Minutes of the meeting of the Departmental Research Project Monitoring Committee (DRPMC) held on 16.01.2024 at 10:00 am in the office of the Dean Faculty of Sciences, University of Jammu, Jammu.

PRESENT:

1. Prof. Anju Bhasin	(Convener)
2. Prof. H.N. Sheikh, HOD	(HOD Chemistry)
3. Prof. Kamal K. Kapoor	(Member)
4. Prof. P.K. Srivastava	(Member)
5. Dr. Monika Gupta	(Member)
6. Prof. Satya Paul	(Special Invitee)
7. Prof. D.S. Sambyal	(Special Invitee)

Item No. 1: To consider the progress report of Research & Seed Grant assigned to the following faculty members of the Department of Chemistry:

(i)	Prof. K.K. Kapoor	(Rs. 2.0 lakh)
(ii)	Prof. H.N. Sheikh	(Rs. 2.0 lakh)
(iii)	Dr. Monika Gupta	(Rs. 2.0 lakh)
(iv)	Dr. Ashwani Kumar	(Rs. 2.0 lakh)

Resolution: The faculty members presented the progress report before the committee members and submitted the hard copy of the same after the discussions and deliberations. The committee members were satisfied with the progress reports of all the projects and appreciated the scientific outcome, especially the sanction of projects by JKSTIC (Prof. K.K. Kapoor, Prof. H.N. Sheikh & Dr. Ashwani Kumar) and submission of SERB-SURE Project to DST, GoI by Dr. Monika Gupta.

Item No. 2: To consider the request of Principal Investigators (PIs) to extend the date of submission of final utilization certificate.

Resolution: The Principal Investigators (PIs) requested to extend the date of submission of final utilization certificate by two months, i.e. March 20, 2024, to enable the PIs to spend the unutilized grant. The DRPMC resolved that the request of PIs be kindly considered for extension by the Dean Research Studies.

The meeting ended with a vote of thanks.

1. Anju Bhasin 2. 3. 4.

5. 6. 7.

Office : 2453969
University : 2435248 } Extension :
: 2435259 } 2617, 2618

Post Graduate Department of Chemistry

University of Jammu

('A^{+}' Grade University- Accredited by NAAC)

Baba Saheb Ambedkar Road, Jammu - 180 006

No. PGD/Chem/

Dated 15-01-2024

NOTICE

Due to unavoidable circumstances, meeting of the Department Research Project Monitoring Committee (DRPMC), scheduled for 15-01-2024 at 4.00 pm, will be held on 16-01-2024 at 10.00 am in the Office of the Dean Faculty of Science to discuss progress report of Research and Seed Grant assigned to following faculty members of the department of Chemistry.

1. Prof. K.K. Kapoor
2. Prof. H.N.Sheikh
3. Dr. Monika Gupta
4. Dr. Ashwani Kumar

The concerned faculty members are requested to submit and present progress report in the meeting

The members of the DRPMC are request to make it convent to attend the meeting.

1. Prof. Anju Bhasin (Convener)
2. Prof. H. N. Sheikh (HOD)
3. Prof. K.K. Kapoor
4. Prof. P.K. Srivastava
5. Dr. Monika Gupta
6. Prof. Satya Paul (Special Invitee)
7. Prof. D.S.Sambyal (Special Invitee)

15-01-2024

Prof. H.N. Sheikh
Head of the Department

Copy to:

Prof. Anju Bhasin Dean Faculty of Science for information please

Office : 2453969
University : 2435248 } Extension :
: 2435259 } 2617, 2618

Post Graduate Department of Chemistry
University of Jammu
('A^{+}' Grade University- Accredited by NAAC)
Baba Saheb Ambedkar Road, Jammu - 180 006

*No. PGD/Chem/*24/ 72-73 *Dated* 11-01-24.

NOTICE

As desired by Dean Faculty of Science, a meeting of the Department Research Project Monitoring Committee (DRPMC) will be held on 15-01-2024 at 4:00 pm in the Office of the Dean Faculty of Science to discuss progress report of Research and Seed Grant assigned to following faculty members of the department of Chemistry.

1. Prof. K.K. Kapoor
2. Prof. H.N.Sheikh
3. Dr. Monika Gupta
4. Dr. Ashwani Kumar

The concerned faculty members are requested to submit and present progress report in the meeting

The members of the DRPMC are request to make it convent to attend the meeting.

1. Prof. Anju Bhasin (Convener)
2. Prof. H. N. Sheikh (HOD)
3. Prof. K.K. Kapoor
4. Prof. P.K. Srivastava
5. Dr. Monika Gupta
6. Prof. Satya Paul (Special Invitee)
7. Prof. D.S.Sambyal (Special Invitee)

Prof. H.N. Sheikh
Head of the Department

Copy to:

Prof. Anju Bhasin Dean Faculty of Science for information please

Utilization of Research & Seed Grant under DIQA

S.No.	Heads	Amount Sanctioned (Rs.)	Utilized (Rs.)	Unutilized (Rs.)
1.	**Hiring of Services**	40000	0	40000
2.	**Equipment**	20000	19990	10
3.	**Consumables**	140000	139467	533
	TOTAL	**200000**	**159457**	**40543**

15-1-2024
(Prof. H. N. Sheikh)

OFFICE OF DEAN RESEARCH STUDIES
UNIVERSITY OF JAMMU

ORDER

Based on the recommendations of the Committee constituted for the purpose vide order N dated 05.12.2022 and also on the recommendations of the Dean of the Faculty concerned, sanc accorded to the payment of Rs. 2,00,000/- as financial assistance in favour Haq Nawaz Sheikh Department of Chemistry as per the below out of the Research & Seed Grant for Professor / Associate / Assistant Professor, un 'Quality Assurance Fund (DIQA)' as per order No. Fin./2022-23/3338-42 dated 16.09.2022:-

a) Hiring of Services / Honorarium for experts	:	40,000/-
b) Equipment (Repair) or any accessory, if needed, to the existing equipment	:	—
c) Purchase of Minor Equipment	:	20,000/-
d) AMC's of existing Equipment	:	—
e) Consumables/Chemicals/Glassware etc.	:	1,40,000/-
f) Contingency	:	—
g) Field work	:	—
h) Any other item	:	—
Total	:	2,00,000/-

You are required to meet the said expenditure as per University norms. The Principal Investig shall submit the bills for pass & payment as per the existing GFR/GeM guidelines to the Grant Sect quantum of assistance sanctioned is required to be exhausted/utilized within a period of one year starti the date of issue of order. Utilization certificate will be submitted after completion of the project.

A detailed report of project shall mandatorily be submitted by PI to the office of the Dean R Studies with a clear statement on whether the said project has enabled the PI to put up a bigger prop funding to any national funding agency.

No. RA/23/6094-7000
Dated: 20/01/23

20/1/2023
Assistant Registrar (

Copy to:

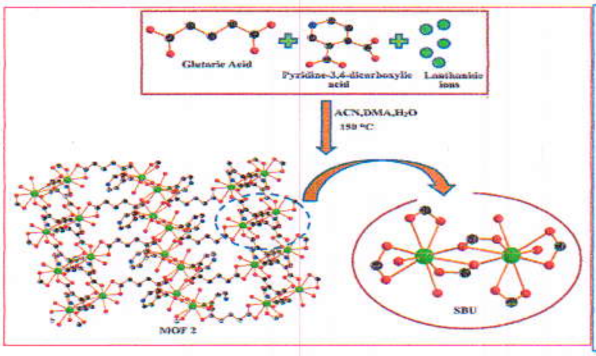
1. Special Secretary to the Hon'ble Vice-Chancellor.
2. Sr. P.A. to DAA/DRS/Registrar/DIQA.
3. Dean of the Faculty concerned.
4. HOD concerned.
5. Principal Investigator.
6. Joint Registrar (Finance).
7. Deputy Registrar (Grants).

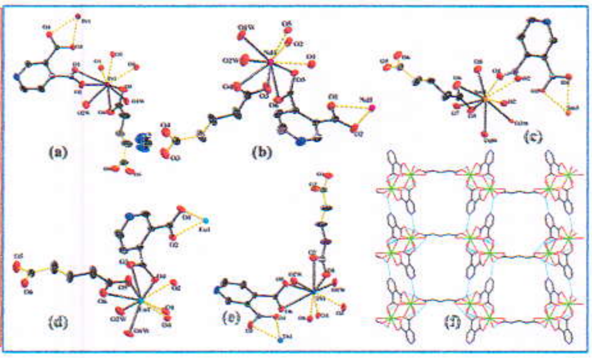
Progress report of the project entitled "***Synthesis, characterization and application of functional Lanthanide-Metal-Organic Frameworks***" supported by Research and Seed Money Grant Assistance for the formulation of the Research Proposal under the Quality Assurance Fund of DIQA, University of Jammu.

Following are the outcomes of the project:

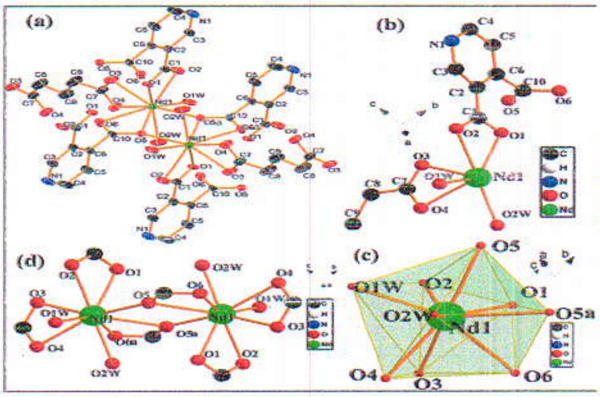
1. Research Seed money grant assistance helped in the procurement of chemicals for carrying out the preliminary investigations.

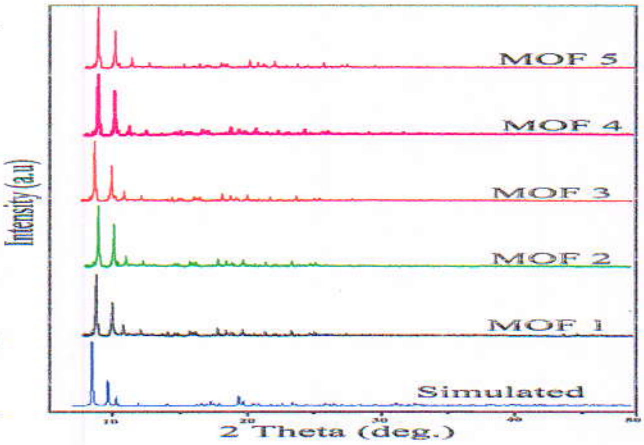
2. Five isostructural lanthanoid metal organic frameworks, namely, $\{[Pr(3,4\text{-}PDA)(Glu)_{0.5}(H_2O)_2]CH_3CN\}$ and $[Ln(3,4\text{-}PDA)(Glu)_{0.5}(H_2O)_2]$: Ln = Nd, Sm, Eu and Tb (where, 3,4-PDA = Pyridine-3,4-dicarboxylic acid, Glu =Glutaric acid) were synthesized *via* solvothermal method.





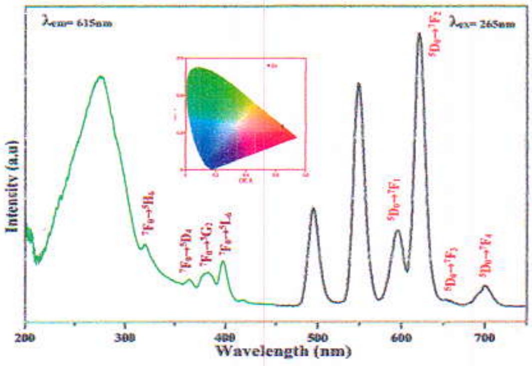
3. These lanthanoid metal-organic frameworks were characterized by FTIR, Single-crystal X-ray diffraction, Powder X-ray diffraction, Hirshfeld surface analysis, DFT calculations, electronic spectroscopy and Photoluminescence.

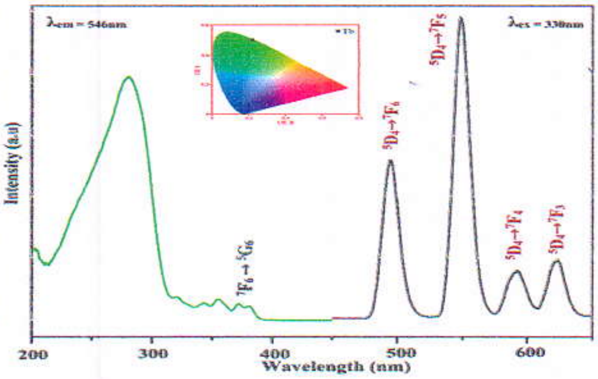




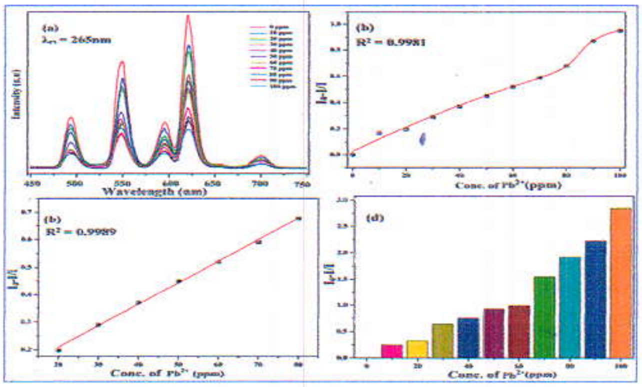
15-1-2024

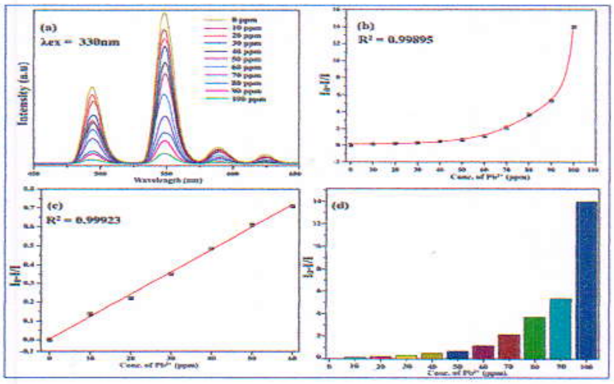
4. The luminescence properties of Eu and Tb based MOFs are highly sensitive for the detection of Pb^{2+} with the lowest detectable change in signal occurring at ~0.014 and ~0.013 *ppm* of Pb^{2+}.





5. The MOF-based luminescence sensors designed demonstrate successful and feasible strategy to use Pyridine-3,4-dicarboxylic acid based ligand as antenna which can efficiently sensitize Eu^{3+} and Tb^{3+} emission. The MOFs show great potential in environmental detection application of Pb^{2+}ion in water.

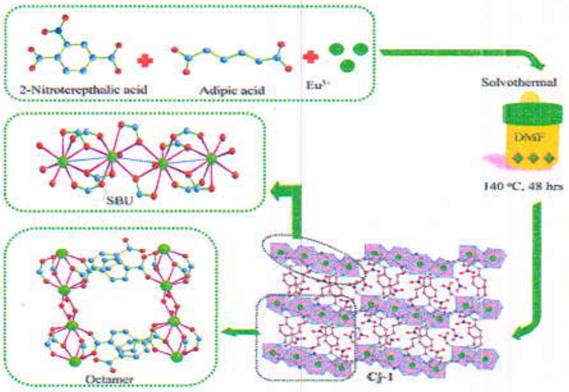


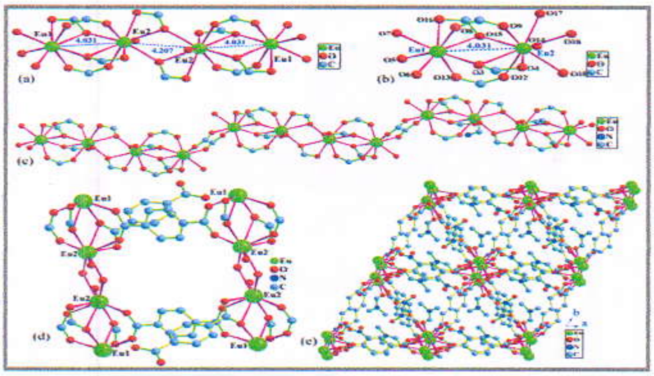


These results were published in a reputed International Journal "*CrystEngComm*" published by Royal Society of Chemistry, London.

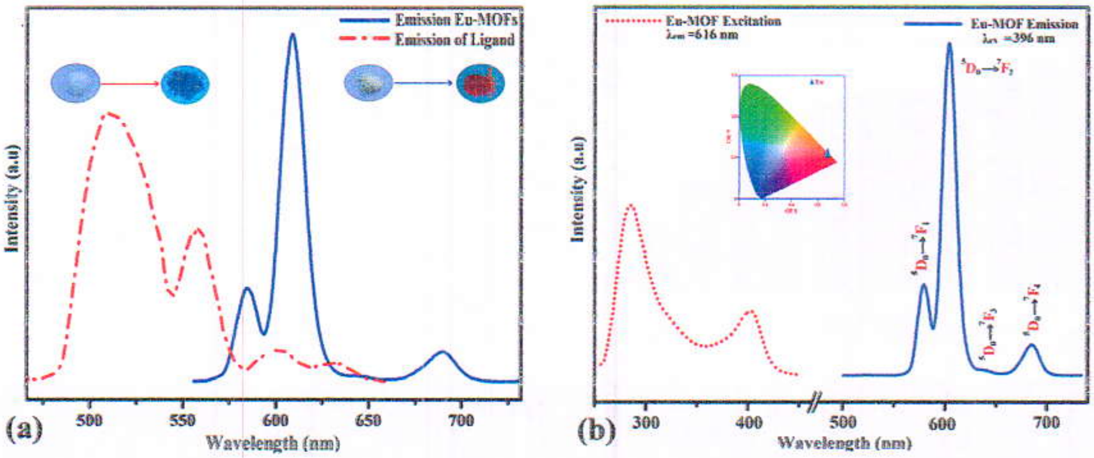
Selective and efficient detection of Pb2+ in aqueous solution by lanthanoid-organic frameworks bearing pyridine-3,4-dicarboxylic acid and glutaric acid
Zaib ul Nisa, Nargis Akhter Ashashi, Richa Singhaal, Musheer Ahmad, Rosa M. Gomila, Antonio Frontera, **Haq Nawaz Sheikh,** *CrystEngComm,* **25**, 2418-2440, **2023**

6. Using a mixed ligand strategy a novel 3D Eu(III) metal–organic framework with tetranuclear SBUs formulated as $[Eu_2(NTA)_2(Ada)(DMF)_2]$ was solvothermally synthesized *via* employing 2-nitroterepthalic acid (NTA) and adipic acid (Ada) as antenna and bridging ligands.

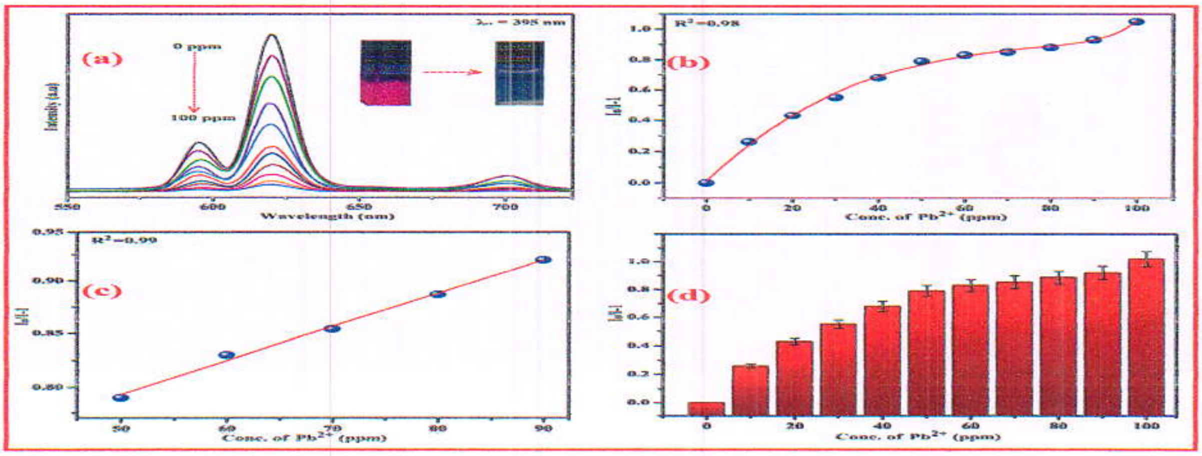




7. Multiple coordination modes and bright luminescent characteristics make MOF ideal for luminescent probes.



8. The MOF is a multi-responsive luminescent sensor for the efficient detection of the Pb^{2+}, MnO_4^- ions and p-NP in aqueous phase.



These results were published in a reputed International Journal "*Journal of Molecular Structure*" published by Elsevier.

3D Water Stable Eu(III)-Organic Framework as Recyclable Multi-Responsive Luminescent Sensor for Efficient Detection of Lead ion, Permanganate anion and para-Nitrophenol in Aqueous Medium Charanjeet Sen, Richa Singhaal, Nargis Akhter Ashashi, Swaita Devi, Musheer Ahmad, **Haq Nawaz Sheikh,** *J. Mol. Str.*, **1290**, 135970, **2023**

Research and seed money grant assistance also helped in preparing a complete research proposal. The findings of this proposal led to the development of a new proposal which was submitted to the Jammu and Kashmir Science, Technology and Innovation Council (JKSTIC). Pertinent to mention that this proposal has been awarded with funding of Rs. 8.20 lakh with Serial .No 7 of the annexure attached (5pages).

Thanks,

15-01-2024

Prof. Haq Nawaz Sheikh
PG Department of Chemistry,
University of Jammu, Jammu.

CrystEngComm

ROYAL SOCIETY OF CHEMISTRY

PAPER

Cite this: *CrystEngComm*, 2023, 25, 2418

Selective and efficient detection of Pb^{2+} in aqueous solution by lanthanoid-organic frameworks bearing pyridine-3,4-dicarboxylic acid and glutaric acid†

Zaib ul Nisa,[a] Nargis Akhter Ashashi,[a] Richa Singhaal,[a] Musheer Ahmad,[b] Rosa M. Gomila,[c] Antonio Frontera[c] and Haq Nawaz Sheikh*[a]

Received 3rd February 2023,
Accepted 14th March 2023

DOI: 10.1039/d3ce00099k

rsc.li/crystengcomm

Optically-active luminescent materials based on lanthanoid ions attract significant attention due to their unique spectroscopic properties and the possibility of application as chemical sensors. Five isostructural lanthanoid metal organic frameworks, namely {[Pr(3,4-PDA)(Glu)$_{0.5}$(H$_2$O)$_2$]CH$_3$CN}(**1**) and [Ln(3,4-PDA)(Glu)$_{0.5}$(H$_2$O)$_2$]: Ln = Nd (**2**), Sm (**3**), Eu (**4**), and Tb (**5**) (where 3,4-PDA = pyridine-3,4-dicarboxylic acid, Glu = glutaric acid), synthesized *via* the solvothermal method are reported. These lanthanoid metal–organic frameworks were characterized by FTIR, single-crystal X-ray diffraction, powder X-ray diffraction, BET, Hirshfeld surface analysis, DFT calculations, electronic spectroscopy, and photoluminescence techniques. MOFs **1–5** show porous two-dimensional (2D) structures. The luminescence properties of MOFs **4** and **5** demonstrated the range of sensing capabilities for some toxic heavy metals. However, MOFs **4** and **5** are highly sensitive for the detection of Pb^{2+}, exhibiting the most effective luminescence quenching with the lowest detectable change in the signal occurring at ~0.014 and ~0.013 ppm of Pb^{2+} with MOFs **4** and **5**, respectively, at room temperature in minutes. The MOF-based luminescence sensors designed in this paper demonstrate a successful and feasible strategy to use pyridine-3,4-dicarboxylic acid-based ligand as an antenna, which can efficiently sensitize Eu^{3+} and Tb^{3+} emission. MOFs **4** and **5** show great potential in the application of environmental detection of Pb^{2+} in water.

Introduction

The degrading impact of rapid urbanization and industrialization on the quality of natural resources has emerged as a matter of concern across the globe. Over the past decade, anthropogenic and industrial activities have increased exponentially, releasing many hazardous metal ions into water bodies and environment, which have been demonstrated to cause many adverse effects on human health and their habitat.[1] Toxicity and pollution caused by heavy metals has proven to be a major threat to flora and fauna and their surrounding environment.[2] Owing to their high water solubility, these hazardous pollutants have become an indispensable part of daily life and pollute the environment for humans as well as aquatic life.[3] The excessive use of harmful chemicals may lead to deleterious health effects and are attributed to oxidative species formed in the body.[4] This leads to lipid peroxidation and permanent damage to the nervous system and circulatory system, resulting in various incurable diseases, such as organ failure, malformation, angiocardiopathy, and cancer.[5] Exposure to such hazardous chemicals has undesirable effects; in particular, long-term low-level exposure is more dangerous.

Among such hazardous substances, heavy metals such as Cd^{2+}, Pb^{2+}, Hg^{2+}, Ni^{2+}, and Mn^{2+} are often encountered in the environment and water bodies. Cd^{2+} exposure at low level over an extended period can result in kidney, bone, and lung diseases.[6] Mercury is one of the most serious contaminants threatening our waters because it is a potent neurological poison to fish, wildlife, and humans.[7] Ni^{2+} and Mn^{2+} ions are not only indispensable biological ions for human beings but are also utilized widely in industrial production. An excess of these ions within the body can result in some severe diseases,

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[b] *Department of Applied Chemistry, Faculty of Engineering & Technology, Aligarh Muslim University, Aligarh, 202002, India*

[c] *Department of Chemistry, Universitat de les Illes Balears, Crts de Valldemossa km 7.5, 07122 Palma de Mallorca, Baleares, Spain*

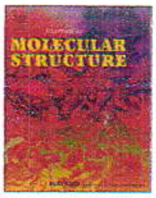
† Electronic supplementary information (ESI) available. CCDC 2201651–2201655. For ESI and crystallographic data in CIF or other electronic format see DOI: https://doi.org/10.1039/d3ce00099k

Journal of Molecular Structure 1290 (2023) 135970

Contents lists available at ScienceDirect

Journal of Molecular Structure

journal homepage: www.elsevier.com/locate/molstr



3D water stable Eu(III)-organic framework as recyclable multi-responsive luminescent sensor for efficient detection of lead ion, permanganate anion and *para*-nitrophenol in aqueous medium

Charanjeet Sen[a], Richa Singhaal[a], Nargis Akhter Ashashi[a], Swaita Devi[a], Musheer Ahmad[b], Haq Nawaz Sheikh[a,*]

[a] *Department of Chemistry, University of Jammu, Baba Sahib Ambedkar Road, Jammu 180006, India*
[b] *Department of Applied Chemistry, Faculty of Engineering & Technology, Aligarh Muslim University, Aligarh, 202002, India*

ARTICLE INFO

Keywords:
Luminescent lanthanide
Metal–organic framework
Sensors
Hazardous chemicals
Photoluminescence studies

ABSTRACT

Using a mixed ligand strategy a novel 3D Eu(III) metal–organic framework with tetranuclear SBUs formulated as $[Eu_2(NTA)_2(Ada)(DMF)_2]$ (**Cj-1**) was solvothermally synthesized by employing 2-nitroterepthalic acid (NTA) as antenna and adipic acid (Ada) as bridging spacer. Multiple coordination modes and bright fluorescence characteristics make Cj-1 ideal as fluorescent probe. Fluorescence studies reveal that Cj-1 emits intense red luminescence and displays excellent water stability and outstanding chemical stability over broad pH range (pH = 2–10). The **Cj-1** exhibits strong luminous sensing response against inorganic ions Pb^{2+}, MnO4$^-$, and *para*-nitrophenol in water with high sensitivity, selectivity, rapid reaction and an outstanding recycle usage. It is interesting to note that the solid sample's color changes from white to brown upon detection of the MnO_4^- ions. This color change signifies luminescence induction, making the method for detecting MnO_4^- ions simple and more practical to everyday life. Powder X-ray diffraction, infrared spectroscopy, elemental analysis, and luminescence methods were used to characterize the compound. The potential sensing mechanisms of **Cj-1**for selective sensing have been thoroughly investigated.

1. Introduction

Metal-organic frameworks (MOFs) is a class of emerging porous crystalline materials being composed of organic linkers and metal centres [1]. These rigid, stable, and developing materials have potential in variety of fields such as drug delivery and release [2–3], gas storage or separation [4–7], heterogeneous catalysis [8–9], magnetism [10–11], chemical sensing [12–16] and so on. Due to their exceptional selectivity, sensitivity, and operating features, luminescent MOF sensors have attracted great deal of attention in variety of applications. Luminescent MOF sensors with high selectivity and sensitivity for detecting anions [15], cations [12–13], explosives [12], small compounds [17–19], and vapours [20–22] have recently been reported. They can be used as chemical sensors because of their ability to transmit the host–guest interaction to measurable levels.

As global industrialization moves forward quickly, substantial amount of metal ions, inorganic anion, and nitro aromatic chemicals are dumped into our living environment, causing serious problems for the environment and public health [23–28]. It is crucial to detect and sense these species in the ecosystem, as they have significant impact on our daily lives and health. Heavy metal ions contribute significantly to water pollution since they are very poisonous, non-degradable and have tendency to bio-accumulate and bio-magnify in the food chain [29–31]. Among all, Pb^{2+} ion is one of the most dangerous heavy metal ions and is commonly found in day to day household items including batteries, gasoline and paint. The effects of lead poisoning can be quite severe, including anemia, weakness and even damage to the kidneys and brain [32]. Due to its ability to pass the placental barrier, lead exposure in pregnant women poses risk to the developing foetus [33]. Pb^{2+} poisoning inhibits hemesynthesis, spermatogenesis, and fetal development in humans and the global ecosystem equilibrium by reducing soil ability to recycle nutrients [34]. On the other hand, industrialization, is also making ionic pollutant more and more hazardous [35–37].

As common powerful oxidant in labs and factories, MnO_4^- anions harm living things and the environment. MnO_4^- anions are utilised as preservatives and disinfectants to improve water quality and treat fish

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https://doi.org/10.1016/j.molstruc.2023.135970
Received 16 January 2023; Received in revised form 5 June 2023; Accepted 6 June 2023

(Rs. In lakhs)

SPONSORED RESEARCH AND EXTENSION-2022-23

University of Jammu

r.	Name of Principal Investigator with Contact Details E-mail /cell No.	DOB/DOR	Subject/Field	Title of the Project Proposal	Institution / Organization	Funds Proposed by the Technical Committee			Remarks
						1st Year	2nd Year	Total	
1	2	3	4	5	6	10	11	12	13
1	Prof. Seema Langer, Dean Life Sciences, Professor & Head, langerseema@yahoo.co.in 9906027016	05-06-1964	Zoology	Investigations on nuritional and clinical significance of fresh water crabs with special emphasis on the effect of frozen storage on their biochemical composition.	Department of Zoology, **University of Jammu**	3.75	2.75	6.50	Recommended
2	Dr.Sikander Pal, Associate Professor, sikanderpal@jammuuniversity.ac.in, sikanderchowdhary@gmail.com 9596744900	27-04-1981	Botany	Genome wide association studies (GWAS) of maize roots for improving traits regulating phosphate use efficiency.	Department of Botany, **University of Jammu**	4.50	3.50	8.00	Recommended
3	Dr.Namrata Sharma, Professor, namratadni@gmail.com 9086003468, 7006275841	17-05-1965	Botany	Exploration of variability in genetic systems of Artemisia species abounding NW Himalayas with emphasis on the economic and evolutionary significance of chromosomal races.	Department of Botany, **University of Jammu**	4.00	3.00	7.00	Recommended

	. Veenu Kaul, Professor, veenukaul@yahoo.co.in 9419137180	08-12-1969	Botany	Evaluation of cytological molecular and biochemical diversity in Drimia indica (Roxb.)Jessop.	Department of Botany, **University of Jammu**	4.00	4.00	8.00	Recommended
5	Dr.S.Bharathiraja, Assistant Professor, bharu.ap@gmail.com 9940453909		Biotechnology	**Surface fabrication of Biopolymer Scaffolds with Nano Hydroxyapatite and extracts of Aegle Msarmelos and/or Catharanthus Roseus for boneRegeneration : An IN-Vitro study.**	**School of Biotechnology, University of Jammu**	4.10	3.75	7.85	Recommended
6	Dr.Madhulika Bhagat, Associate Professor, Madhulikasbt@gmail.com 9419124018	09-04-1979	Biotechnology	Development of polymeric nanogels loaded with essential oil from medicinal and aromatic plants.	School of Biotechnology, **University of Jammu**	4.50	3.00	7.50	Recommended
7	Prof.Haq Nawaz Sheikh, Professor, hnsheikh@jammuuniversity.ac.in hnsheikh07@gmail.com hnsheikh@rediffmail.com 7006282861, 9419148792	23-08-1969	Chemistry	Development of Luminescent Lanthanide-Coordination Polymers/Metal organic Frameworks as Chemical Sensors.	Department of Chemistry, **University of Jammu**	4.50	3.70	8.20	Recommended
8	Dr.Ashwani Kumar, Senior Assistant Professor, ashwani.kalsi@gmail.com 9419860841, 9596895135	17-05-1986	Chemistry	Temperature dependent physicochemical studies of citrates/tartrates in aqueous solutions of ionic liquids.	Department of Chemistry, **University of Jammu**	4.00	3.30	7.30	Recommended

	f. Devinder Singh, Professor, drdssambyal@rediffmail.com 9419244710	11-03-1966	Chemistry	Synthesis of photo-catalytically active nano-crystalline mixed oxides alnd their applications in the removal of organic dyes for environmental remediation.	Department of Chemistry, **University of Jammu**	5.10	3.75	8.85	Recommended
10	Prof. Kamal K. Kapoor, Professor & Head, kamalkka@gmail.com, kamalkapoor@jammuuniversity.ac.in 9419134807, 7006298353	15-03-1965	Chemistry	Synthesis of hybrid molecules based on styrylquinoxalinones, donepezil and other bio-active heterocyclic compounds as anti-Alzheimer agents.	Department of Chemistry, **University of Jammu**	5.50	3.80	9.30	Recommended
11	Prof. Lalit Sen Sharma, Professor, lalitsensharma@jammuuniversity.ac.in 0191-2432715	12-04-1969	Computer Science/IT	Assimilating Domain knowledge using Ontology Mapping for enhanced reasoning capability.	Department of Computer Science & IT **University of Jammu**	2.75	2.50	5.25	Recommended
12	Dr.Sheetal Ambardar, Assistant Professor, sheetalambardar@gmail.com 9419117624	09-09-1970	Biotechnology	Microbiome analysis of the rhizosphere of medicinal herb Tulsi (Ocimum sanctum l.).	School of Biotechnology, **University of Jammu**	4.30	2.30	6.60	Recommended
13	Dr.Chinmoyee Maharana, Assistant Professor, chinmoyee@gmail.com chinmoyee.maharana@jammuuniversity.ac.in 9717961237		Zoology	Investigation of circulatory miRs in neurodegenerative diseases: Implications for biomarker discovery and therapeutics.	Department of Zoology , **University of Jammu**	4.50	3.50	8.00	Recommended

	jender Kumar Bajaj, Professor, bajajbijenderk@gmail.com 9419102201	05-05-1969	Biotechnology	Anti-inflammatory potential of probiotic lactic acid bacteria isolated from unique ecological niches of Jammu and Kashmir	School of Biotechnology, **University of Jammu**	4.25	4.25	8.50	Recommended
15	Jyoti Vakhlu, Professor, jyotimetagenomic@gmail.com 9419117624	09-09-1970	Biotechnology	Identification of genes and metabolites responsible for plant growth promotion and bio-control activity of Bacillus sp.strain D5 of saffron.	School of Biotechnology, **University of Jammu**	4.10	2.25	6.35	Recommended
16	Dr.Sushil Kumar Pandey, Professor, kpsushil@rediffmail.com 0191-2453969, 9419147679	20-07-1963	Chemistry	New metal complexes with phosphor-I, I-dithiolate ligands; Synthesis, characterization and application	Department of Chemistry, **University of Jammu**	4.90	3.35	8.25	Recommended
17	Prof. Sanjana Kaul, Professor, sanrozie@rediffmail.com 9410237291	30-08-1967	Biotechnology	Bioprospecting endophytic microbes from saffron for bioactive secondary metabolites.	School of Biotechnology, **University of Jammu**	4.25	3.25	7.50	Recommended
18	Dr. Satya Paul, Professor, satyapaul@jammuuniversity.ac.in 0191-243969, 9419147677	10-06-1967	Chemistry	Development of supported metal organic frameworks for removal of pollutants from waste water; and their applications in organic synthesis.	Department of Chemistry, **University of Jammu**	5.10	3.80	8.90	Recommended

UNIVERSITY OF JAMMU

APPLICATION FORM FOR SEED GRANT/RESEARCH GRANT

(Submit in Duplicate)

Name and Designation	**HAQ NAWAZ SHEIKH** **PROFESSOR**
Date of Birth	23rd August, 1969
Department/Centre/Institiue	CHEMISTRY
Area of Research (in Bold)	**MOFs (Metal Organic Frameworks)**
Specialization Area	Inorganic Chemistry
Details of Funding requested (a)- (h)	
(a) Hiring of Services/ Honorarium for Experts Justification	Rs. 40,000/-
(b) Equipment (Repair) or any accessory of need to the existing Equipment Justification	-
(c) Purchase of Minor Equipment Justification	Rs. 20,000/-
(d) AMCs of Existing Equipments Justification	-
(e) Consumables/Chemicals/Glassware etc Justification	Rs. 1,40,000/-
(f) Contingency Justification	-
(g) Field Work Justification	-
(h) Any other Item after the Approval of Competent Authority Justification	-
(i) Summary of the Proposal (Atleast 3000 words)	To be submitted on a separate sheet

Professor Haq Nawaz Sheikh
Name and Signature of the Faculty

Dated: 27-10-2022

Recommendations of DRC

1. 2. 3. 4.

5. 6. 7. 8.

Head of the Department

Annexure-I

SUMMARY OF THE PROPOSAL

Synthesis, characterization and application of functional Lanthanide-Metal-Organic Frameworks

Origin of the Proposal:

Design and development of metal-organic frameworks (MOFs) and /or coordination polymers (CPs) of lanthanides is being pursued because of their interesting structural as well as topological diversity and functional application.The relevance of CPs design is because of the aesthetic beauty associated with their crystalline nature, high and permanent porosity, extraordinary surfaces for catalysis, tunable pore size, potential scalability to industrial scale that have made these materials attractive target for further study. Coordination polymers are highly crystalline in nature and have high surface area with highly tunable porosity and adjustable chemical functionalities that make them extremely attractive for various applications.These materials have proved their promising applications in the fields of gas storage and separation, catalysis, chemical sensing, molecular wires, drug delivery, electrical conductance, magnetism and in optical properties. Coordination bonds in them provide much stronger and directional interaction which endows them with a variety of intriguing properties. Luminescent/fluorescent sensing platforms properties of lanthanide - CPs and/or MOFs is getting emissive attention due never-ending novel structural possibilities and modulation/tuning of emissive color and color intensity by structural manipulations. The changes in emission intensity, emission lifetime and wavelength by modifying the structural motifs in CPs/MOFs can lead to several benefits such as development of ratio metric luminescent chemical sensors. Luminescent/fluorescent sensing properties of MOFs have increased demand for timely and accurate environmental pollution monitoring and control with outstanding performance, i.e., high sensitivity, high selectivity, and reliability. Metal–organic frameworks (MOFs), also known as porous coordination polymers, are a fascinating class of highly ordered crystalline coordination polymers formed by the coordination of metal ions/clusters and organic bridging linkers/ligands. Owing to their unique structures and properties, i.e., high surface area, tailorable pore size, high density of active sites, and high catalytic activity, various MOF-based sensing platforms have been reported for environmental contaminant detection including anions, heavy metal ions, organic compounds, and gases. As some lanthanide Sm, Eu, Tb and Dy have their signature emissions in the visible region which can be sensitized *via* antenna effect by incorporating a strongly absorbing luminophores. Luminescence-based temperature sensors are superior to traditional temperature sensors due to their simplicity, accuracy, non-invasiveness, and ability to work in fast moving objects and strong electromagnetic fields. A lanthanide sensor can be designed in the form of a CP/MOF provided metal center provides the advantage of a pair of thermally coupled energy states and organic linker acts as robust and effective sensitizer via antennaeffect.

The central idea of this summary is to design, characterize and explore potential applications of coordination polymers/metal organic framework by self-assembly of lanthanides and suitable organic.

Synthetic Procedures

Glassware and minor equipments such as UV chamber, autoclaves, cuvettes, glassware are required for the research purpose.

Solvents require for synthesis of Coordination Polymers/MOFs:

Functional coordination polymers based on trivalent lanthanide ions with aromatic linkers will be synthesized solvothermally/hydrothermally using solvents like dimethylformamide (DMF), dimethylacetamide (DMA), diethylformamide (DEF), diethylacetamide (DEA), dimethyl sulfoxide (DMSO), acetonitrile (ACN), Ethanol etc.

Chemicals requirement for synthesis of Coordination Polymers/MOFs:

Various transition metals, lanthanides and aromatic poly/dicarboxylates ligand such as 2,5-furandicarboxylic acid, 5-hydroxyisopthalic acid, 5-aminoisopthalic acid, 2,5-thiophenedicarboxylic acid,isophthalic acid, terephthalic acid, 2,6-naphthalenedicarboxylic acid, trimesic acidsetc. will be used as rigid linkers because they impart rigidity to designed CPs. Along with them various flexible ligands are required that provide porosity to CPs/MOFs. These flexible ligands to be used are oxalic acid, succinic acid, fumaric acid, glutaric acid, adipic acid, pimelic acid etc.

Equipment and characterization techniques requirements:

The composition and structural features of the synthesized CPs/MOFs will be established by Single crystal X-ray diffraction Spectroscopy, Powder X-ray diffraction Spectroscopy, Fourier transform infrared (FTIR), thermal gravimetric analysis (TGA), elemental analysis, scanning electron microscopy (SEM), transmission electron spectroscopy (TEM), ultraviolet, visible, near-infrared, inductively coupled plasma mass spectrometry (ICP-MS). Photoluminescent properties and luminescence decay will be explored by fluorescence spectrophotometer.

Review of status of Research in thesubjectfrom our Laboratory

Kumar *et al.* have assembled six novel coordination polymers with heteroaromatic carboxylate ligands with general formulae $[Dy(3,5\text{-}pdc)(3,5\text{-}pdcH)(H_2O)_2]_n\cdot nH_2O$, $[Pr_2(3,5\text{-}pdc)_3(H_2O)_2]_n\cdot 2n(H_2O)$, $[Sm_2(3,5\text{-}pdc)_3(H_2O)_3]_n\cdot nH_2O$, $[Eu_2(3,5\ pdc)_3(H_2O)_3(CH_3CHO)]_n\cdot n[2(H_2O)(DMF)]$, $[Gd_2(3,5\text{-}pdc)_3(H_2O)_2]_n\cdot 2nH_2O$, $[Er(3,5\text{-}pdc)(adip)_{0.5}(H_2O)]_n$; (adip= adipic acid, 3,5-pdc =3,5-pyridinedicarboxylic acid). The synthesized coordination polymers were characterized by single crystal X-ray diffraction, FT-IR, PXRD, thermogravimetric (TGA) analysis, DFT studies and Hirshfeld surface analysis (HSA). $[Sm_2(3,5\text{-}pdc)_3(H_2O)_3]_n\cdot nH_2O$ exhibit efficient ligand sensitized characteristicluminescence. Magnetic studies reveal weak ferromagnetic interactions in the synthesized coordination polymers. Hirshfeld Surface Analysis of the compounds shows dominant intermolecular interactions on the d_{norm} surfaces.[1] Kariem and co-workers have reported syntheses of five coordination polymers (CPs) with the formulae $[Ln(hip)(adip)_{0.5}(H_2O)_2]_n.nH_2O$; Ln = Pr, Nd, Tb, Dy and Ho; (hip = 5-hydroxyisophthalic acid, Adip = adipic acid). Structural analysis of the coordination polymers reveal that all these CP crystallize in monoclinic *C2/c*space group. $[Tb\ (hip)\ (adip)_{0.5}(H_2O)_2]_n.nH_2O$ emit strong ligand sensitized typical *f-f* luminescence emission. The N_2 adsorption isotherm of CP $[Pr(hip)\ (adip)_{0.5}(H_2O)_2]_n$. nH_2O reveals characteristic type IV isotherms with H3-type hysteresis loop.[2]

Kumar and *et. al.* through a dual-ligand strategy reported eight isorecticular lanthanide(III) metal−organic frameworks (Ln-MOFs) with the general formula $\{[Ln(2,5\text{-}FDA)_{0.5}(Glu)(H_2O)_2]\cdot xH_2O\}_n$ [Ln = Sm (1), Eu (2), Gd (3), Tb (4), Dy (5), Ho (6), Er (7), and Yb (8); where $2,5\text{-}FDA^{2-}$ = furan-2,5-dicarboxylate and Glu^{2-} = glutarate; x = 0.5 for 1, 2, and 4 and x = 0 for 3 and 5−8], synthesized under solvothermal conditions by using an N,N′-dimethylformamide/H_2O mixed solvent system. Single Crystal X-ray data reveal that all eight Ln-MOFs 1−8 crystallize in the orthorhombic Pnma space group. All of the MOFs are isomorphous as well as isostructural with distorted monocapped square antiprismatic geometry around the Ln1 metal center. In Ln-MOFs 1−8, the $2,5\text{-}FDA^{2-}$ and Glu^{2-} ligands exhibit $\mu_2\text{-}\kappa^4$, $\eta^1 :\eta^1 :\eta^1 :\eta^1$ and $\mu_3\text{-}\kappa^5$,$\eta^2 :\eta^1 :\eta^1 :\eta^1$ coordination modes, respectively. Assembled Ln-MOFs **1−8** consist of the 2D cem topological type. The designed Ln-MOFs 1−8 are further explored for structure-corroborated density functional theory study. Room temperature magnetic properties of Ln-MOFs 3 and 5 and photoluminescence properties of Ln-MOFs 2 and 4 and have also been explored.[3]Yawer and colleagues have synthesized two

NIAH) $(H_2O)_2]\cdot CH_3CN\cdot H_2O\}n$ (2), $\{[Gd$ (5-NIA) (5-NIAH)$(H_2O)_2]\cdot(H_2O)_2\}n$ (3), $\{[Tb$ (5-NIA) (5-NIAH) $(H_2O)_2]\cdot CH_3CN)\}n$ (4), [Dy (5-NIA) (5-NIAH) $(H_2O)_2]n$ (5), [Ho(5-NIA) (5-NIAH) $(H_2O)_2]n$ (6) and $[Er_2$ (5-NIA)$_3(H_2O)_3(CH_3CN)]n$ (7) with two-dimensional structures. The assynthesizedpolymers are characterized by powder X-ray crystallography, infrared spectroscopy, thermogravimetricanalysis, photoluminescence and DFT studies. The luminescence properties of [Tb (5-NIA) (5-NIAH) (H2O)2]·CH3CN)}n (4) is investigated.[7]

Review of status of Research in the Subject Internationally

Zhou and colleagues synthesized a lanthanide coordination polymer (LCP) with the formula $\{[Eu_2(L_3)_2(HCOO)_2(H_2O)_6]H_2O\}n$ (H_2L_3 = 9,9-dimethylfluorene-2,7-dicarboxylic acid). Using the Eu^{3+}cation, the L_3 ligand in this LCP acted as a μ_4-bridge to connect oxygen and four Eu^{3+} ions atoms of each carboxylate moiety that were assembled in this way to create a 3D *pcu* type architecture.[8] Liu and co-workers have constructed two-dimensional water stable lanthanide coordination polymers $\{[Eu(L)(HCOO)](H_2O)\}n$ (H_2L = isomer of 5-((pyridin-3-yloxy)methyl)isophthalic acid). Single Crystal X-ray diffraction analysis reveals that Eu−CP is formed by binuclear metal clus0ters and bridged linker COO- and HCOO-. The luminescence property of Eu−CP is explored at room temperature at solid-state. Eu−CP emits bright and stable red light due to the antenna effect from ligand to metal ion. The characteristic emission peaks of Eu^{3+} can be detected in spectra. The luminescent intensity of Eu−CP can be sensitively quenched by inorganic ions Fe^{3+}, CrO_4^{2-}, $Cr_2O_7^{2-}$ and organic molecule 4-nitrophenol (4-NP). Eu−CP can be a multiresponsive luminescence sensor in water phase. Furthermore, the mechanism for the selective sensing of Cr(VI), Fe^{3+}, or 4-NP is also explored which can mainly be explained by energy competition between the absorption of the analytes and the excitation of Eu−CP.[9] Zhang *et. al.* successfully synthesized a series of five three-dimensional Ln(III) MOFs (metal-organic frameworks) as $[Ln_4(\mu_6\text{-}L)_2(\mu\text{-}HCOO)(\mu_3\text{-}OH)_3(\mu_3\text{-}O)(DMF)_2(H_2O)_4]n$ {Ln = Tb (1), Eu (2), Gd (3), Dy (4), and Er (5)} was successfully obtained via a solvothermal reaction between the corresponding lanthanide(III) nitrates and phenylpyridinetricarboxylic acid, 2-(5-carboxypyridin-3-yl)terephthalic acid (H_3L). All the obtained polymers were fully characterized and their structures were established by single crystal X-ray diffraction. All crystals are isostructural and possess porous networks of the flu topological type, which are driven by the cubane-like $[Ln_4(\mu_3\text{-}OH)_3(\mu_3\text{-}O)(\mu\text{-}HCOO)]^{6+}$ blocks and $\mu_6\text{-}L_3-$ spacers. Luminescent and sensing properties of 1−5 were investigated revealing a unique capability of Tb-MOF 1 for sensing acetone and metal(III) cations (Fe^{3+} or Ce^{3+}) with high efficiency and selectivity.[10]Shang *et.*

al. has synthesized two series of lanthanide metal organic frameworks (Ln–MOFs) $[Ln(HL)(H_2O)_3]\cdot H_2O$ and $[Ln(HL)(H_2O)_2]$ (Ln = Tb, **1**; Dy, **2**;Ho, **3**; Er, **4**; Tm, **5**; Yb, **6** and; have been successfully assembled by Ln^{3+} ions and asymmetric polycarboxylate ligand 3-(3′,5′-dicarboxyl-phenoxy) phthalic acid (H_4L). The crystal structures, photoluminescence and magnetic properties of these compounds have been investigated. Single crystal X-ray study reveal that **1, 4, 5** and **6** are isostructural and show 2D layer frameworks constructed by hydrogen bonding interactions between the coordination water molecules and the oxygen atoms of the carboxyl group. Dysprosium and Holmium complexesshow 3D frameworks with two different interlayer channels decorated by ligands and lanthanide metals. The emission spectra show that complex **1** displays an intense green light emission and can selectively and sensitively detect for Fe^{3+} ion and nitromethane. In addition, Near Infra–Red (NIR) luminescence and magnetic susceptibility measurements further reveal that these compounds are promising functional materials.[11]

Singh and co-workers constructed a solid ternary complexes of terbium(III) ion based on β-diketone ligand acetylacetone (acac) and monodentate auxiliary ligands (aqua/urea/triphenylphosphineoxide/pyridine-N-oxide). The compounds were characterized by means of elemental analysis, infrared (IR), and proton nuclear magnetic resonance (NMR) and spectral techniques. The optical characteristics were investigated with absorption as well as photoluminescence spectroscopy. A good thermal stability behavior of compounds was examined by TGA/DTA analysis. The luminescence decay time of as-synthesized complexes were also calculated by monitoring at emission wavelength corresponding to $^5D_4 \rightarrow {}^7F_5$ transition. Luminescent behavior of synthesized ternary compounds was performed in order to determine the function of auxiliary ligands in the enhancement of luminescence intensity produced by central terbium(III) ion. The color coordinates values advocated that compounds showed bright green emission in visible region in electromagnetic spectrum.[12] Das *et. al.* reported synthesis of two lanthanide-containing structurally analogous porous coordination polymers (PCPs) with the general molecular formula $[Ln_2(L1)2(H_2O)4(ox)]n.4nH_2O$ (where L1 = fumarate, ox = oxalate; Ln = Dy (1), Gd (2)). Thermogravimetric analysis (TGA) and TG-MS measurements performed on 1 and 2 suggest that both the solvated water molecules in the crystal lattice and four coordinated water molecules on the respective lanthanides in 1 and 2 are removed upon activation. Due to the removal of the waters molecules, crystals lost their crystallinity and became amorphous, as confirmed by powder X-ray diffraction (PXRD). Magnetization relaxation dynamics probed reveal two different relaxation processes with effective energy barriers of 53.5 and 7.0 cm^{-1} for 1, which have been rationalized by detailed ab initio calculations. For the isotropic lanthanide complexes 2, magnetocaloric effect (MCE) efficiency was estimated through detailed magnetization measurements. It was estimated as $-\Delta Sm$ values of 41.62 J $kg^{1-\ K-1}$ for 2.[13]Peng and colleagues by utilizing 1H-imidazole-4,5-dicarboxylic acid constructed three isostructural lanthanide coordination polymers (CPs), denoted as $\{[Ln_2(OH)_2(L)_2]\cdot(DMF)\cdot(H_2O)_4\}n$ (Ln = Gd (1), Eu (2), Dy (3); L = 1- (4-carboxybenzyl)imidazole-4-carboxylic acid), containing a 1D infinite $[Ln_4(OH)_4]$ sub chain have been successfully constructed. The structures of 1-3 could be determined by single-crystal and powder X-ray diffraction studies, and herein the structural characteristics of 1 and 2 shows that 1 and 2 crystalize in monoclinic space group C2/c and structure 3 crystalize in monoclinic space group P21/c. The extremely connected mode between the multifunctional ligand and 1D building units is responsible for the exceptional chemical stability of three lanthanide CPs. In addition, a study of the magnetic properties reveals that 1 displays a large magnetic entropy change ($-\Delta Sm = 30.33$ J kg^{-1} K^{-1} with T = 2 K and $\Delta H = 7$ T). Furthermore, genetic algorithm and quantum Monte Carlo methods were combined to simulate the magnetic coupling parameters of compound 1, shedding light on the effect of linking bridges on magnetic propagation. Eu complex shows intense luminescence in the range of 350−710 nm.[14]

Lian*et. al.* has synthesized three novel coordination polymers, namely, $\{[Pr(TTTPC)\cdot(H_2O)_2]\cdot2Cl\cdot NO_3\cdot4H_2O\}n$ (I), $\{[Gd(TTTPC)\cdot(H_2O)_2]\cdot2Cl\cdot NO_3\cdot4H_2O\}n$ (II) and $\{[Yb(TTTPC)\cdot(H_2O)_2]\cdot3Cl\cdot NO_3\cdot0.5DMA\cdot6H_2O\}n$ (III) were synthesized in conventional aqueous solutions with H3TTTPC ligands (H3TTTPC = 1,1',1''-(2,4,6-trimethylbenzene-1,3,5-triyl(methylene))-tris(pyridine-4-carboxylic acid), DMA = N,N-dimethylacetamide) and characterized by infrared spectrometry and single crystal X-ray diffraction. Experimental results show that these MOFs are isomorphous and isostructural, containing the unit of cavate 14-membered cages ($Pr_2(OCO)_4$), based on which to generate a one-dimensional (1D) infinite linear metallic chain through the linkage of two COO- groups that are further interlinked reciprocally to polymerize into three-dimensional (3D) porous frameworks.[15]Han and co-workers develop novel luminescent lanthanide coordination polymers (NH_2-BDC–TbGMP CPs)-based ratiometric fluorescence probe is designed for quick and visual detection of Pi. The NH_2-BDC–TbGMP CPs are constructed by the self-assembly of 2-aminoterephthalic acid (NH_2-BDC) and guanine monophosphate (GMP) with terbium ions (Tb^{3+}). Inherent fluorescence of NH_2-BDC is quenched *via* static quenching, while the nonluminous Tb^{3+} can emit strong green fluorescence due to the antenna effect between Tb^{3+} and GMP. Pi can competitively combine with Tb^{3+} to interrupt the interaction of NH_2-BDC–TbGMP CPs system, further causing the fluorescence decrease of Tb^{3+} and the emission increase of NH_2-BDC. Accordingly, the ratiometric fluorescence sensing of Pi can be attained by constantly recording the variations of two fluorescence signals.[16]Ayscue*et.al.* synthesized a series of lanthanide organic hybrid materials *via* hydrothermal methods and structurally characterized them using single-crystal X-ray diffraction. Four phases were obtained from reactions of La, Eu, and Tb ions with 1,10-phenanthroline (phen) and 2-thiophenecarboxylate (TC): $[La_2(phen)_2(k_1\text{ -}TC)_2(\mu_2\text{ -}TC)_2(\eta_3\text{ -}TC)_2(H_2O)_2]$ (La-1/La-2), $[Eu_2(phen)_2(k_2\text{ -}TC)_2\ (\mu_2\text{ -}TC)_2(\eta_3\text{ -}TC)_2]\cdot 2(H_2O)$(Eu-3), and $[Tb_2(phen)_2(k_2\text{-}TC)_2(\mu_2\text{-}TC)_4]\cdot 2(H_2O)$ (Tb-4). Four distinct phases ascend from subtle differences in ligand binding modes and supramolecular interactions. Ln doping was explored and resulted in analogous heterometallic systems, $[Eu_{2-x}Lax(phen)_2(k_2\text{-}TC)_2(\mu_2\text{-}TC)_2(\eta_3\text{- }TC)_2]\cdot 2(H_2O)$ ($Eu_{2-x}La_{x\text{-}3}$; x = 0.47−1.51) and $[Tb_{2-y}La_y(phen)_2(k_2\text{- }TC)2(\mu_2\text{-}TC)_4]\cdot 2(H_2O)$ ($Tb_{2-y}La_{y\text{-}4}$; y = 0.42, 0.67). The photoluminescent properties of these materials were evaluated using steady-state and time-dependent techniques to obtain excitation and emission profiles, transition energies, and lifetimes. The La phase exhibited ligand-based emission, whereas both Eu and Tb phases formed characteristic red and green metal-centered emission, respectively.[17]Herein, Li and co-workers report a series of fluorene-based lanthanide metal–organic frameworks ($[Ln_2(FDC)_3DMA(H_2O)_3]$DMA 4.5H2O, Ln = Sm (1), Eu (2), Gd (3) and Tb (4), H_2FDC = 9,9-dimethyl 2,7-fluorenedicarboxylic acid, DMA = dimethylacetamide). Single-crystal X-ray diffraction revealed that compounds 1–4 are isostructural, crystallizing in triclinic space group P1 and display a 3D neutral framework. MOF 2 exhibits intense characteristic red emission of Eu^{3+} ions in the solid state and high selectivity for Fe^{3+} and Pb^{2+} ions through fluorescence quenching and enhancement effect in aqueous solutions, respectively. Interestingly, the fluorescence intensity of MOF 2 shows a good linear relationship with Pb^{2+} concentration in the range of 0.02–0.1 mM. Furthermore, the dynamic and static quenching constants are calculated by the fluorescence lifetime and titration experiments in low concentration of Fe^{3+}.[18]

References

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2. M. Kariem, M. Yawer, M. Kumar, H. N. Sheikh, P. Sood and S. S. Kolekar, *J. Solid State Chem.,***2017**, *255*, 61-69.
3. M. Kumar, L. H. Wu, M. Kariem, A. Franconetti, H. N. Sheikh, S. J. Liu, S. C. Sahoo, A. Frontera, *Inorg. Chem.*, **2019**, *58*, 7760-7774.