Heavy Metal Removal Capacities and Broad-Spectrum Antibacterial Activities of a Zinc-based Metal-organic framework

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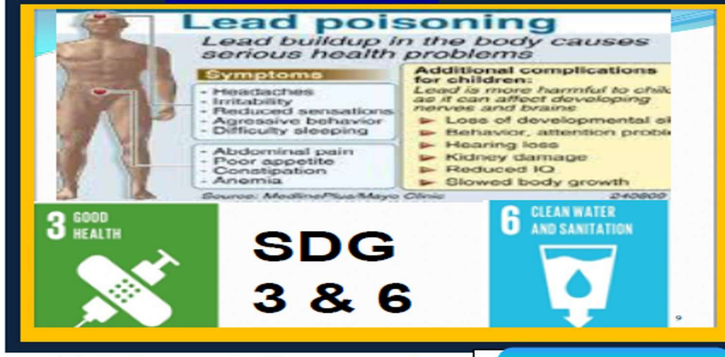
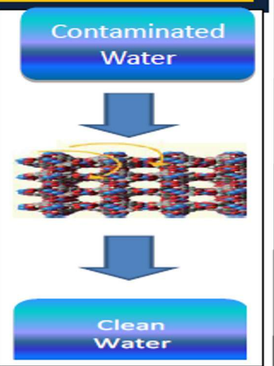
INTRODUCTION



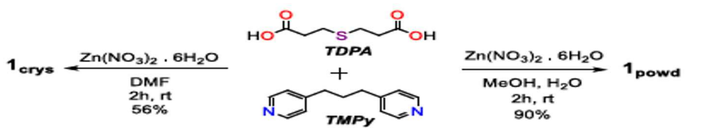
Metal-organic Frameworks

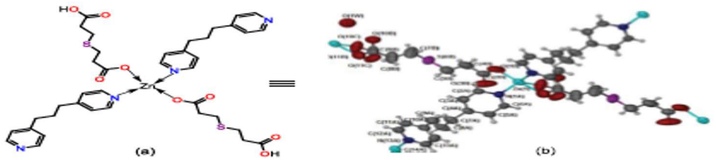
Metal Organic Frameworks (MOFs) are porous crystalline coordination networks composed of organic linkers and metal centers. This study investigated heavy metal sorption and antibacterial properties of a Zn-based MOF containing Sulphur atom

-Metal center
- Organic Linker

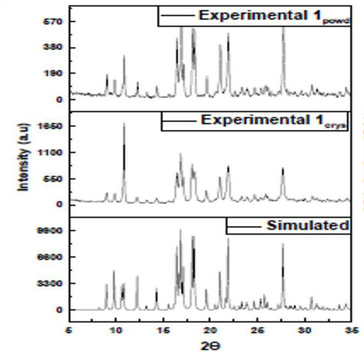


EXPERIMENTAL

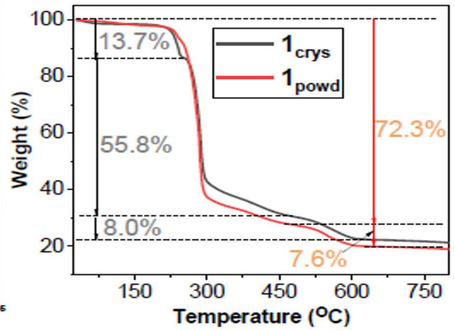




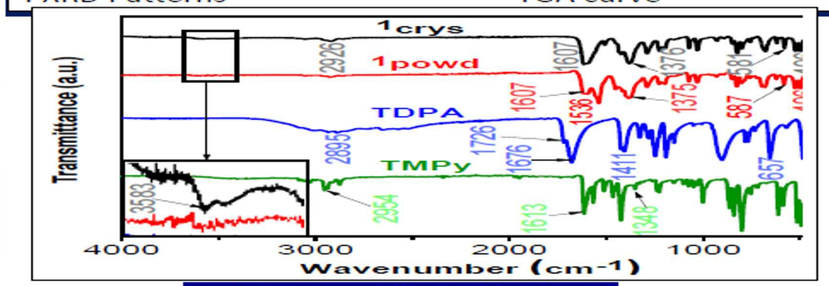
RESULTS



PXRD Patterns



TGA curve



ANTIBACTERIAL ACTIVITY

Table 1: Diameters of zones of inhibition (mm) of the action of 1_{powd}, TDPA and TMPy against some bacteria strains

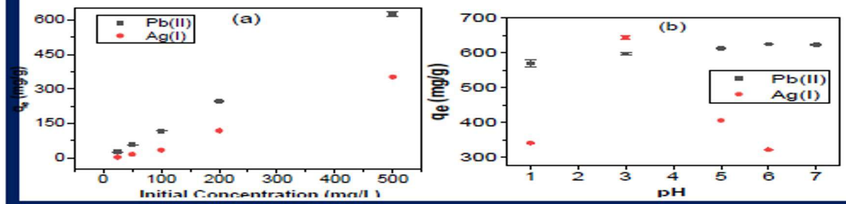
Agent	*S. aureus*	*B. subtilis*	*P. aeruginosa*	*S. typhi*	*E. coli*	*K. pneumonia*
1_{powd}	11	11	19	16	14	13
TDPA	5	10	12	-	7	-
TMPy	6	9	-	-	-	-

DEDUCTION AND CONCLUSION

The high removal capacity of 1_{powd} for the metal ions was attributed to the presence of free lone pairs of electrons on the sulfur atoms capable of coordinating with the metal ions, consistent with the Hard/Soft Acid/Base (HSAB) rule. In addition, compounds containing the sulfur donor applied to metal removal are often prepared by the post-synthetic modification but in this case, the MOF was synthesized in only one facile synthesis stage, without any need for further functionalization.

ADSORPTION STUDIES

The synthesized MOF $(Zn(TDPA)_2(TMPy)_2]_n$ was used for the adsorption of Pb(II) and Ag(I)



ADSORPTION THERMODYNAMIC PARAMETERS

Table 2: Adsorption kinetic parameters for the adsorption of Pb(II) and Ag(I) over $(Zn(TDPA)_2(TMPy)_2]_n$

Metal	Temperature (K)	ΔG (kJ mol^{-1})	ΔH (kJ mol^{-1})	ΔS (J mol^{-1} K^{-1})
Pb(II)	299	-6.96	5.26	40.74
	313	-7.57		
	323	-7.98		
	333	-8.39		

Pseudo-second order model gave a better agreement with those of the experimental values than Pseudo-first order model.

ADSORPTION ISOTHERMS

Table 3: Isotherm parameters with coefficient of determination

Isotherm model	Parameter	Pb(II)	Ag(I)
Langmuir	Q_m (mg/g)	-338.98	-56.63
	K_L(L/mg)	-0.0179	-0.0044
	R^2	0.5874	0.4981
Freundlich	n	0.64	0.53
	K_f	2.26	0.013
	R^2	0.9781	0.9778

Performance Evaluation

Adsorbent	Metal	Q_{max} (mg/g)
Copper- and cobalt-1,2,4,5-tetrabenzenecarboxylates	Pb	4.3
Thiol-modified cellulose composite	Pb	137.7
Modified UiO-66-NH_2	Pb	232.0
Melamine–formaldehyde–thiourea (MFT) chelating resin	Ag	60.1
Smectite organofunctionalized with thiol groups	Ag	111.0
1_{powd}	Pb, Ag	666.7

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