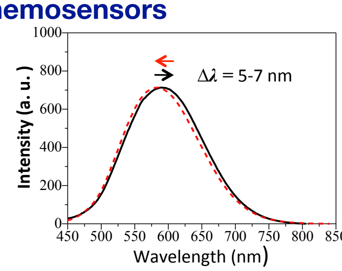
3. Trinuclear Pyrazole Copper(I) Complex as Vapochromic Chemosensors



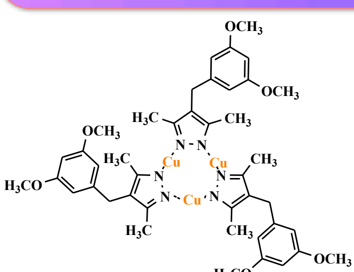
Copper(I) 3,5-Dimethyl Pyrazolate Complex



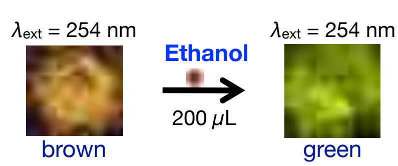
- **Response time: ~**
- **Reusability: ~**

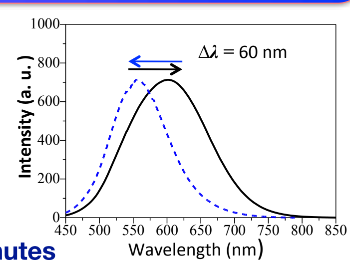


The Importance of Molecular Structure for Improving Sensing Capability



Copper(I) (4-(3,5-dimethoxybenzyl)-3,5-Dimethyl Pyrazolate Complex





- **Response time: 35 minutes**
- **Reusability: reversible**

Ghazalli, N.F., *et al.*, *Advanced Materials Research* **2014**, *970*, 44

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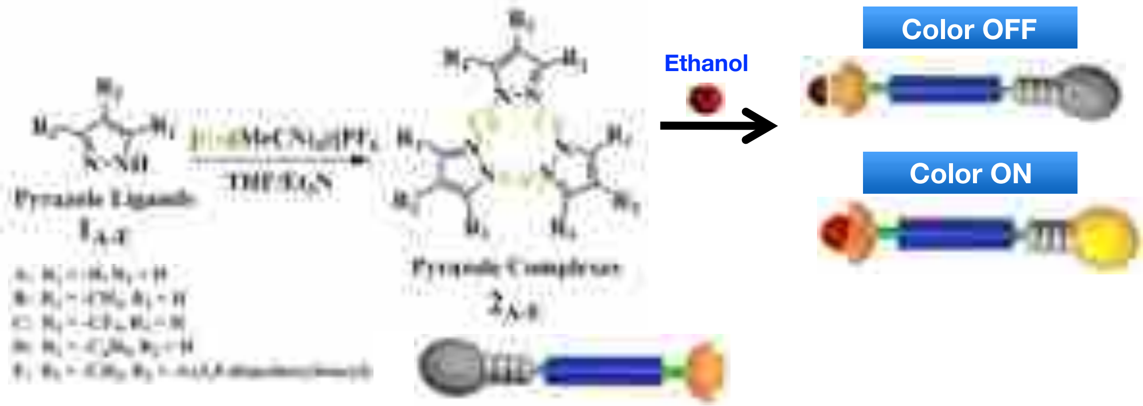
Research Objectives

Effect of Molecular Structures of Copper(I) Complexes with Different Side-Chains at Pyrazole Ring on Vapochromic Chemosensors of Alcohol



- Synthesis of Copper(I) Pyrazolate Complexes
- Phosphorescent Properties of Copper(I) Pyrazolate Complexes
- Sensing Capability of Copper(I) Pyrazolate Complexes

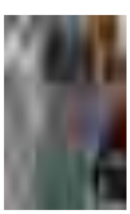
Synthesis of Copper(I) Pyrazolate Complexes

100 mL Schlenk (1st STAGE)

- Vacuum
- Changed air with N_2 gas
- Dry THF
- pyrazole ligand (**1_A, 1_B, 1_C, 1_D, 1_E**)
- Degassed (3 times)
- Poured ($[Cu(MeCN)_4]PF_6$ 1 equi.
- Mix 5 minute under N_2
- Triethylamine 2 equi.
- Stirred overnight at room temperature
- Remove THF by trapping
- Dissolve with dry CH_2Cl_2

200 mL Schlenk (2nd STAGE)

- Vacuum
- Changed air with N_2 gas
- Dry methanol



Transfer with cannula

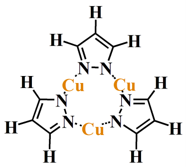
- In-Situ recrystallization with CH_2Cl_2 to dry methanol (except for 2_C uisng dry hexane)
- In-Situ Filtration with cannula and filter paper
- Collected, Dry-off, and Flow N_2 gas

Product Copper(I) Complexes
Solid Powder

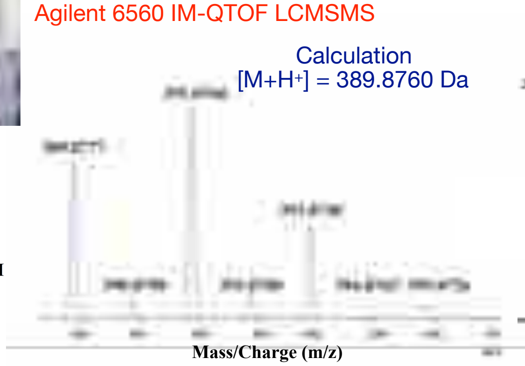
2_A: R_1 = $-CH_3$, R_2 = H
2_B: R_1 = $-CH_3$, R_2 = H
2_C: R_1 = $-CF_3$, R_2 = H
2_D: R_1 = $-C_6H_5$, R_2 = H
2_E: R_1 = $-CH_3$, R_2 = -4-(3,5-dimethoxybenzyl)

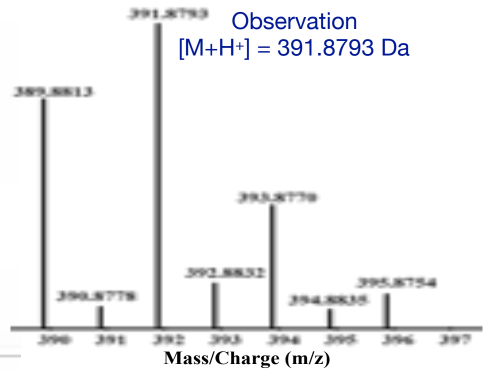
$[Cu(MeCN)_4]PF_6$ = tetrakis(acetonitrile)copper(I)hexafluorophosphate

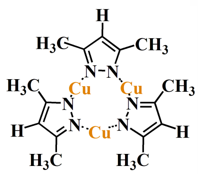
Mass Spectra of Copper(I) Pyrazolate Complexes



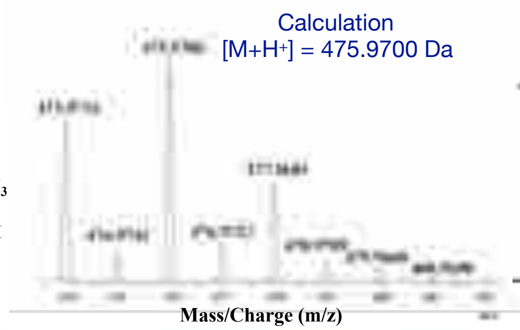
2_A

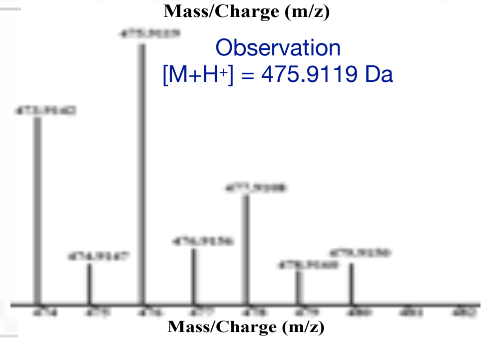






2_B





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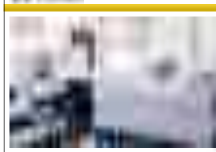
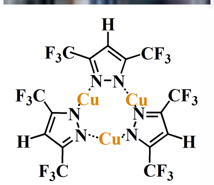
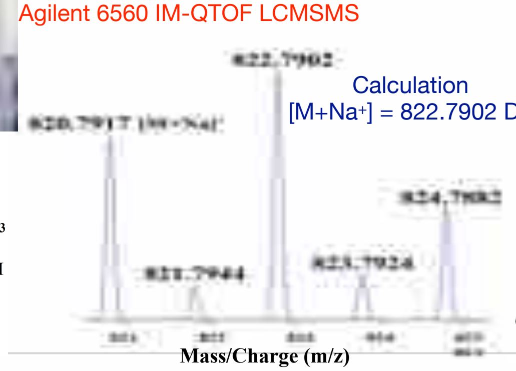
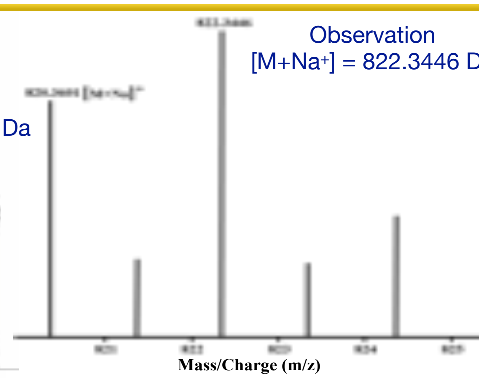
Mass Spectra of Copper(I) Pyrazolate Complexes

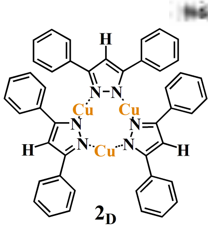




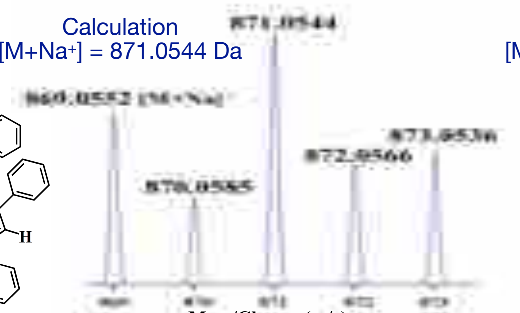
2_C

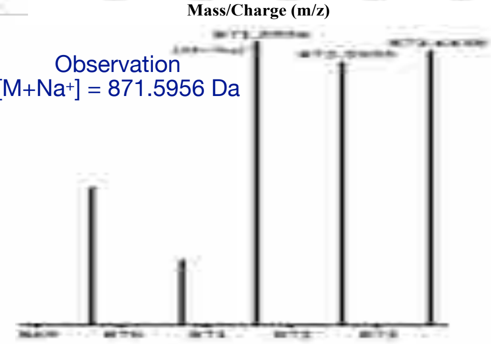






2_D





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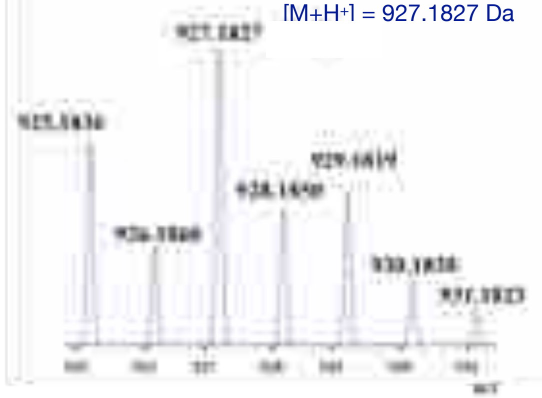
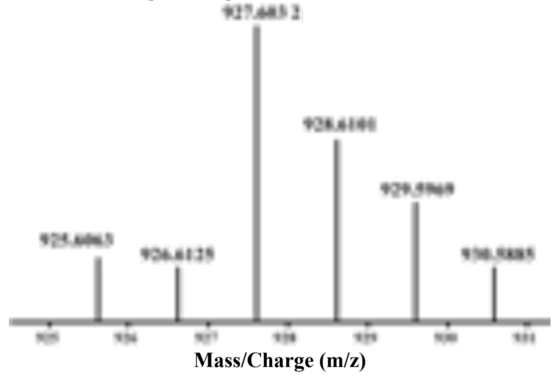
Mass Spectra of Copper(I) Pyrazolate Complexes

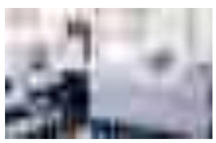
Calculation
[M+H+] = 927.1827 Da

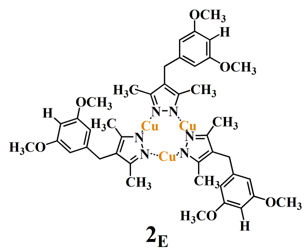


Observation
[M+Na+] = 927.6032 Da



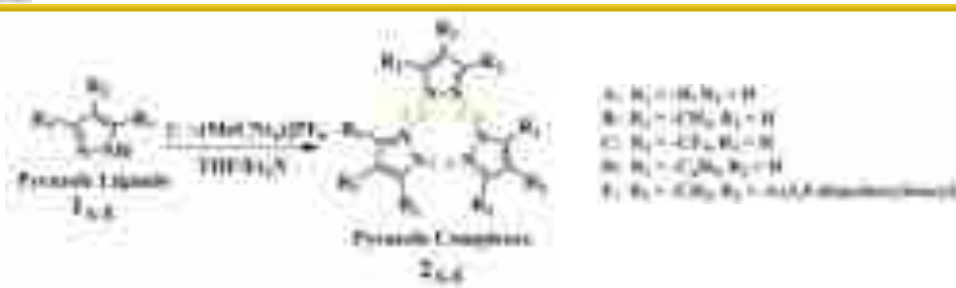
Agilent 6560 IM-QTOF LCMSMS





2_E

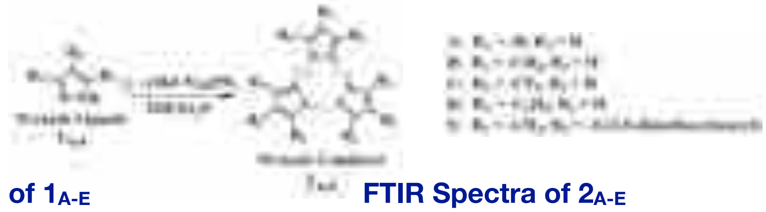
Mass Spectra of Copper(I) Pyrazolate Complexes



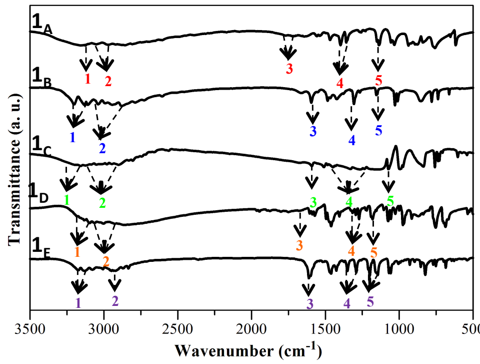
Similar monoisotope patterns and mass value (m/z) of calculated and observed copper complexes

Complexes	Molecular Formula	Molecular Weight (Da.)			
		Calculated $[M+H]^+$	Observed $[M+H]^+$	Calculated $[M+Na]^+$	Observed $[M+Na]^+$
2_A	$C_9H_9Cu_3N_6$	389.8760	391.8793	–	–
2_B	$C_{15}H_{21}Cu_3N_6$	475.9700	475.9119	–	–
2_C	$C_{15}H_3Cu_3F_{18}N_6$	–	–	822.7902	822.3466
2_D	$C_{45}H_{33}Cu_3N_6$	–	–	871.0544	871.5956
2_E	$C_{42}H_{51}Cu_3N_6O_6$	927.1827	927.6032	–	–

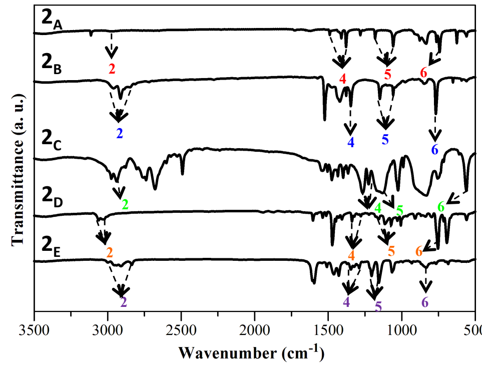
FTIR Spectra of Copper(I) Pyrazolate Complexes



FTIR Spectra of 1A-E



FTIR Spectra of 2A-E



- Disappearance of vibration bands for N–H stretching and bending from 1° and 2° amine groups at 3201-3058 cm^{-1} (**1**) and 1750-1595 cm^{-1} (**3**) in Pyrazolate Complexes
- Formation of new vibration bands for N–Cu–N at 560-632 cm^{-1} (**6**) in Pyrazolate Complexes

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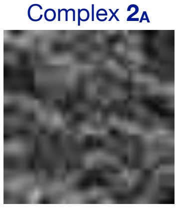
Photographs of Copper(I) Pyrazolate Complexes

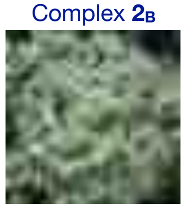
Photograph Images under Daylight

Complex **2A**



greenish-gray

Complex **2B**



greenish-white

Complex **2C**

green-white

Complex **2D**

white-greenish

Complex **2E**

greenish-white

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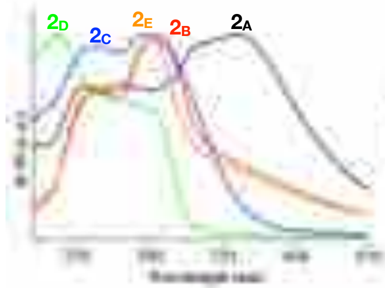
Phosphorescent Properties of Copper(I) Complexes

Green to Red Emission of Trinuclear Copper(I) Pyrazolate Complexes

Absorption Spectra of 2_{A-E}

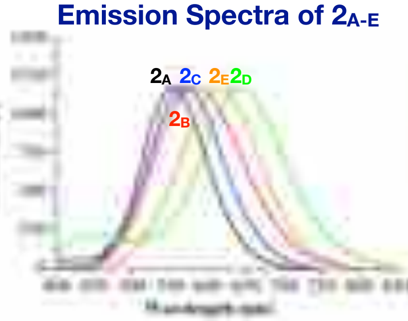


Photograph Images under Daylight

Complex 2_A | Complex 2_B | Complex 2_C | Complex 2_D | Complex 2_E

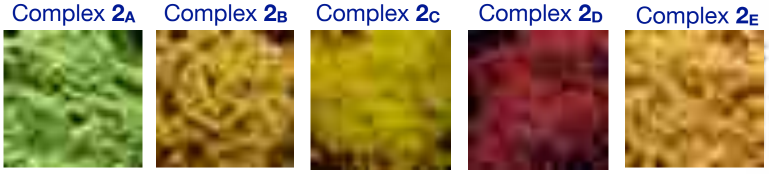
greenish-gray | greenish-white | green-white | white-greenish | greenish-white

Emission Spectra of 2_{A-E}



Photograph Images under λ_{ext} = 254 nm

Complex 2_A | Complex 2_B | Complex 2_C | Complex 2_D | Complex 2_E

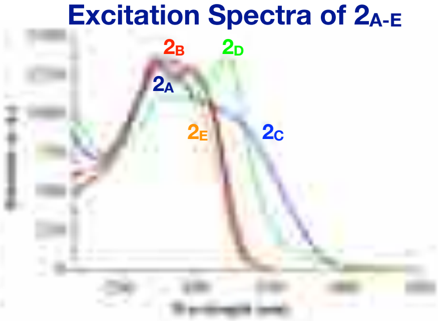


greenish, λ_{em} = 553 nm | orange, λ_{em} = 584 nm | greenish, λ_{em} = 570 nm | red, λ_{em} = 644 nm | orange, λ_{em} = 616 nm

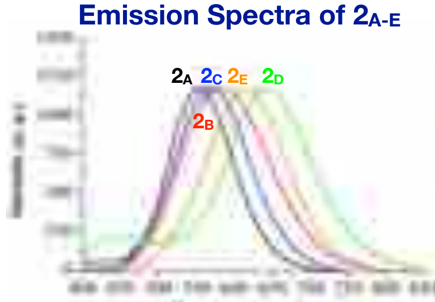
Phosphorescent Properties of Copper(I) Complexes

Large Stokes Shifts and Microsecond Lifetimes of Trinuclear Copper(I) Pyrazolate Complexes

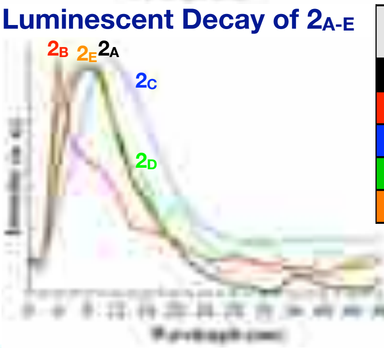
Excitation Spectra of 2_{A-E}



Emission Spectra of 2_{A-E}

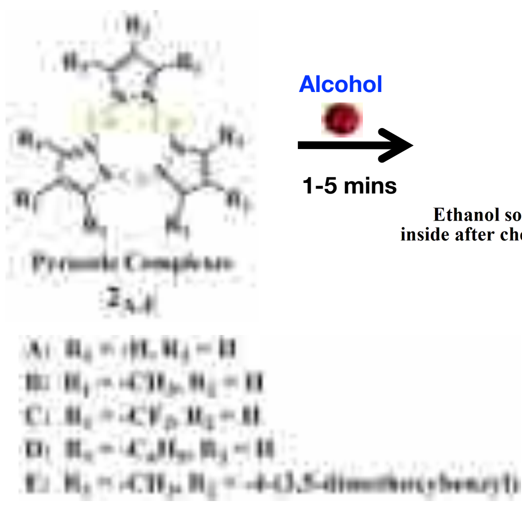


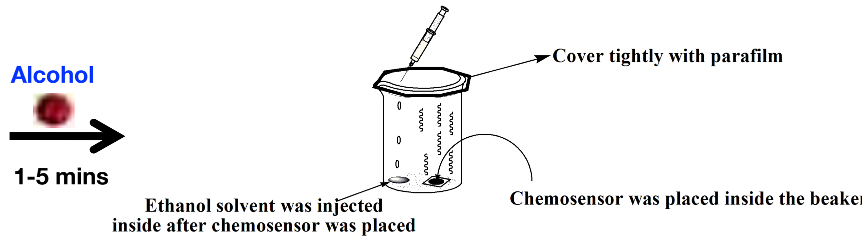
Luminescent Decay of 2_{A-E}



Copper(I) Complexes	Luminescence Lifetime (μs)	λ_{max} of Excitation (nm)	λ_{max} of Emission (nm)	Stokes Shift (nm)
2_A	7.437 ± 0.7	274	553	279
2_B	7.594 ± 1.5	280	584	304
2_C	7.370 ± 0.4	280	570	290
2_D	8.685 ± 0.3	322	644	322
2_E	8.162 ± 1.8	278	616	338

Vapochromic Chemosensors of Ethanol



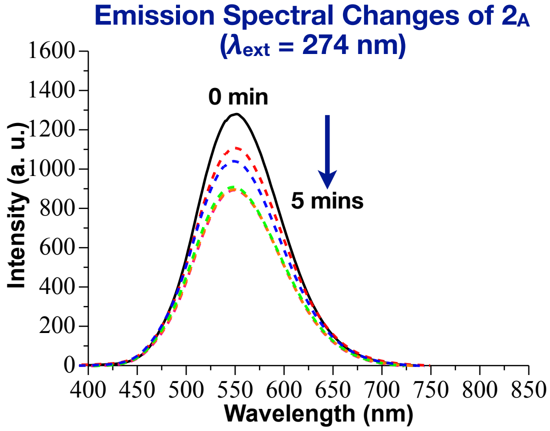


Sensing Capability

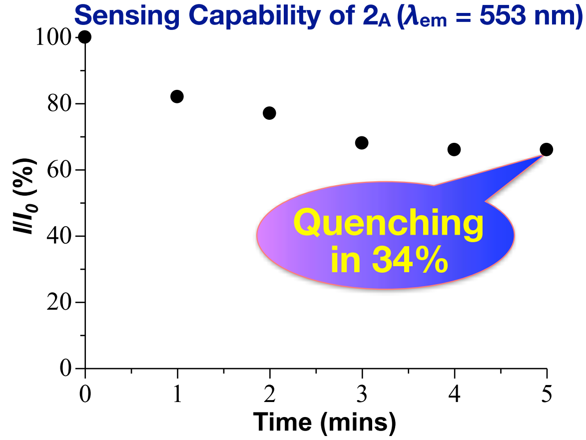
1. Emission Changes
2. Color Changes

Sensing Capability of Chemosensor 2_A (R_1 = H, R_2 = H)

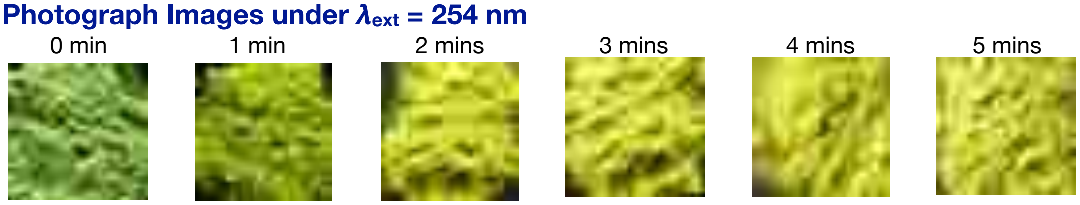
Emission Spectral Changes of 2_A (λ_{ext} = 274 nm)



Sensing Capability of 2_A (λ_{em} = 553 nm)



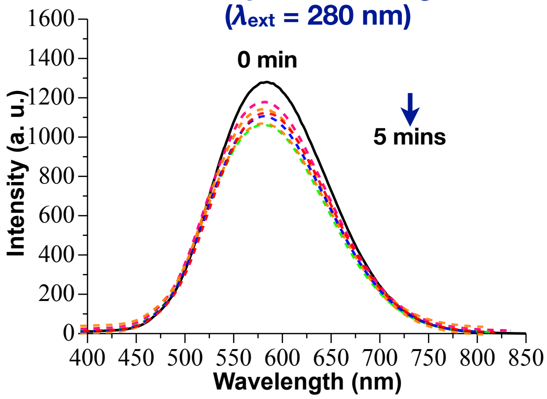
Photograph Images under λ_{ext} = 254 nm



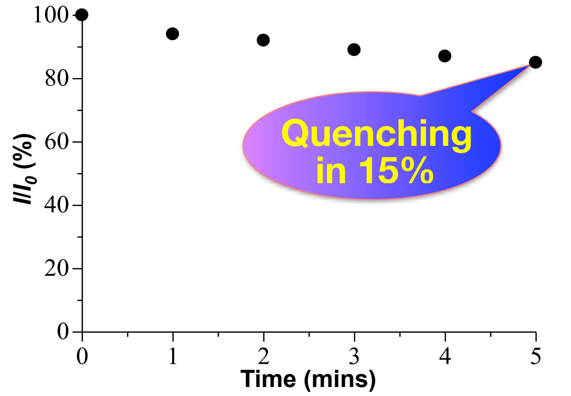
Color change from green to green-yellowish in 5 minutes

Sensing Capability of Chemosensor 2_B ($R_1 = CH_3$, $R_2 = H$)

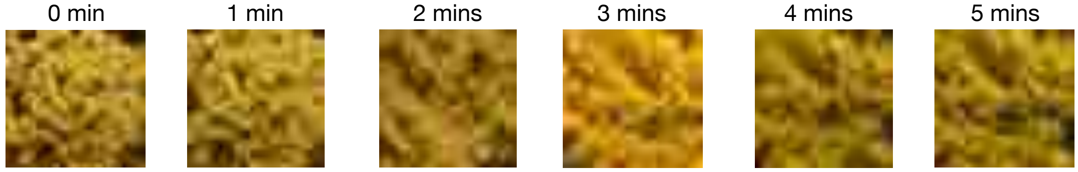
Emission Spectral Changes of 2_B (λ_{ext} = 280 nm)



Sensing Capability of 2_B (λ_{em} = 584 nm)



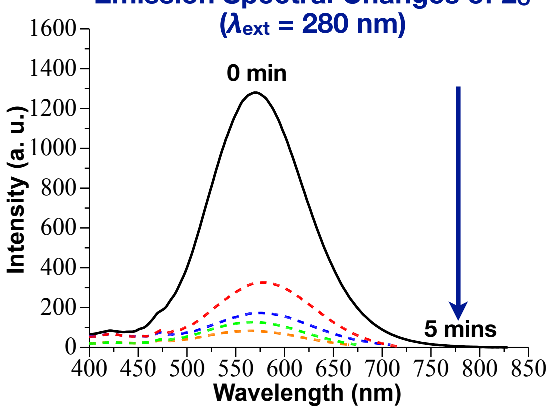
Photograph Images under λ_{ext} = 254 nm



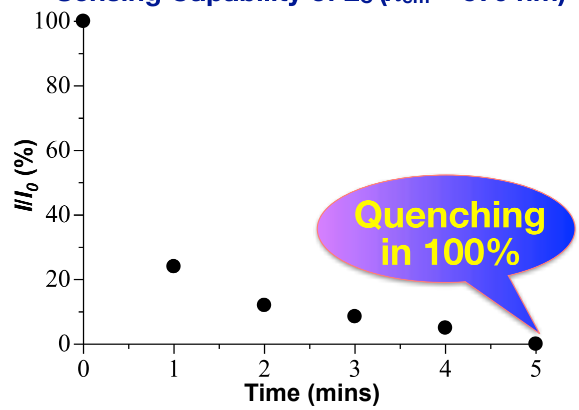
No color change of original orange in 5 minutes

Sensing Capability of Chemosensor 2_C ($R_1 = CF_3$, $R_2 = H$)

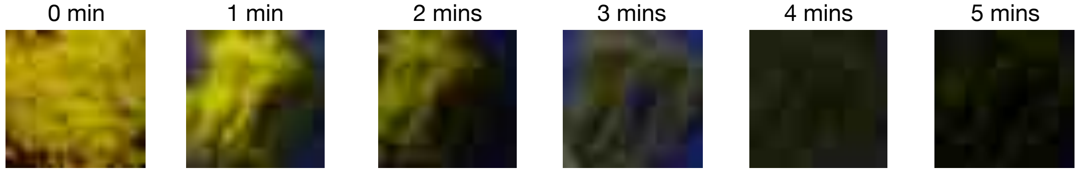
Emission Spectral Changes of 2_C (λ_{ext} = 280 nm)



Sensing Capability of 2_C (λ_{em} = 570 nm)



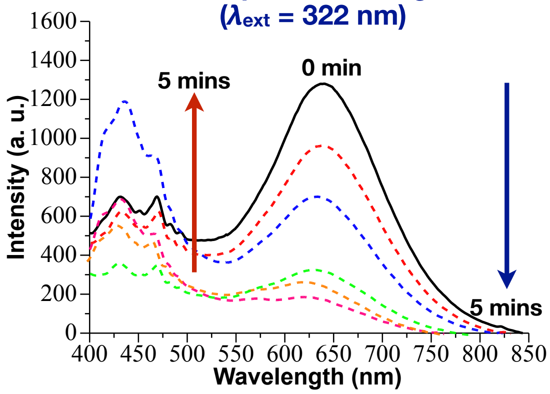
Photograph Images under λ_{ext} = 254 nm



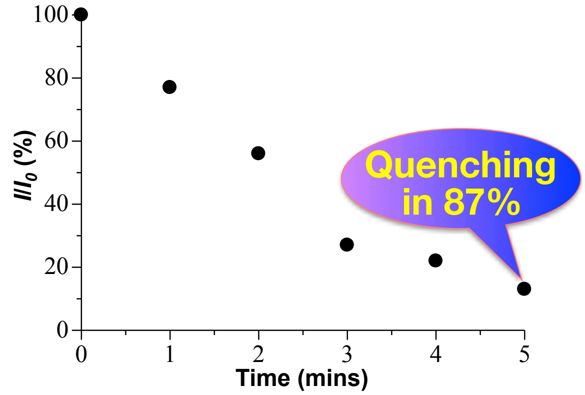
Color change from greenish to dark (less emissive) in 5 minutes

Sensing Capability of Chemosensor 2_D ($R_1 = C_6H_5$, $R_2 = H$)

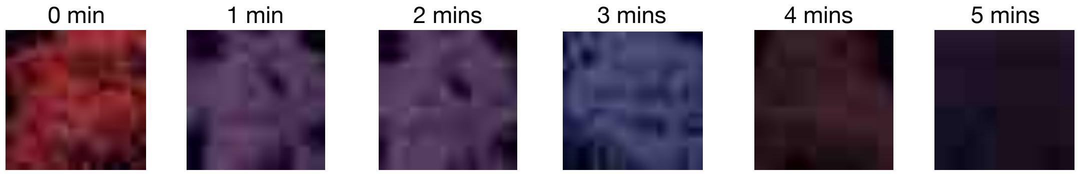
Emission Spectral Changes of 2_D (λ_{ext} = 322 nm)



Sensing Capability of 2_D (λ_{em} = 644 nm)



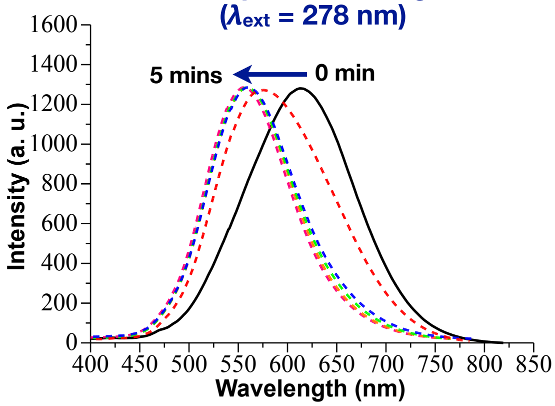
Photograph Images under λ_{ext} = 254 nm



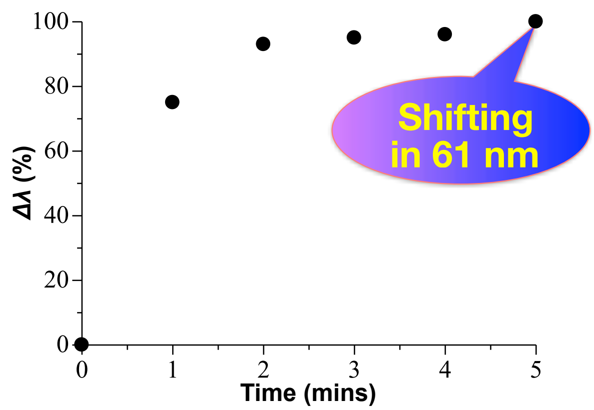
Color change from red to dark-red in 5 minutes

Sensing Capability of Chemosensor 2_E ($R_1 = CH_3$, $R_2 = -(OCH_3)_2Bz$)

Emission Spectral Changes of 2_E (λ_{ext} = 278 nm)



Sensing Capability of 2_E (λ_{em} = 616 nm)

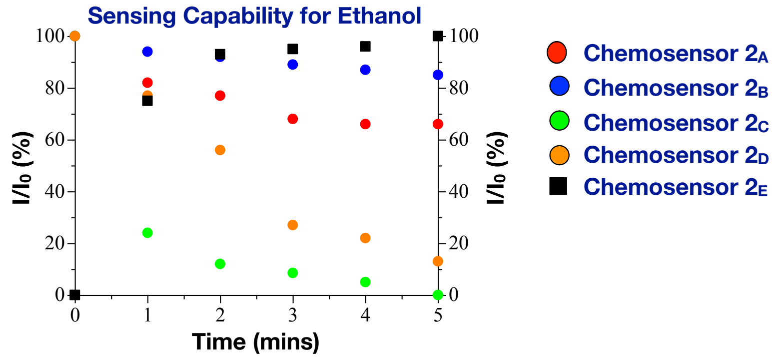


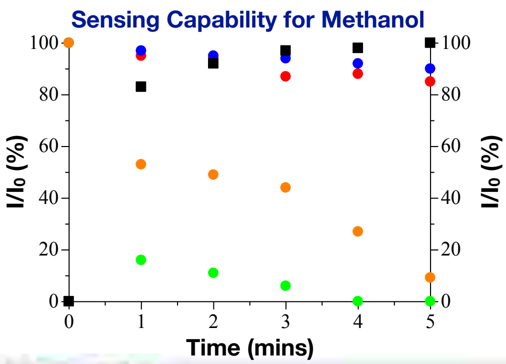
Photograph Images under λ_{ext} = 254 nm

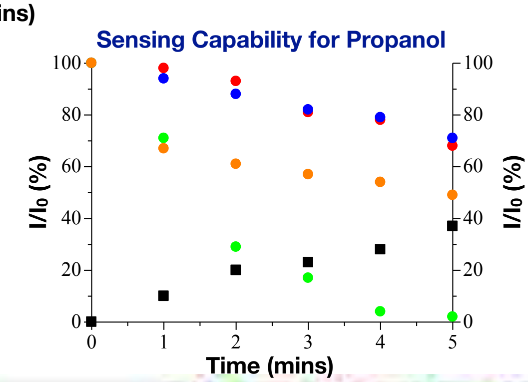
Color change from orange to green in 5 minutes

Sensing Capability of Chemosensor 2_{A-E}

Chemosensor 2_E still gave the best sensing capability for detection of methanol to propanol

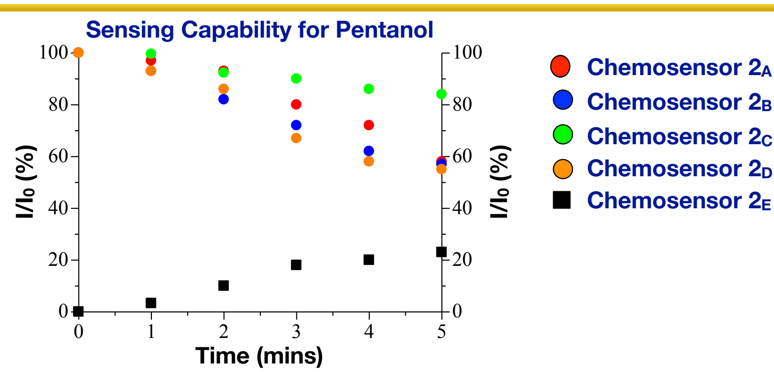


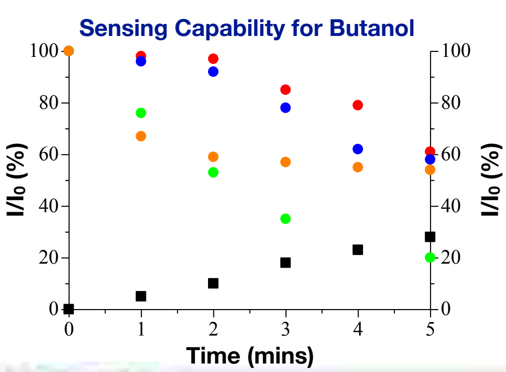


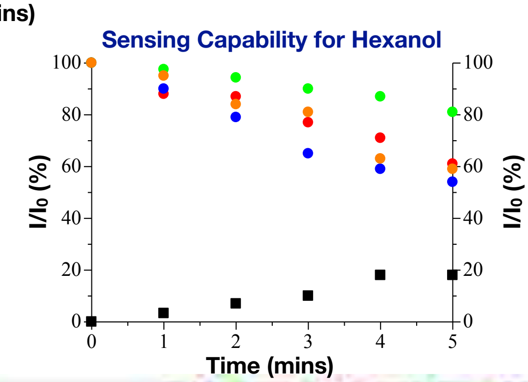


Sensing Capability of Chemosensor 2_{A-E}

Chemosensor 2_E gave significant decreasing capability for detection of butanol to haxanol with increasing hydrophobicity of vapors

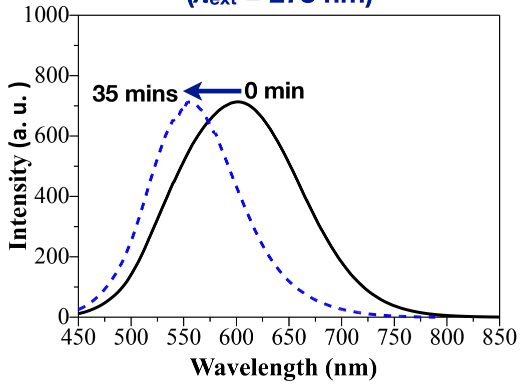




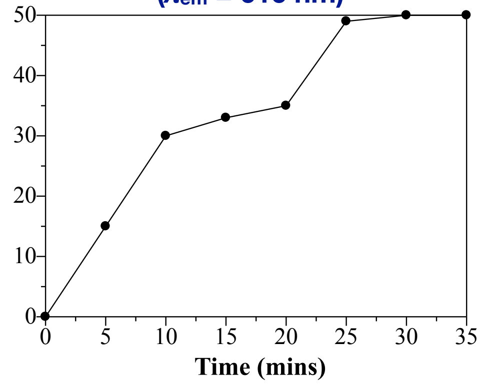


Sensing Capability of Chemosensor 2_E ($R_1 = CH_3$, $R_2 = -(OCH_3)_2Bz$)

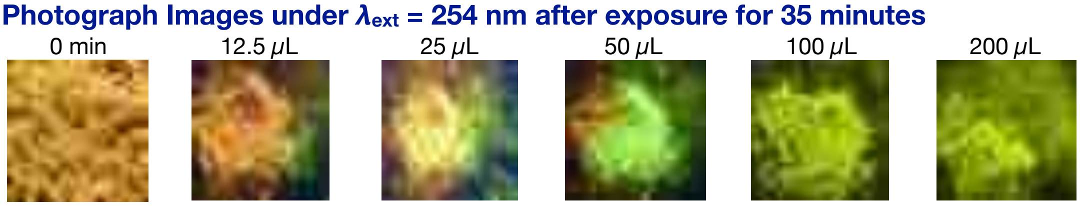
Emission Spectral Changes of 2_E (λ_{ext} = 278 nm)



Sensing Capability of 2_E (λ_{em} = 616 nm)



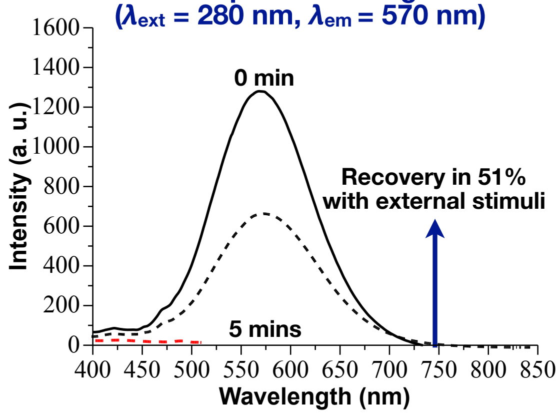
Photograph Images under λ_{ext} = 254 nm after exposure for 35 minutes



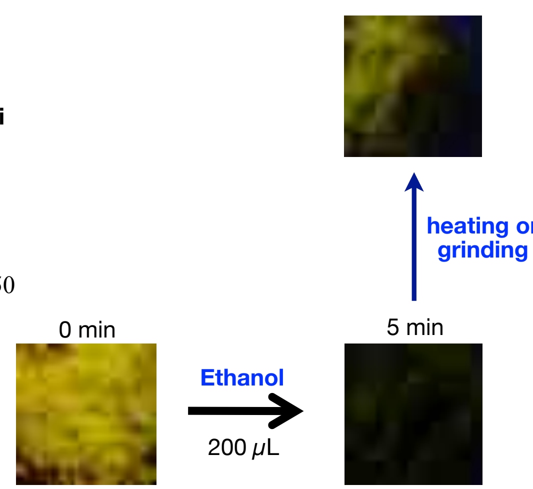
Color change from orange to green even with 100 μL Ethanol

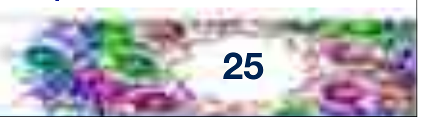
Reusability Testing of Chemosensor 2_C ($R_1 = CF_3$, R_2 = H)

Emission Spectral Changes of 2_C (λ_{ext} = 280 nm, λ_{em} = 570 nm)



Photograph Images under λ_{ext} = 254 nm

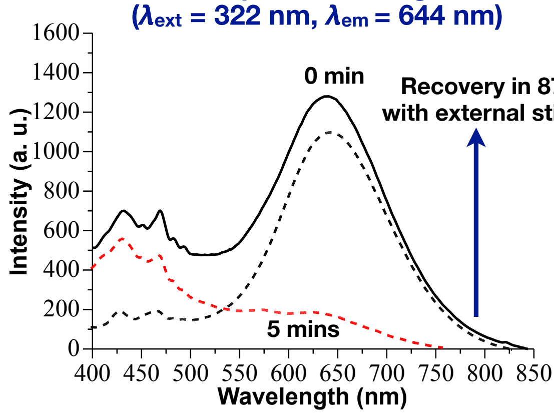




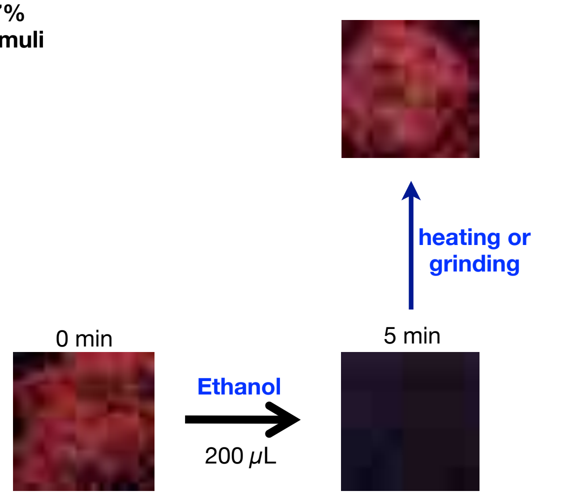
Recovery of green with with less emissive using external stimuli compared to the original color

Reusability Testing of Chemosensor 2D ($R_1 = C_6H_5$, R_2 = H)

Emission Spectral Changes of 2D (λ_{ext} = 322 nm, λ_{em} = 644 nm)



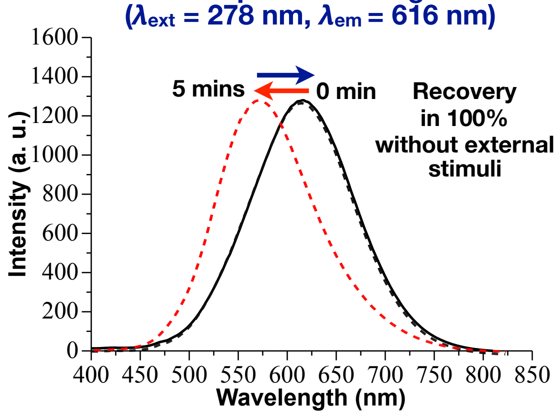
Photograph Images under λ_{ext} = 254 nm



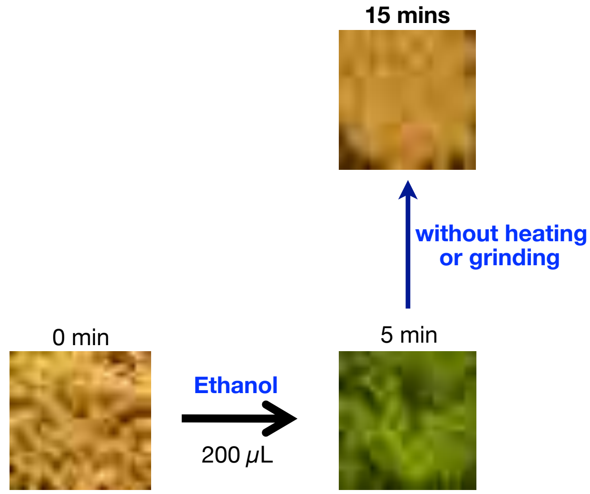
Recovery of red with less emissive using external stimuli compared to the original color

Reusability Testing of Chemosensor 2E ($R_1 = CH_3$, $R_2 = -(OCH_3)_2Bz$)

Emission Spectral Changes of 2E (λ_{ext} = 278 nm, λ_{em} = 616 nm)

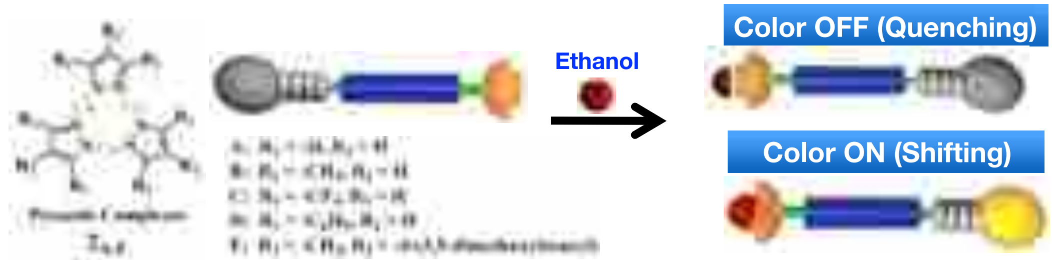


Photograph Images under λ_{ext} = 254 nm



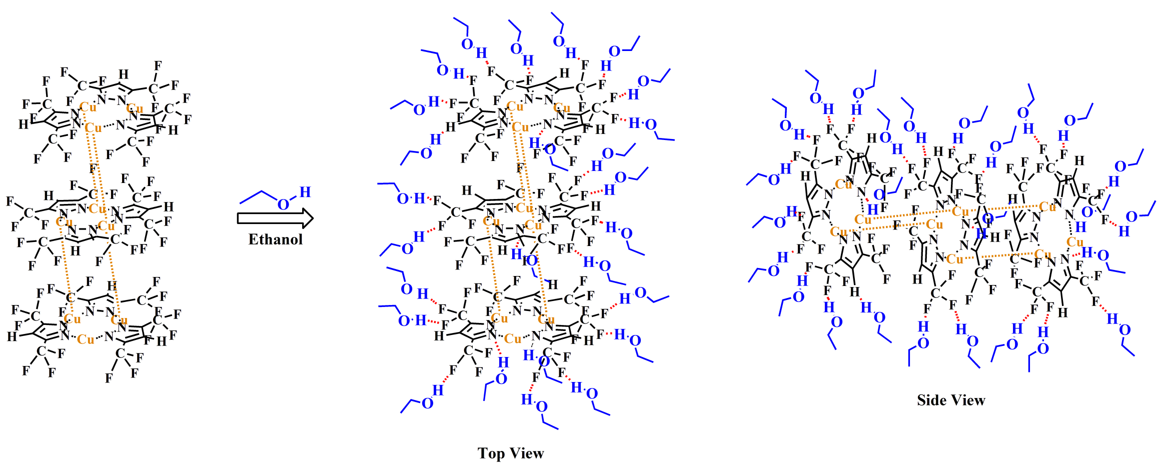
Recovery of red with less emissive using external stimuli compared to the original color

Sensing Capability of Chemosensor 2_{A-E}



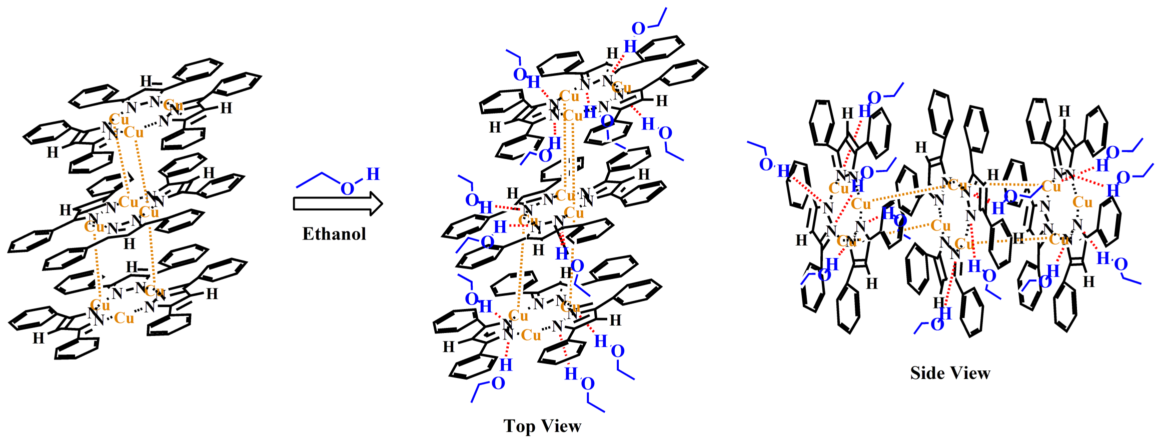
Chemosensors	Sensitivity	Re-usability	Phenomena
2_A	Slow	No	Quenching
2_B	Slow	No	Quenching
2_C	Very Fast	51% (Heating)	Quenching
2_D	Medium	87% (Grinding)	Quenching
2_E	Very Fast	100% (Naturally)	Shifting

Proposed Mechanism for Chemosensor 2_C



- Formation of intermolecular hydrogen bonding interaction between high electronegative F atom of CF_3 (trifluoromethyl) in *meso* position of the pyrazole ring to the OH of ethanol in the higher number (18 of F atoms)
- Formation of intermolecular hydrogen bonding interaction between high electronegative N atom of the pyrazole ring to the OH of ethanol

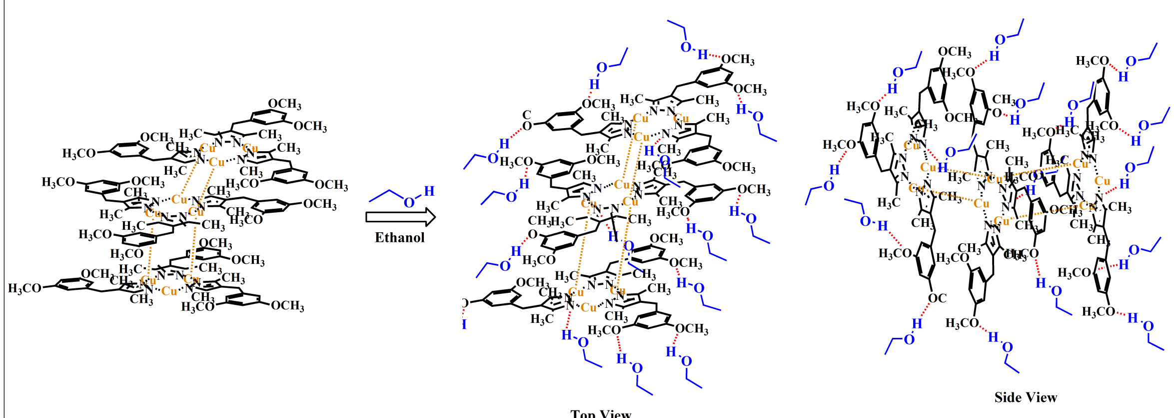
Proposed Mechanism for Chemosensor 2_D



- Formation of intermolecular hydrogen bonding interaction between high electronegative N atom of the pyrazole ring to the OH of ethanol

- Formation of photoinduced energy transfer from the triplet excited state of the Cu(I)-Cu(I) interaction to the emission site of stacked phenyl ring at the *meso* position of the pyrazole ring with new emission band around 430-460 nm as a blue-green emission

Proposed Mechanism for Chemosensor 2_E



- Short distance of Cu(I)–Cu(I) interaction tends to encourage the formation of a weak intermolecular hydrogen bonding interaction between OH of ethanol with electronegative O atoms of the methoxy groups at the benzyl ring

Conclusions

1. Successful synthesis of trinuclear copper(I) pyrazolate complexes with different alkyl side-chains at the pyrazole rings as a powder with different color appearances under daylight in high yield.
2. Successful characterization of phosphorescent properties of trinuclear copper(I) pyrazolate complexes with different alkyl side-chains at the pyrazole rings as green, orange and red emission with lifetime at microsecond and a large Stokes shift.
3. Successful investigation of sensing capability of trinuclear copper(I) pyrazolate complexes with different alkyl side-chains at the pyrazole rings with chemosensors 2_E as the best chemosensor for detection of methanol to propanol.

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Acknowledgements

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SUPRAMOLECULAR FUNCTIONAL NANOCHEMISTRY LABORATORY (RESEARCH GROUP)

THANK YOU.....

- Doctoral Students (7):
  - Juan Matmin (Completed PhD)
  - Norsahika Mohd Basir (Completed PhD)
  - Nur Fatiha Ghazalli (D3)
  - Mohamad Azani (D3)
  - Nurliana Roslan (D3)
  - Abdul Hamid Umar (D3)
  - Nurul Husna Sabran (D1)
- Master Students (1):
  - Goh Cheow Kit (M1)

Picture with PhD Students