

Photocatalytic Degradation of 2,4-D Herbicides on Melamine Ligand Coordinated Al Metal-Organic Frameworks Incorporating Al₂O₃ Nanoparticle

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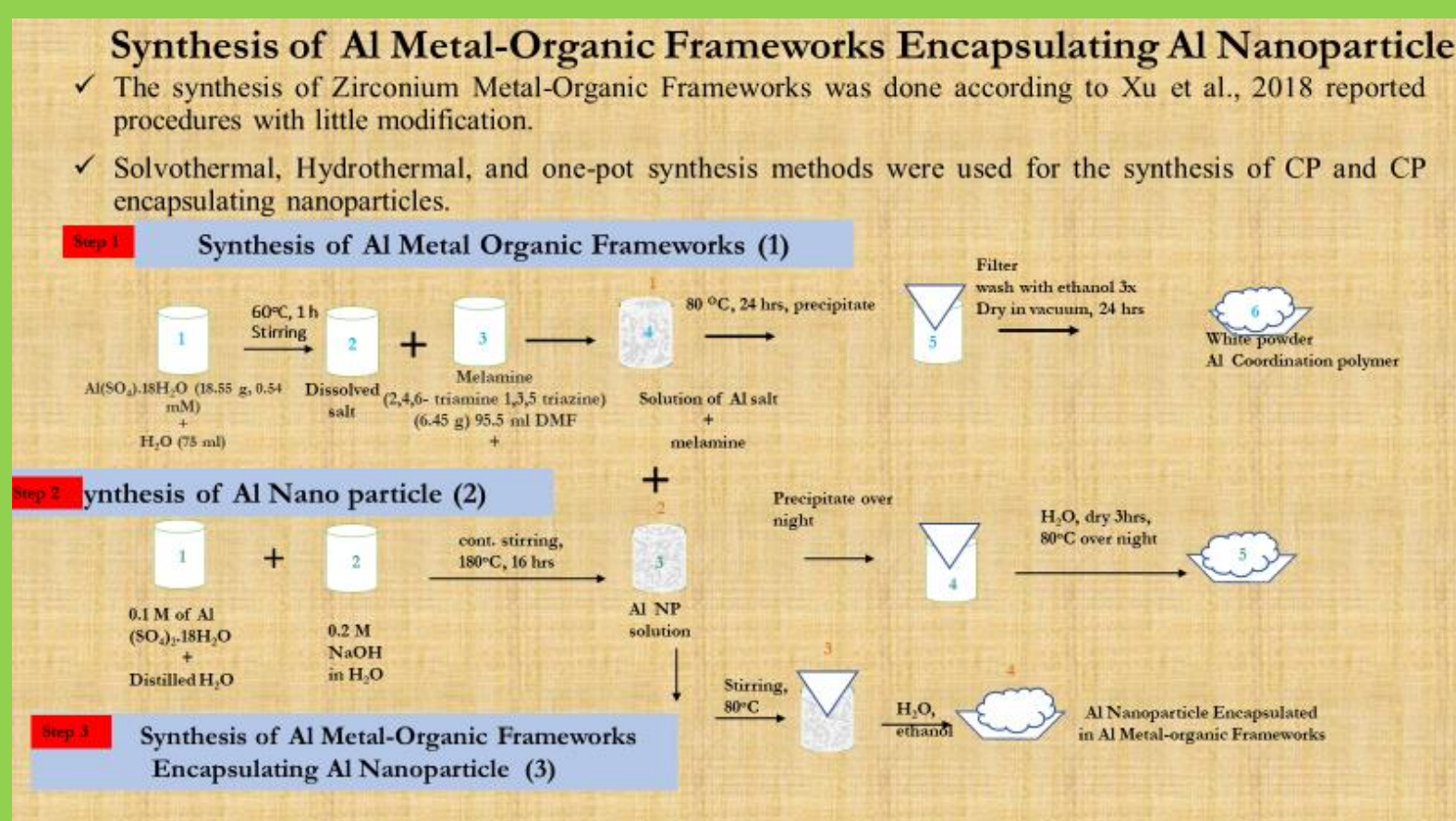
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Introduction

- Metal-organic frameworks are a class of porous materials which are synthesized through the self-assembly of metal ions and organic linkers.
- In particular, the incorporation of nanoparticles in MOFs attracts much attention because of the benefits of novel chemical and physical properties exhibited by certain classes of nanoparticle
- In this work, metal organic frameworks from; Aluminium, metal salt using melamine beds as linker molecules (ligands) to encapsulate their corresponding nanoparticles to produce a composite

Materials and methods

- In this work all the chemical used were purchased from Sigma-Aldrich (of analytical grade) and used without further purification.



- Irradiation was performed with a medium pressure- lamb (400 W), placed in axial position inside a cooling water jacket system.

- The wavelength of maximum of the light source of lamb is 365 nm. Constant agitation was assured by means of a magnetic stirrer placed at the reactor base.

- The reactor was initially loaded with 30 ml of 2,4-D aqueous solution at 20 mg/L and 100 mg of the photocatalyst.

- The mixture was maintained in the dark for 30 min under stirring to reach adsorption equilibrium, and was then irradiated.

- Samples taken after irradiation time intervals were centrifuged at 3000 tr/min for 10 min.

- The residual concentration was determined from UV-vis absorption characteristic with the calibration curve method at wavelength of maximum absorption of 283.

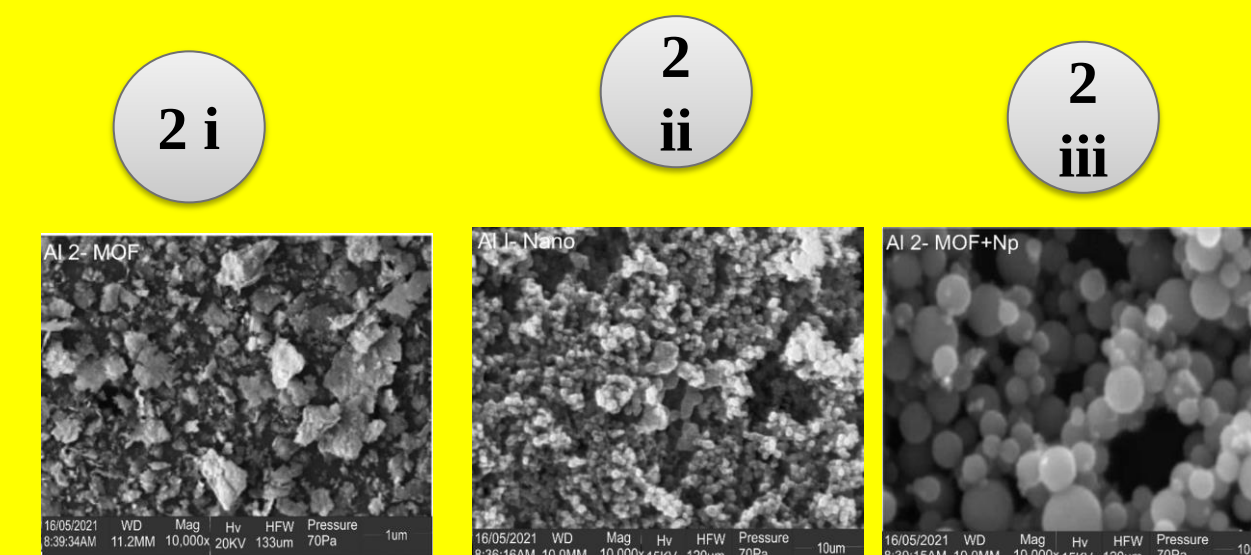
Results

Characterization

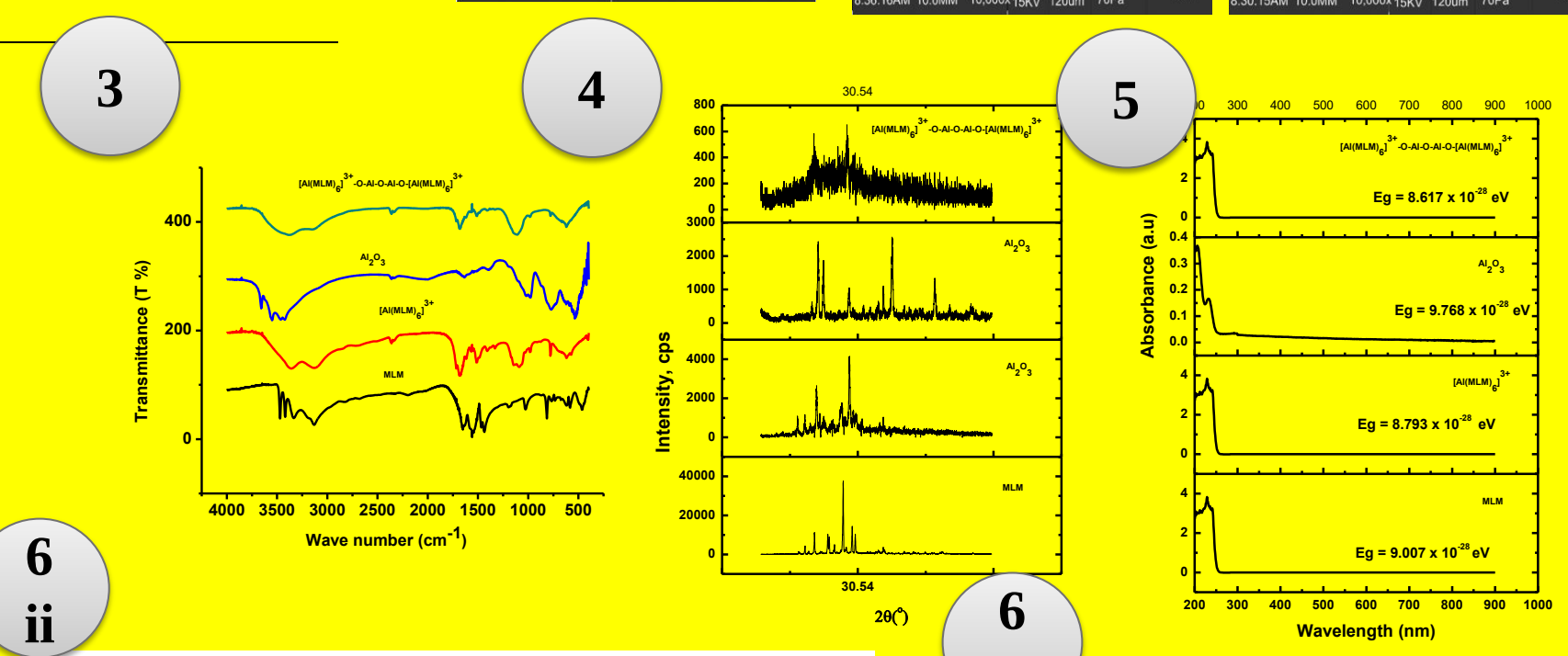
- ✓ Figure 1- Physicochemical Properties of Compounds Al-mlm, Al₂O₃, and Al-mlm encapsulating Al₂O₃

Compound	Appearance	%Yield	Mp (°C)	M.wt (g/mol)	%N
Melamine	White powder	-	301.8	126.12	-
Al-mlm	White powder	89	304.91	800	4.5
Al ₂ O ₃	White powder	78	305.8	101.96	-
Al-mlm encapsulating Al ₂ O ₃	White powder	71	332	911.10	4

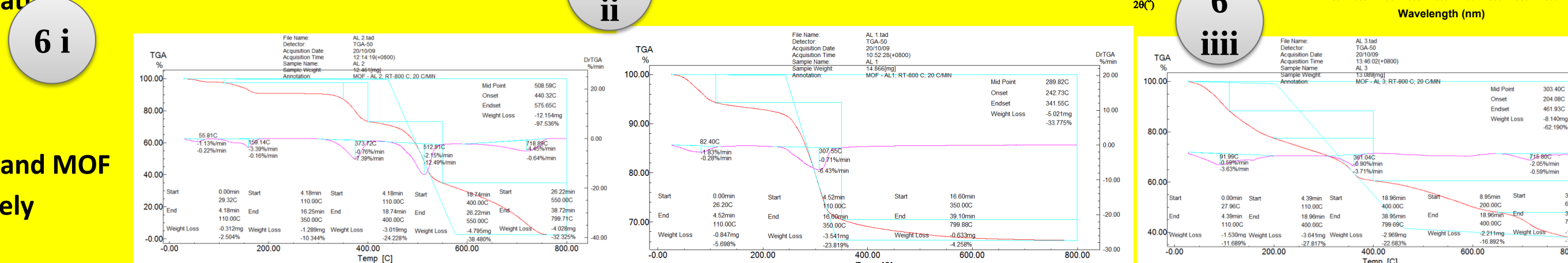
- ✓ Figure 2 (i, ii, iii) is the SEM analysis of (MOF, nanoparticle and MOF encapsulating nanoparticles) respectively



- ✓ Figure 3 is the FTIR spectra of (melamine ligand, MOF, nanoparticles and MOF encapsulating nanoparticles) respectively



- ✓ Figure 4 is the XRD pattern of (melamine ligand, MOF, nanoparticles and MOF encapsulating nanoparticles) respectively



- ✓ Figure 5 is the UV-vis spectra of (melamine ligand, MOF, nanoparticles and MOF encapsulating nanoparticles) respectively

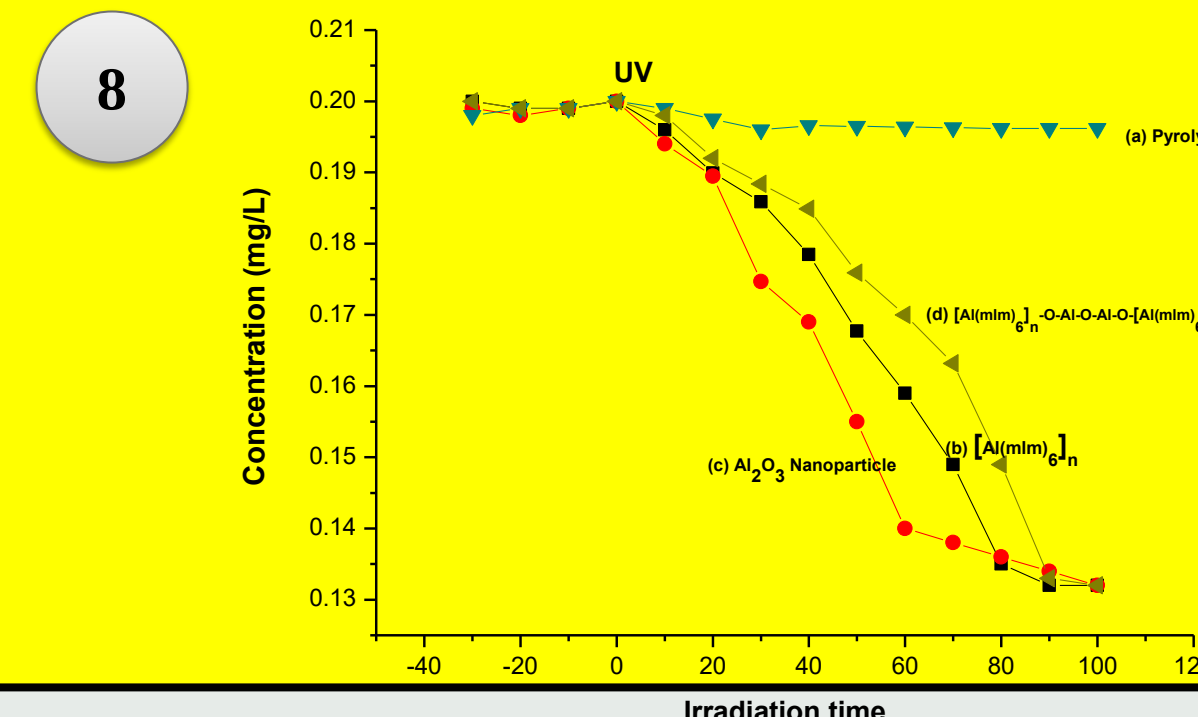
- ✓ Figure 6 (i, ii, iii) is the TGA analysis of (MOF, nanoparticles and MOF encapsulating nanoparticles) respectively

Catalyst Samples	BET surface area (m ² /g)
Al-mlm	142.670
Al ₂ O ₃	225.200
Al-mlm Encapsulating Al ₂ O ₃ nanoparticles	258.320

- ✓ Figure 7 - BET analysis of MOF, nanoparticle and MOF encapsulating nanoparticles

Photocatalytic Degradation

- ✓ Figure 8 - 2,4-D degradation onto MOF, nanoparticles and MOF encapsulating nanoparticles composites.



Conclusions

- Al-MOF, Al₂O₃ nanoparticles and Al-MOF Encapsulating Al₂O₃ were successfully synthesized and characterized using (FTIR), (BET), (SEM/EDX), (XRD), (TGA) and (UV-vis).
- The photocatalytic activity maintained its high response at Al-MOF encapsulating Al₂O₃ nanoparticle
- It is concluded that the modified materials exhibited efficient for the photocatalytic degradation of 2,4-D herbicide.
- This enhance photocatalytic activity can be attributed to the crystallinity, small sizes of composites, increased surface area achieved and reduced band gap.

References

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