



Kampus
Merdeka
INDONESIA JAYA

FACULTY OF TEACHER TRAINING AND EDUCATION
UNIVERSITY OF BENGKULU

CERTIFICATE

THIS CERTIFICATE IS AWARDED TO

Dewi Handayani

as

Presenter

with the title

SINTESIS DAN KARAKTERISASI LANTANUM-METAL ORGANIC FRAMEWORKS DAN UJI POTENSINYA
SEBAGAI SENSOR KATION-ANION LOGAM

at

THE FIRST INTERNATIONAL SCIENCE AND EDUCATION SUMMIT (1st ISES 2022)

"Transforming Science and Education on Emerging Digitalization Era"

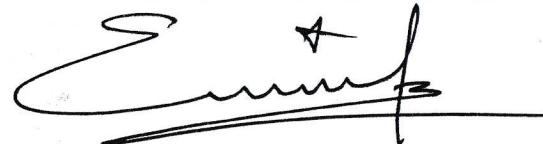
Bengkulu, October 15th-16th 2022

DEAN OF FKIP UNIB



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Sains/Pendidikan Sains

1	Abdul Rahman Singkam*, Mustika Elmi Dayana, Inka Puspita, Monica Grevinda, Tri Nadia Agustin	PEMETAAN TINGKAT KESULITAN MATERI UN BIOLOGI SMA/MA PADA SETIAP INDIKATOR BERDASARKAN NILAI UN SMA/MA SE-PROVINSI BENGKULU TAHUN 2015-2019
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3	Ahmad Syarkowi	Profile of the level of student satisfaction in carrying out online physics learning from a gender perspective
4	Wiwit *, Pratiwi Kiki Ramadhanti , Febrian Solikhin, Dewi Handayani	Development of a cognitive evaluation tool based on iSpring Suite 9 in Buffer Solution material
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10	Desti Fitria R* , Dedy Hamdani , Desy Hanisa Putri	PENGEMBANGAN ALAT PENGUKUR DEBIT DAN VOLUME AIR BERBASIS ARDUINO UNO MENGGUNAKAN SENSOR FLOW YF-S401
11	Nurhamidah*, Dewi Handayani	PENGEMBANGAN SOFT SKILLS MAHASISWA MELALUI INTEGRASI PEMBELAJARAN STEM PJBL PADA TOPIK SENYAWA ORGANIK
12	Abdul Rahman Singkam, Mustika Elmi Dayana*, Inka Puspita, Monica Grevinda, Tri Nadia Agustin	PEMETAAN DAN IDENTIFIKASI SAMPAH DI WILAYAH UNIVERSITAS BENGKULU
13	Andang Wijanarko	Design and Development of Digital Game-Based Learning for High School Students in Chemistry Learning

Moderator: Abdul Rahman; Ahmad Syarkowi

***Presenter**

Time	
Universitas Bengkulu	13.30-13.40
Universitas Bengkulu	13.40-13.50
Universitas Bengkulu	13.50-14.00
Universitas Bengkulu	14.00-14.10
Universitas Bengkulu	14.10-14.20
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Universitas Bengkulu	14.30-15.40
Universitas Bengkulu	14.40-14.50
Universitas Bengkulu	14.50-15.00
Universitas Bengkulu	15.00-15.10
Universitas Bengkulu	15.10-15.20
Universitas Bengkulu	15.20-15.30
Universitas Bengkulu	15.30-15.40



SYNTHESIS AND CHARACTERIZATION OF LANTANUM-METAL ORGANIC FRAMEWORK AND THEIR POTENTIAL AS SENSOR FOR INORGANIC IONS

(The topic is part of Material Chemistry Course Taught in Year 3 students of Chemistry Education)

Sura Menda Ginting¹, Dewi Handayani¹, Rina Elvia¹, Intan Dwi Lestari, Uli Rosidah

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Faculty of Teacher Training and Education

University of Bengkulu

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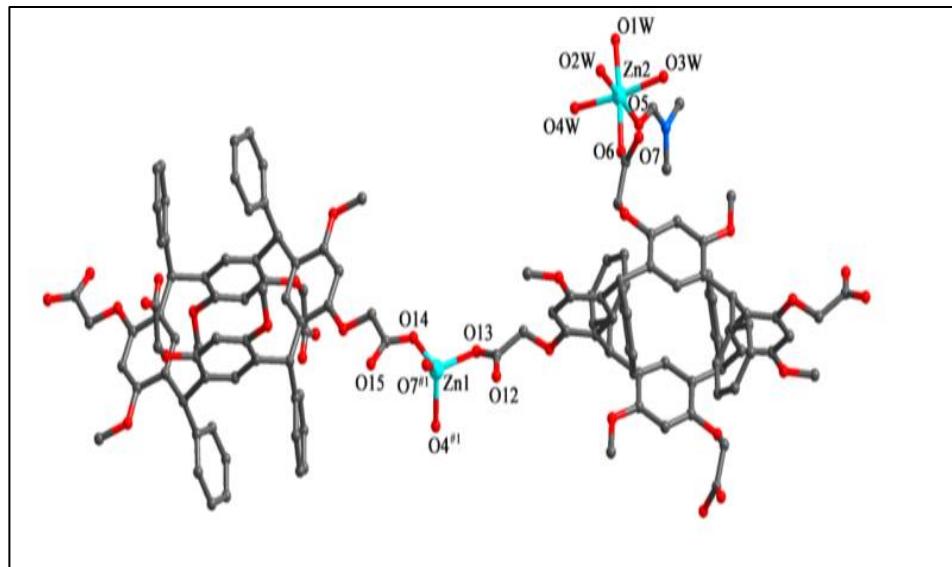
- Introduction: Metal Organic Framework
 - MOF: Coordination network between metal and organic ligands containing potential voids, thus potentially porous material and large surface area
 - MOFs: potential material for various application
 - Large variety of ligand with large variety of structures
 - Metals for MOFs mostly from transition metal series on periodic table



- Introduction:

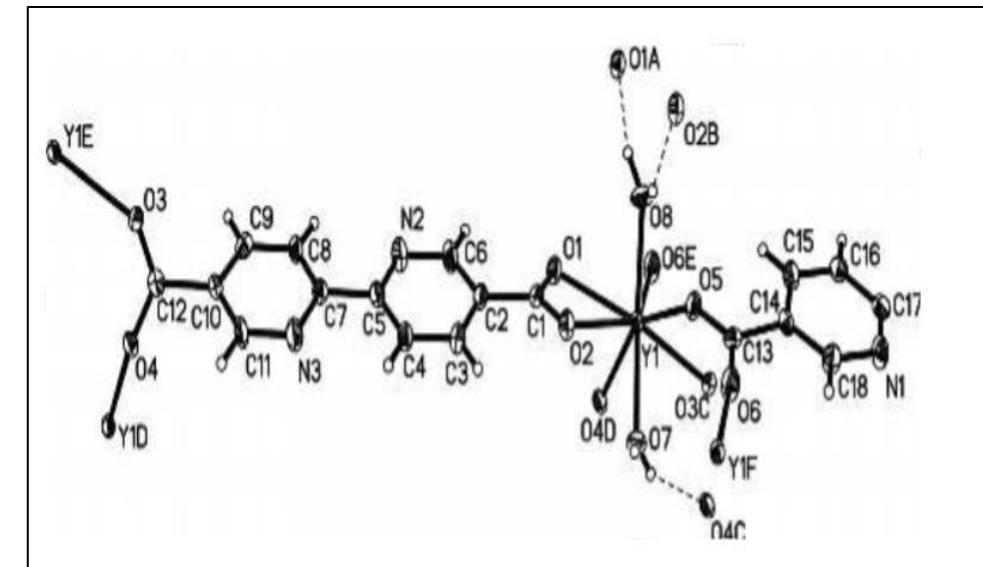
- Lanthanides MOFs

- Additional accessibility of *f*-orbitals, offer more stability
 - Shows some luminescence characteristic suitable for light-response



Decomposes $\approx 251^{\circ}\text{C}$

Zhao et al. *Inorganic Chemistry*. 2016, 55 (5), 2261-2273.



Decomposes $\approx 580^{\circ}\text{C}$

Wu, Y. et al. *Molecules*. 2014, 19 (9), 14352-14365.

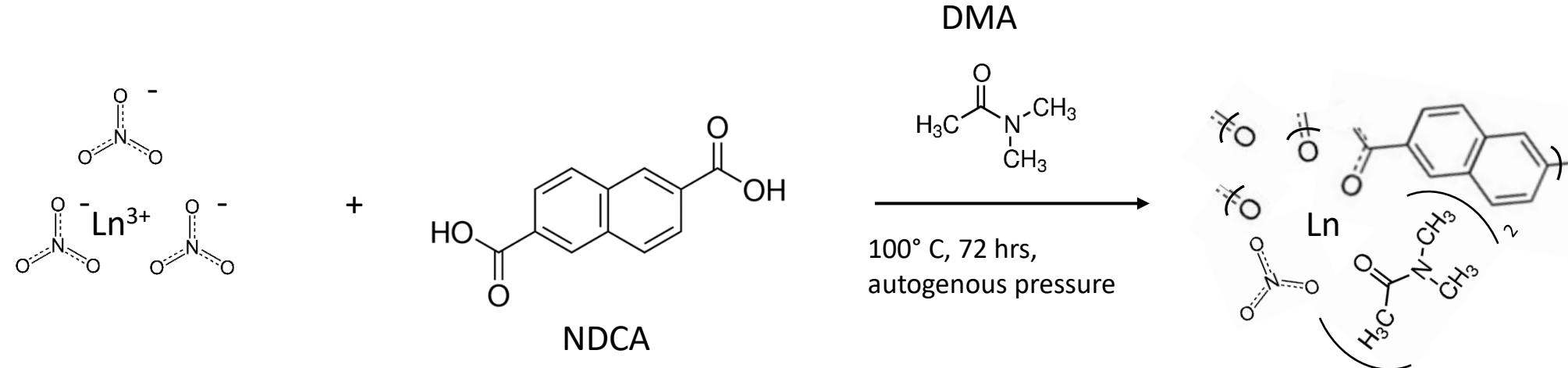


- Synthesis:

- Starting materials:

- La(III) nitrate hexahydrates
 - 2,6-naphthalenedicarboxylate (NDC) acid or Benzene-1,4-dicarboxylic (BDC) acid.
 - *N,N'*-dimethylacetamide (DMA)

- Method: solvothermal



- Previous Research

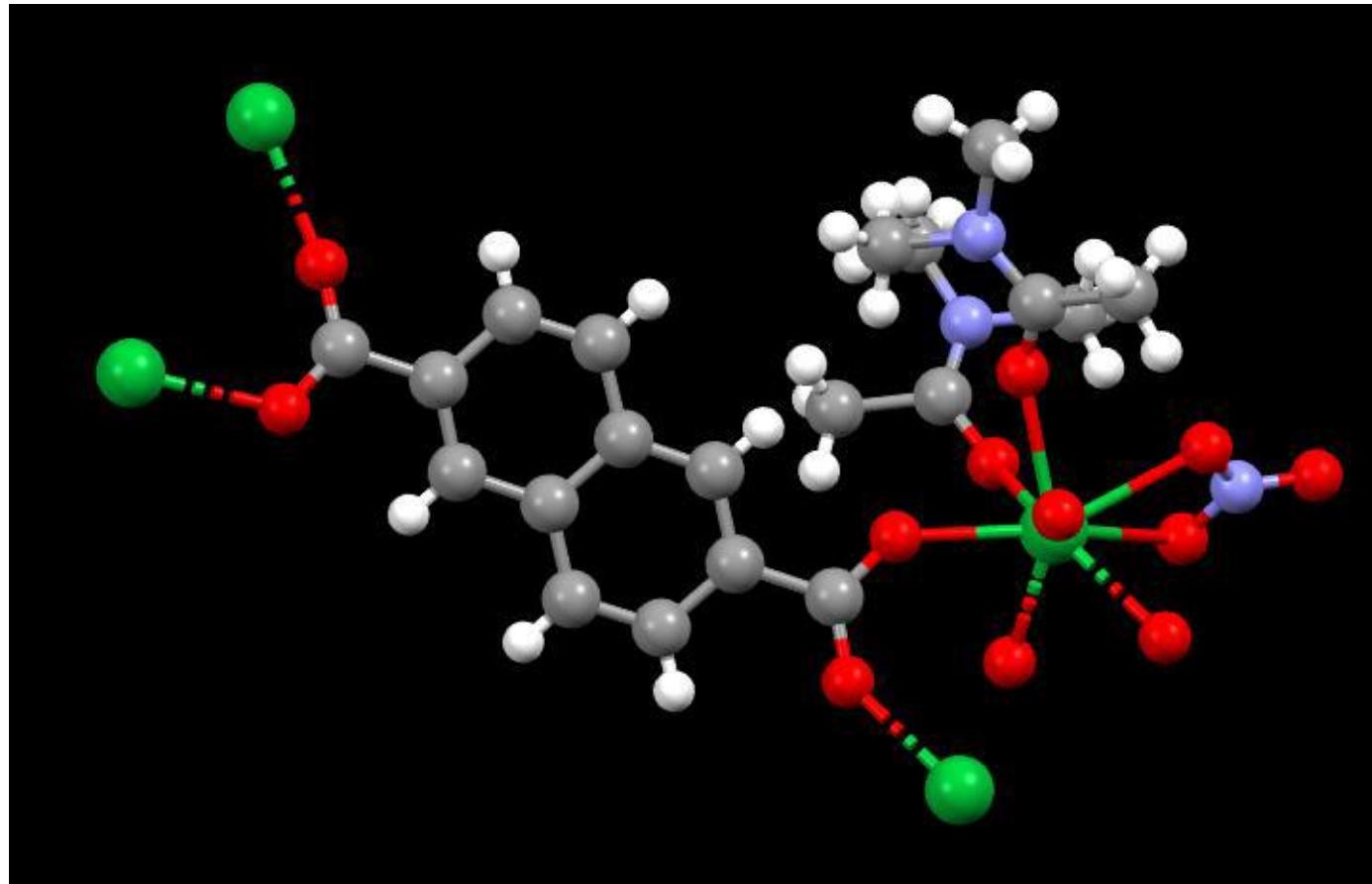


Lanthanide Series (Lanthanoids)

1 1IA 1A																			18 VIIIA 8A
1 H Hydrogen 1.008	2 He Helium 4.003																		
3 Li Lithium 6.941	4 Be Beryllium 9.012																		
11 Na Sodium 22.99	12 Mg Magnesium 24.305	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIIB 7B	8 VIII 8	9 VIII 8	10 VIII 8	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	2 He Helium 4.003		
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 83.789		
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.007	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 128.904	54 Xe Xenon 131.294		
55 Cs Cesium 132.905	56 Ba Barium 137.328	57-71 Lanthanide Series	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.085	79 Au Gold 196.967	80 Hg Mercury 200.592	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018		
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103 Actinide Series	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [278]	110 Ds Darmstadtium [281]	111 Rg Roentgenium [280]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [286]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]		
Lanthanide Series		57 La Lanthanum 138.905	58 Ce Cerium 140.119*	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.243	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.984	64 Gd Gadolinium 157.25	65 Tb Terbium 158.025	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967			
Actinide Series		89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]			



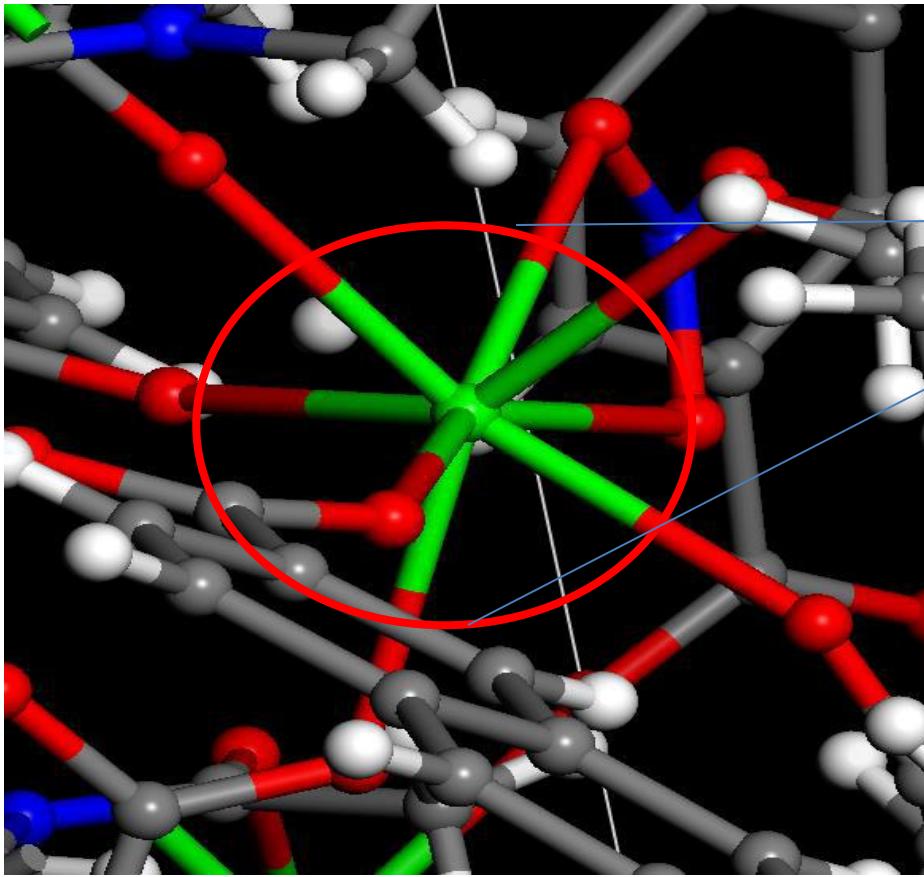
- Characterization of $[\text{Ln}(\text{NDC})(\text{DMA})_2(\text{NO}_3)]_n$



The green sphere is Ln,
grey sphere C,
blue sphere N,
red sphere O
white sphere H



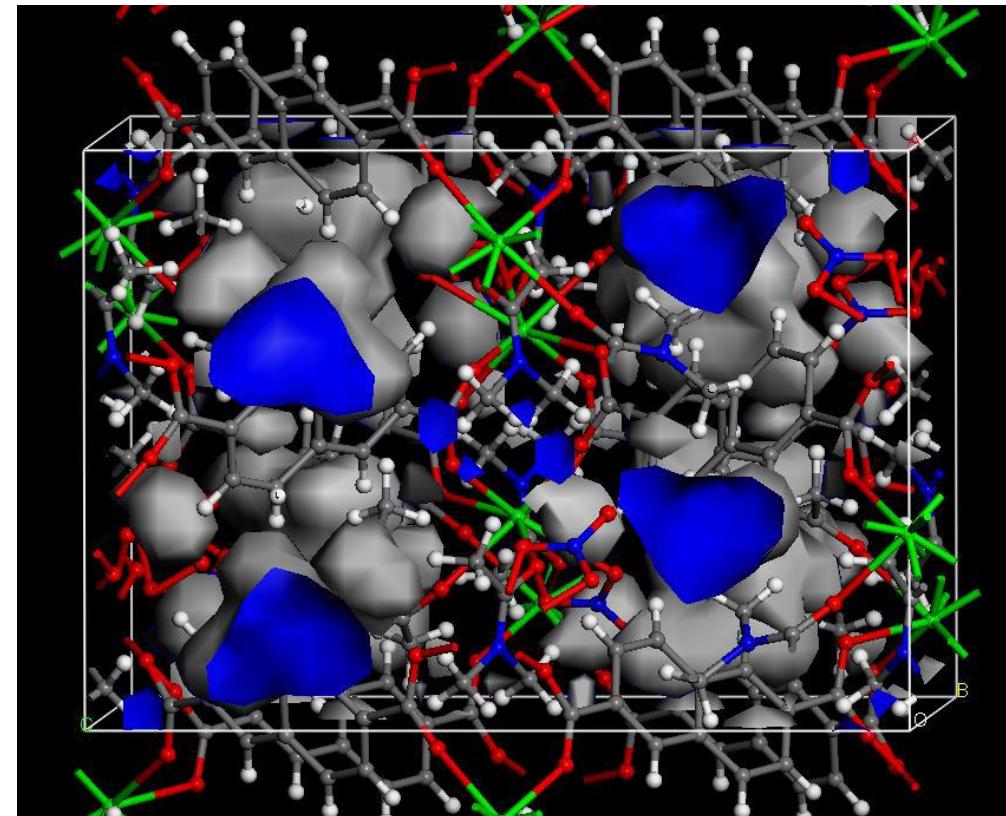
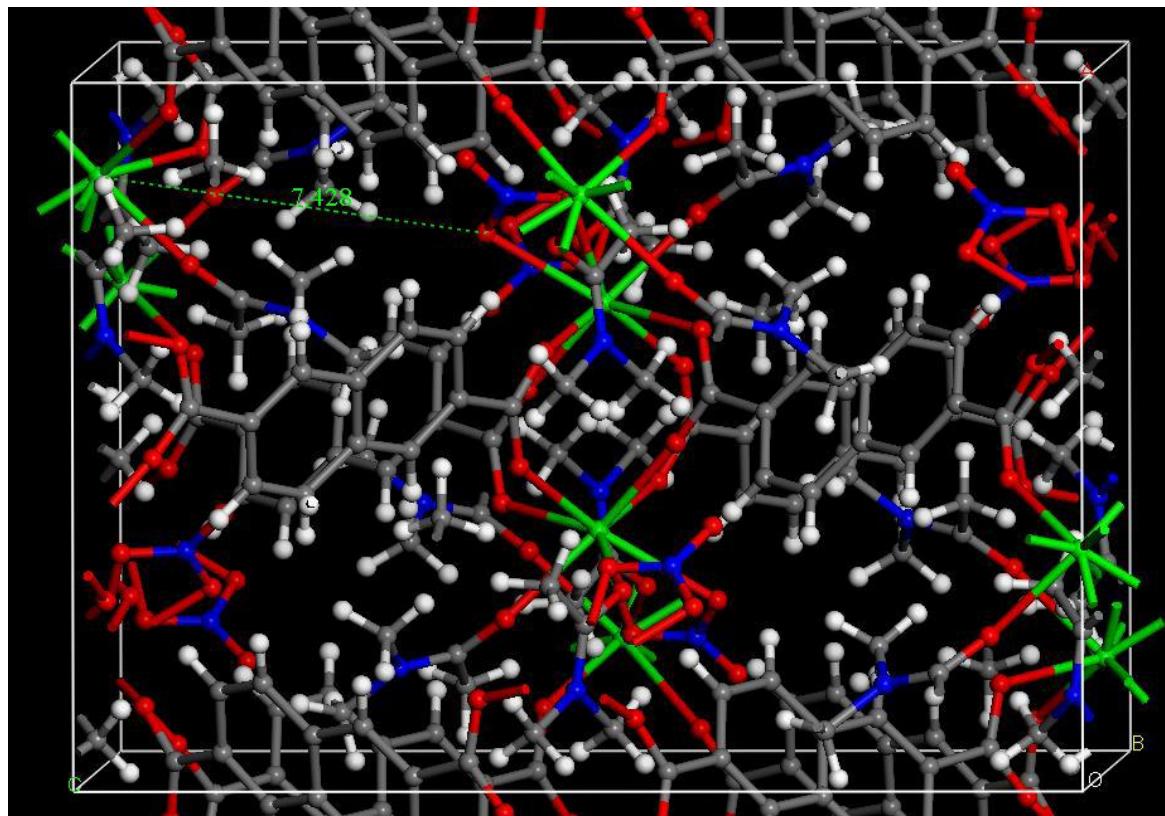
- Characterization of $[\text{Ln}(\text{NDC})(\text{DMA})_2(\text{NO}_3)]_n$



- Ln has 8 coordination number
 - One Ln is bonded to one NDC, two DMA and one NO_3^- (bidentate mode) in the unit cell.
 - It is also bonded to three NDC in adjacent cell, shown by the broken bonds. (previous slide)



- All LnMOFs are isostructural
- Contain channels within the structure which can be inserted by guest molecules to trigger electronic responses



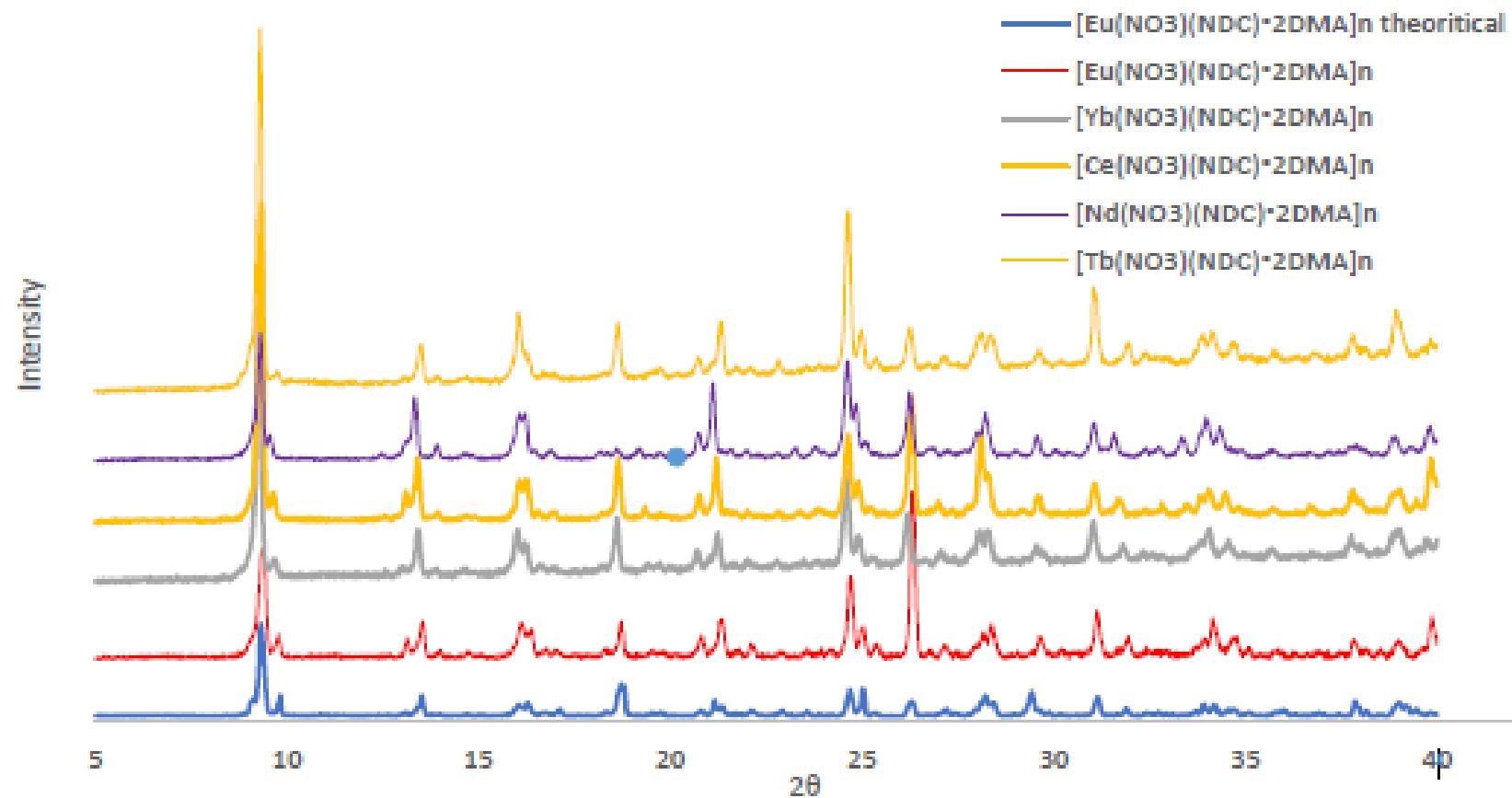
Lee, B.; Richards, F. M.. *J. Mol. Biol.* **1971**, *55* (3), 379–400.

Connolly, M. L. *J. Appl. Crystallogr.* **1983**, *16* (5), 548–558.

Connolly, M. L. *J. Mol. Graph.* **1993**, *11* (2), 139–141

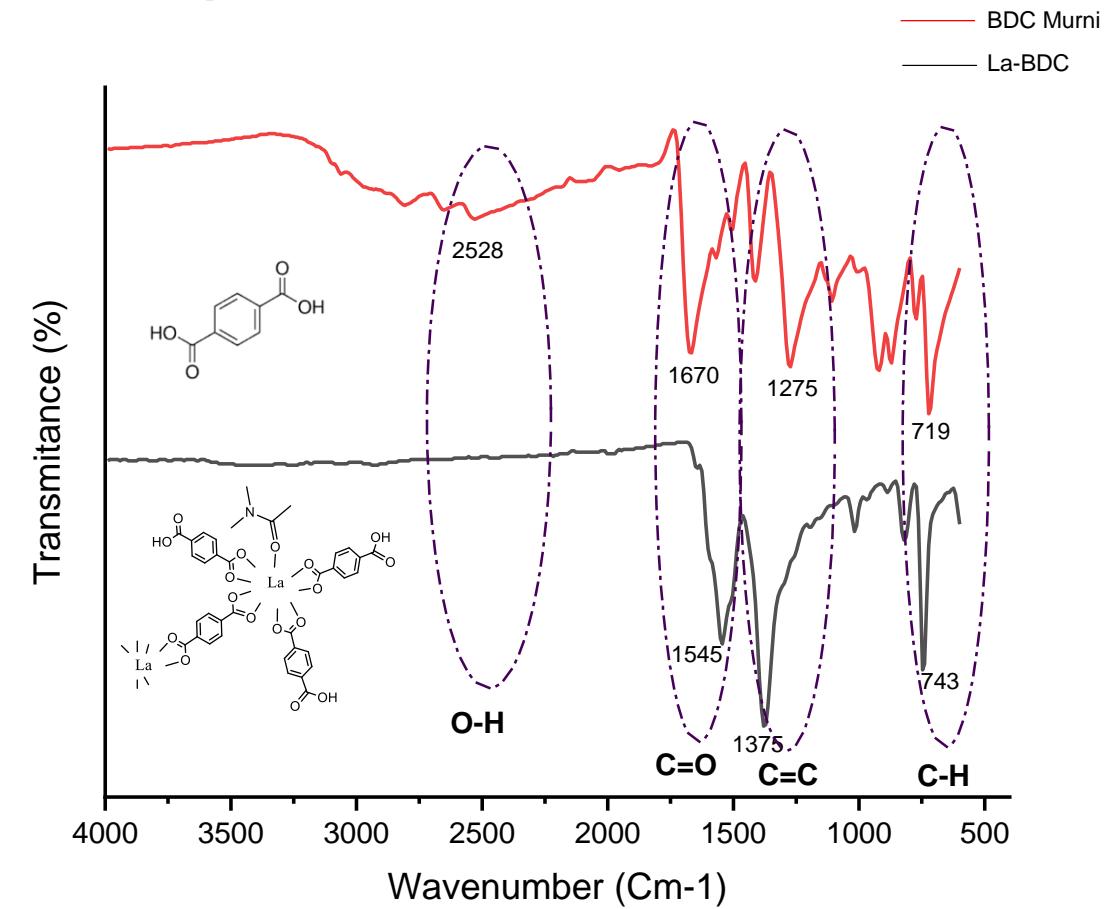
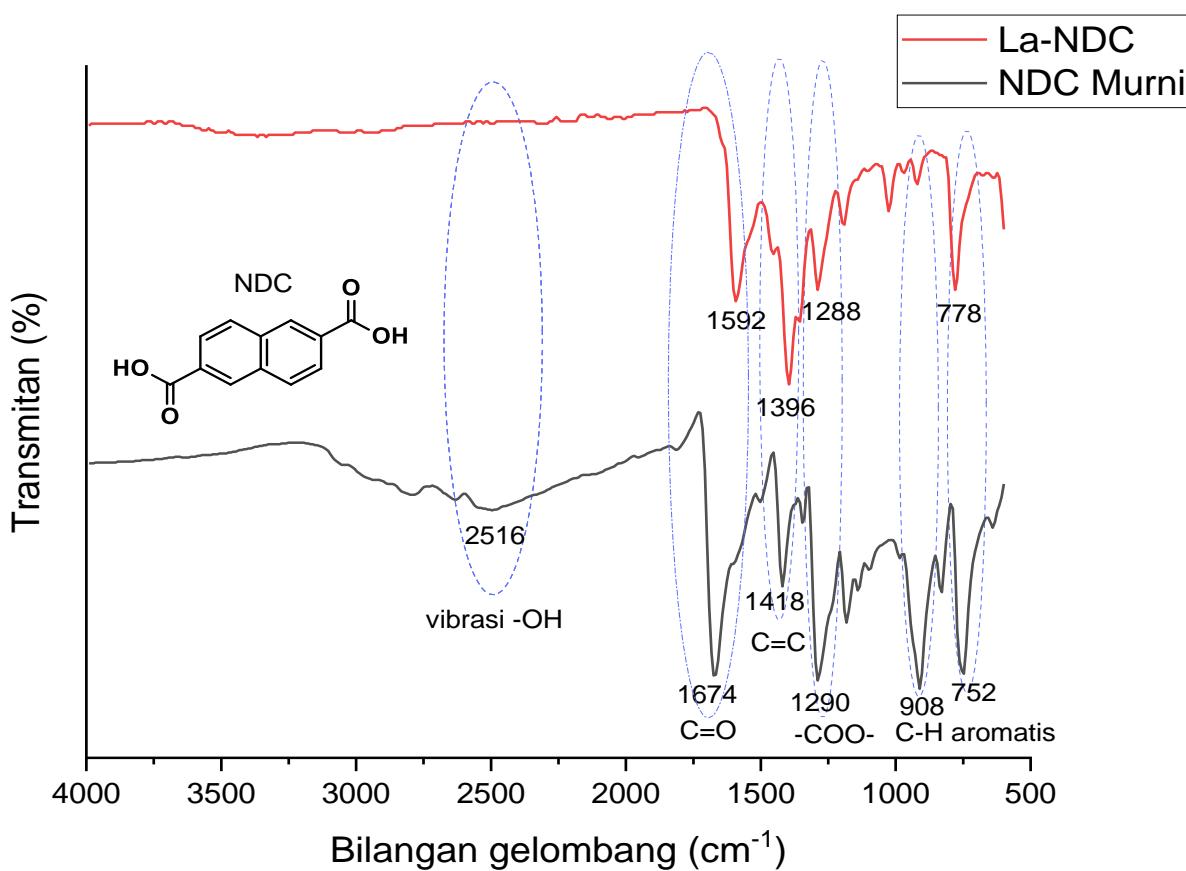


Isostructural $[L(\text{NO}_3)(\text{NDC}) \cdot 2\text{DMA}]_n$

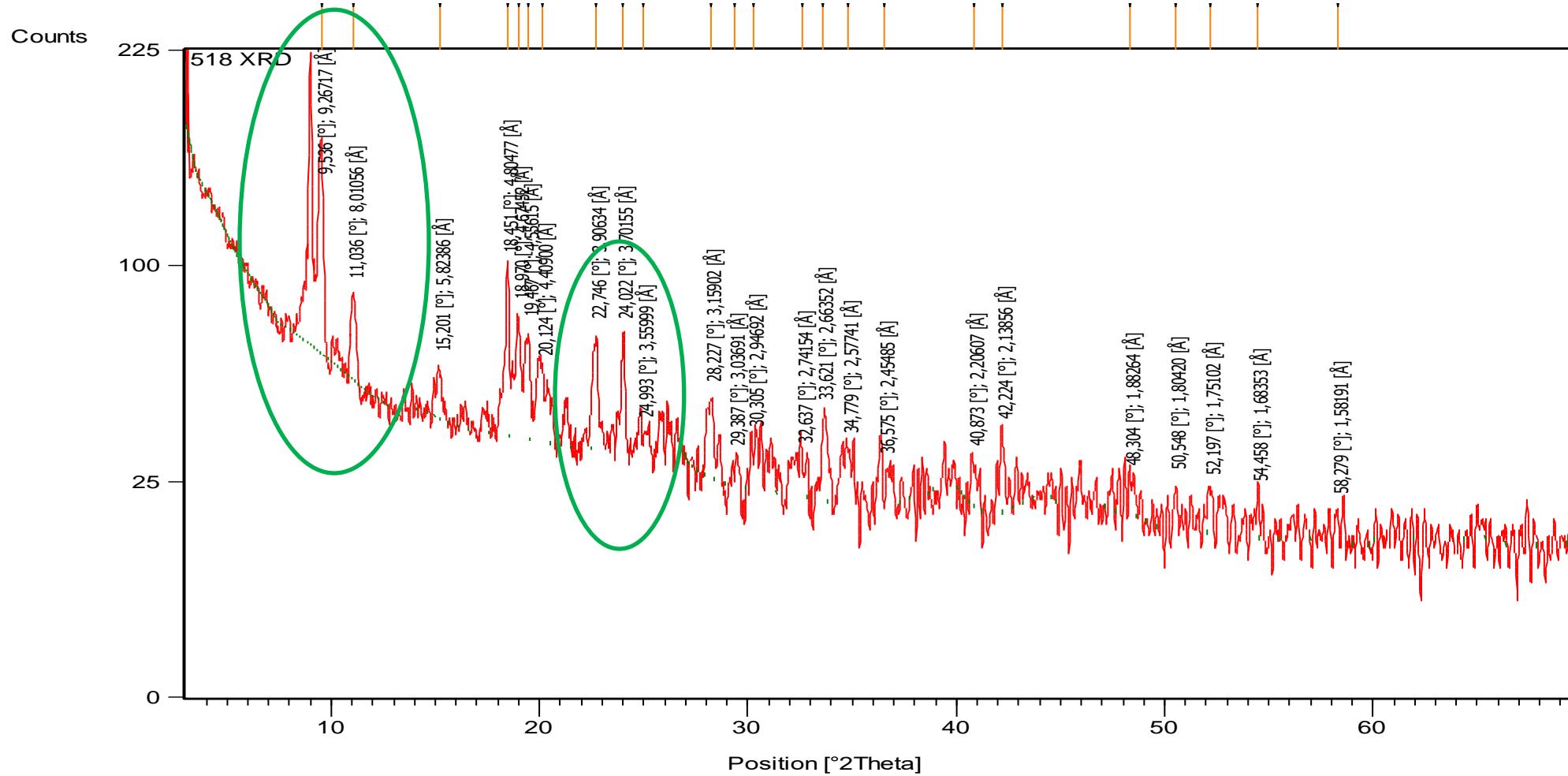




- Lanthanum MOF with NDC and BDC (FTIR-Spectra)

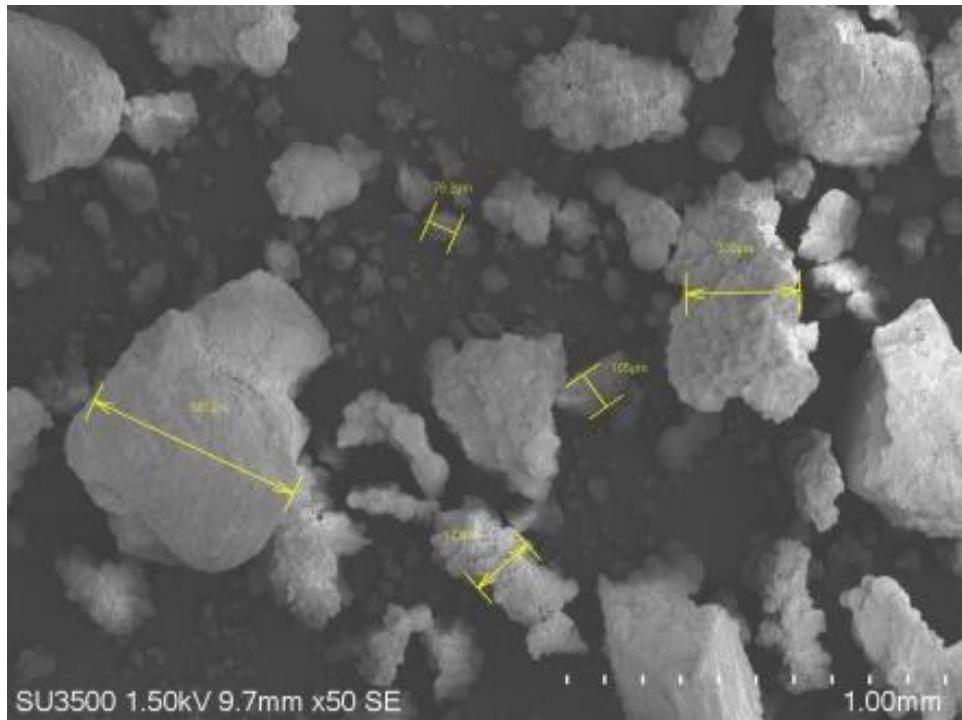


- Lanthanum MOF with NDC and BDC (PXRD)

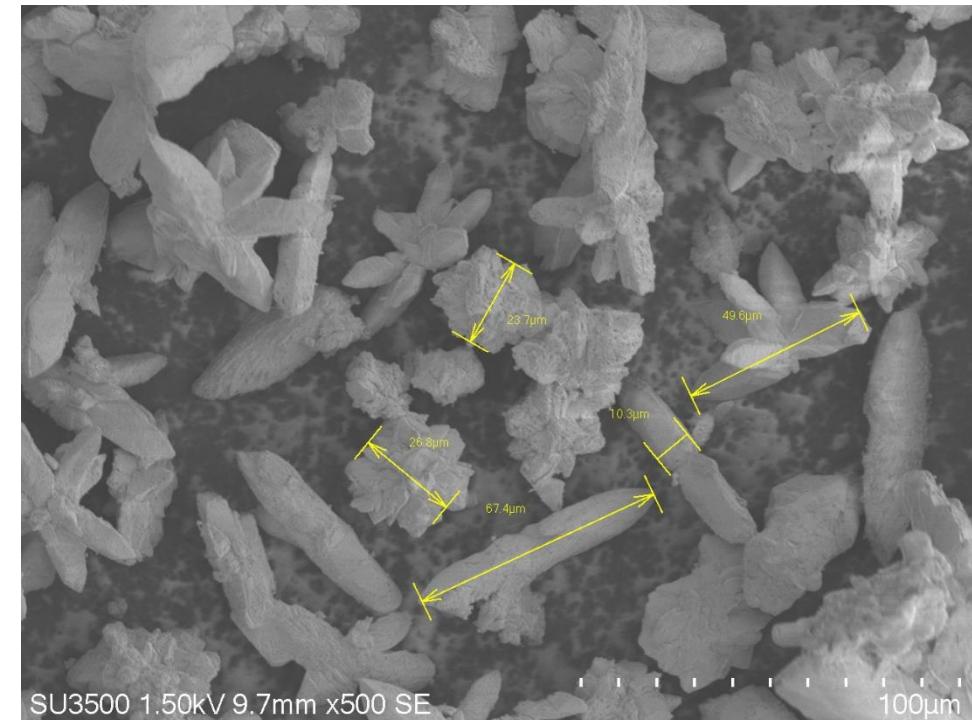




- Lanthanum MOF with NDC and BDC (SEM Results)



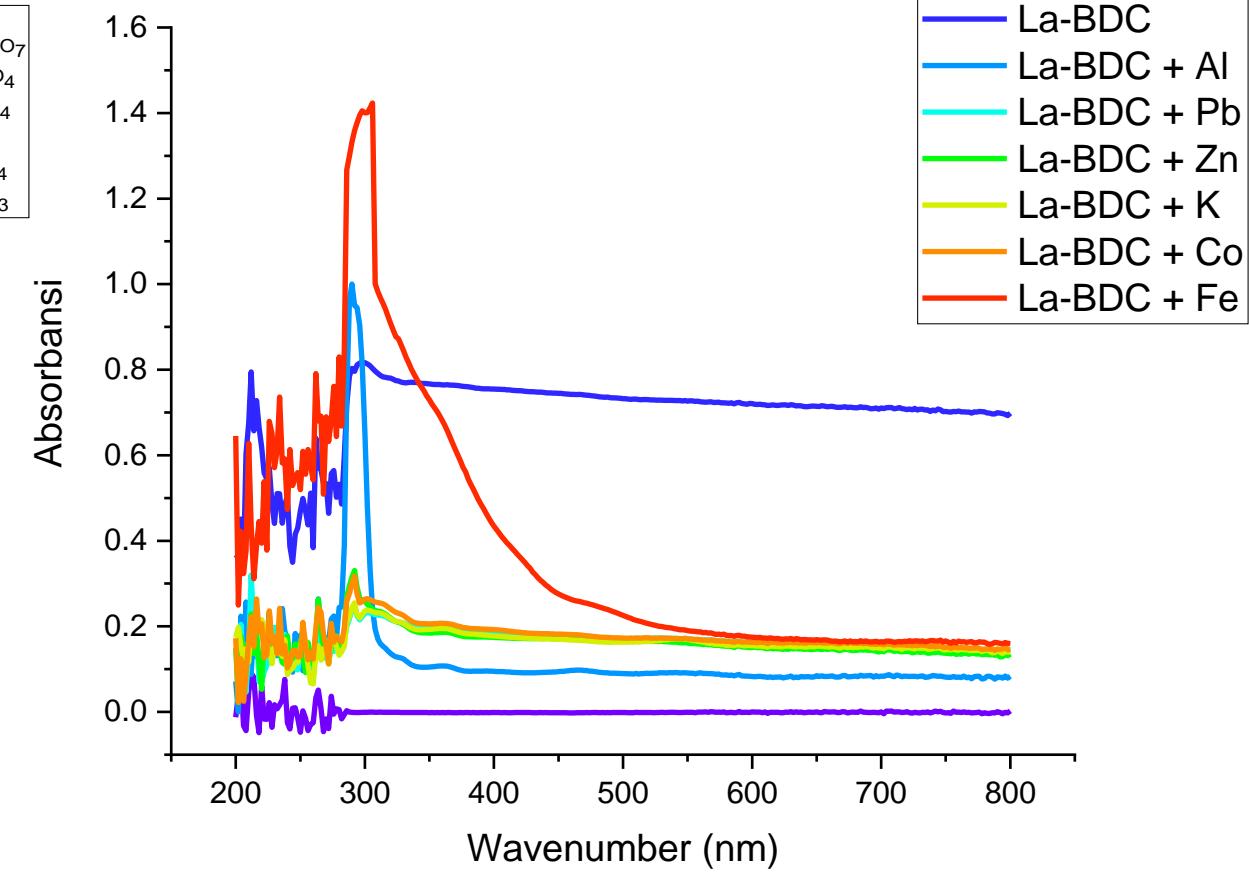
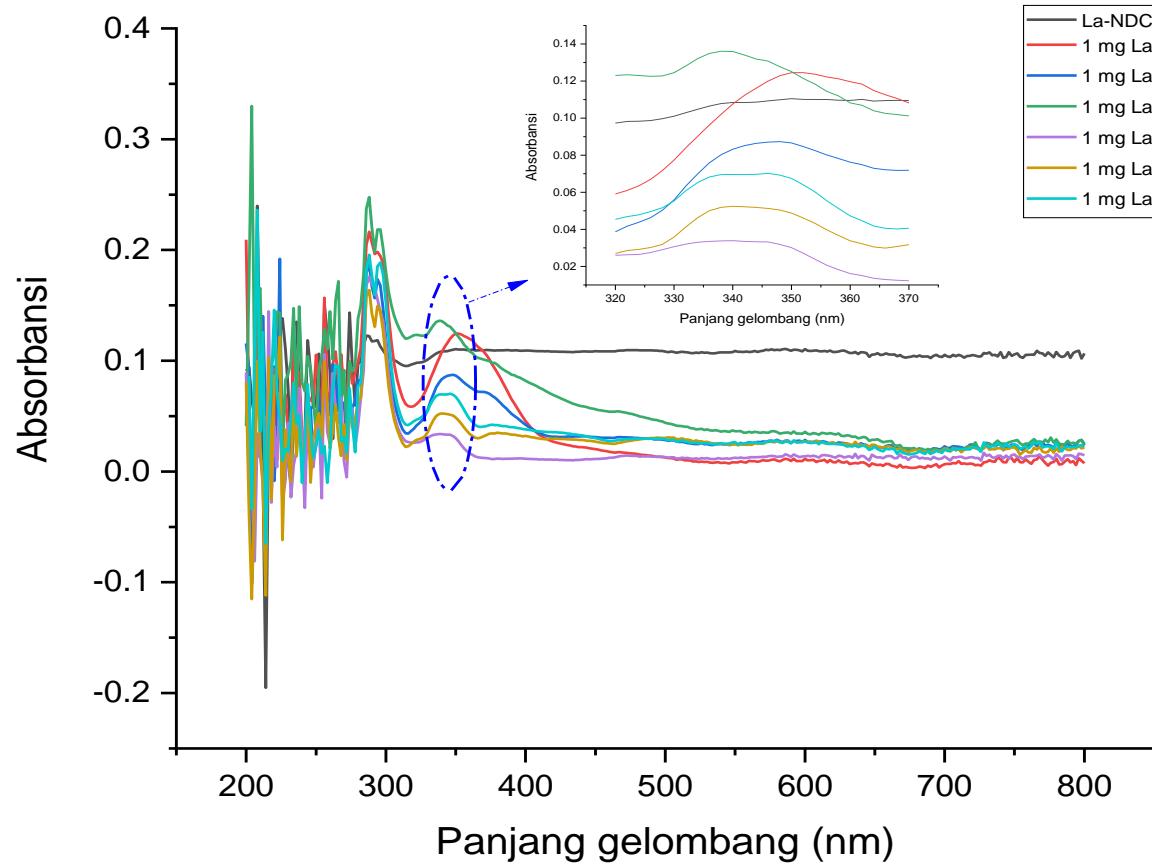
La-NDC



La-BDC

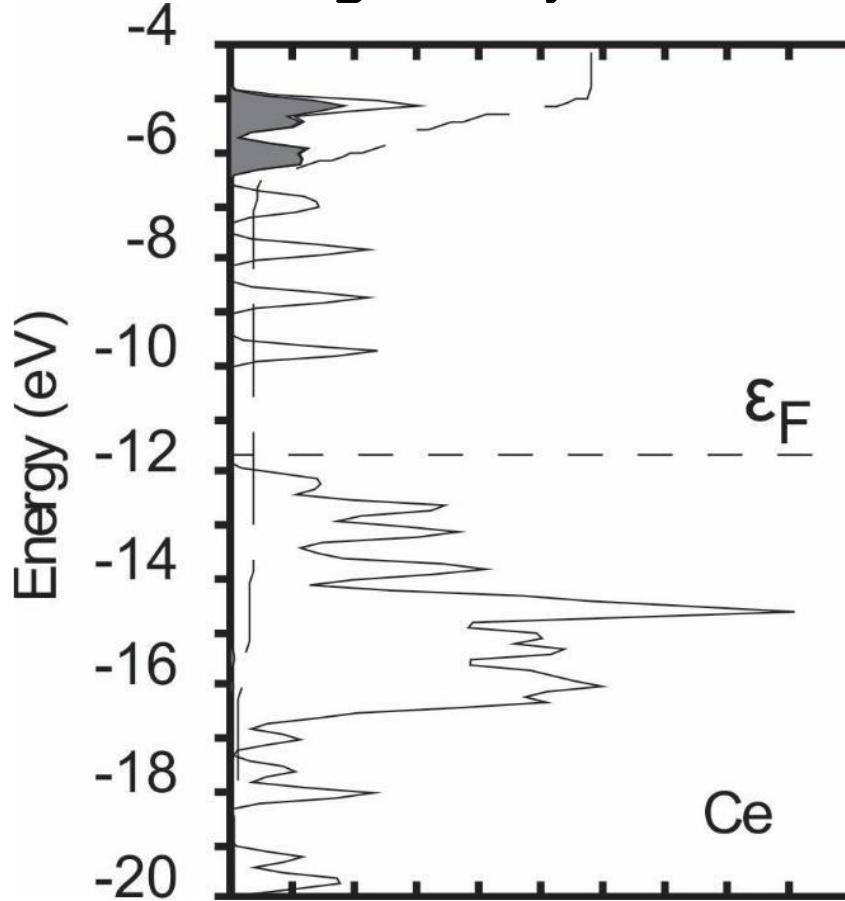


- Lanthanum MOF with NDC and BDC (Electronic Responses)





- Sensing ability of LnMOFs



Electronic configuration* of CeMOF:

Band gap of *ca.* 2 eV.

The HOMO and LUMO consist mostly of the organic ligand NDA π and π^* orbitals.

The Ce^{3+} states are high above the Fermi level and do not participate in the electronic transitions.

Depending on the relative position of the HOMO of the guest molecules, the fluorescence intensity of the LnMOF can be reduced or enhanced upon absorption of the guest molecules

Total DOS (solid curve)

Integrated value (dashed curve)

Contribution of Ce^{3+} (shaded area) of $[\text{Ce}(\text{NDC})(\text{DMA})_2(\text{NO}_3)]_n$

The horizontal dashed line is the Fermi level

*calculated using Extended Hückel method.



Conclusion

- La-NDC and La-BDC were successfully synthesis based on comparation of PXRD pattern of previous Ln-MOF and FTIR results
- SEM results of La-NDC and La-BDC MOFs shows impurities present. However, crystals were formed with a more unanimous shape for La-BDC.
- La-NDC shows responses of oxo-anions and La-BDC shows responses to Al^{3+} and Fe^{3+}
- Further study is needed for their potential as sensor based on electronic properties



Question(s)?