



**CELLULOSE BASED PCC FILLED BY METAL ORGANIC FRAMEWORK
EFFICIENT HETEROGENEOUS CATALYST FOR COMPOSITE MATERIALS**

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ABSTRACT

MOF composites Precipitation calcium carbonate (PCC) packed were used to create metal-organic framework components. Inter-fiber connections are reduced in the cellulose, allowing the production of MOF. The resulting cellulose compounds have zeolite-like properties and more specific areas. The composite materials are analyzed using SEM, and co₂ absorption studies. The results have sustained idea that produced cellulose paper MOF synthetic fibers get a lot of gas adsorption potential (N₂, CH₄, H₂, CO₂, etc.). Cellulose is a frequently examined and common chemical. We look at how cellular platforms have aided the formation of various MOFs and provide some insight into the wide range of uses for these new materials, including pesticide



removal, pollution capture, antimicrobial surfaces, dangerous chemical degradation, and selective gas adsorption.

KEYWORDS: *Metal Organic Frameworks, cellulose, SEM, precipitated calcium carbonate (PCC).*

1. INTRODUCTION

MOFs have an open framework that can be porous as part of their structure (porous materials). Metal-organic frameworks (MOFs) are a form since they have more than 6000 m² of contact area per gram. A MOF consists of three main components: (a) an inorganic component consisting of either an action or a well-defined pore with established specifications by the collaboration of physical and chemical moieties; (b) It consisting of two or more substituents having the capability of organizing magnetic captions, such as carboxylate pyridine or phosphoric groups.

Most MOFs have a reticular structure, which means that if the ligand length is extended, the enlarged MOFs will keep their crystal structure. The porosity of MOFs may be precisely adjusted since the expanded structure is a coordination of the ligands to the metals. The most common ligands are mono or polycyclic aromatic molecules that only react under extreme circumstances (for example strong acids).

Increased amounts of metabolites can be added to the binding to help the reaction work under softer conditions. Introns do not contribute to the MOF's diffraction signal because they are neither part of the building and have a degree of flexibility they can be investigated using analytical techniques like FTIR and NMR. This paper offers new Nano lightweight structures for electrochemical reactions capacitors that have advantages such as simplicity of production, large and active surface energy, and containing aqueous stability [1]. The focus of metal-organic framework (MOF) material is changing from fundamental investigations to commercial products, such as designing MOF adsorbents and separators for selective capture and separations [2-3]

2. RELATED WORK

The creation and implementation of novel magnetic metal-organic frameworks are described in this research (MOF). For the amount of MOF, extraction time, pH of extracting, type, volume, and content of the eluent, and desorption time, these results were 35 mg, 7 min, 6.8, K₂SO₄NaOH, 5 mL, 9.8 (w/v percent) 0.05 mol L⁻¹, 15.5 min, respectively [4].

Composite panels and many layers of wax-printed paper chromatography were used to construct the well-based platform. The well was filled with KI and glucose concentrations, which flowed through the device and reacted with the GOx MOF organisms between layers to produce a yellow-brown colour with the required discrimination, stability, and durability [5-6].

The novel compound was prepared at room temperature for a short time when the process variables were improved. The MOFs produced from tetrahedral ligands, PCN-521 had the greatest BET surface area (3411 m² g⁻¹), pore size (20.5 20.5 37.4), and void volume (78.5 percent) [7-8].

The manufacture of conductive MOF Nano fibers (NWAs) and their application as the only working electrode in steady super capacitors was discussed. This research [9-10] explores the potential of metal-organic frameworks (MOFs) for CO₂ capture from flue gases using the VPSA

method. PCN-777, a metal-organic framework (MOF), has been developed and produced thanks to topological rationalization. Among the known Zr-MOFs [11-12].

Coordination polymers (CPs) are special types of polymer with a molecular structure that consists of an infinite array of repeating metal centers linked by organic ligands and connected by coordination bonding [13]. It is particularly completely given that the actual catalyst loading was only 0.055 percent due to the surface-only catalysis seen [14].

Until the conclusion of the preceding year, the papers were published. MOF and even the field's first article. Creating defects at certain crystallographic locations of MOFs also boosted their photo catalytic efficiency [15].

PROPOSED METHOD

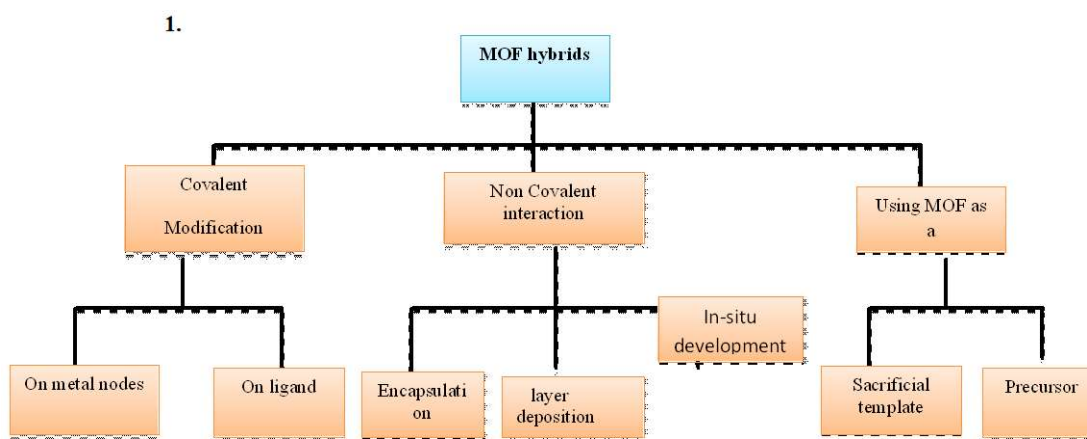


Figure 1: Proposed metal-organic framework

Covalent modifications: Covalent alterations to MOF lattices after synthesis include concerted covalent adaptations to transfer metals and covalent to ligands for MOF complex formation, leading in improved structure activity. To avoid structural sacrifice, MOF structures that are appropriate for atomic change are typically designed and transparent.

Non covalent Interactions:

Although covalent modification is a useful method for creating MOF hybrids, not all materials or organic molecules can be fully linked with MOFs without considerable performance loss. Many MOF combinations have already been made utilizing easy procedures such as combining, laminating, mounting, and other non-covalent bonding methods.

$$A = \frac{W2-W1}{W1} \times 100\% \quad (1)$$

The PCCP weights were W1 and W2, and the MOF depositing proportion on PCCP or PFP was A.

$$q = q_{m=1} b_1 p^{1/m^2} / 1 + b_1 p \quad (2)$$

The effect of PCC on the depositing concentration:

The PCC addition level can be increased by increasing the MOF forming ratio. PCC particles result through fiber–fiber interaction, which increases the number of hydroxyl groups on the surface of a material, allowing MOF crystals to form. As a result, MOF deposition has been boosted, which can assist reduce production costs while also improving optical quality. In the industry, a common filler addition is 20–30 percent. As a result, utilizing PCC to increase the MOF deposition ratio is projected to diminish the MOF tissue composite's durability.

Catalytic Preparation:

A catalytic propargylic alcohol was used to test the efficiency of catalysts. Add the platform, 0.6 equivalence of DBU, 2 mL of CH₃CN, and 1 mol of catalyst to the mixture. It was sealed and circulated at room temperature with the insertion of a CO₂ balloon. The amount of catalyst used in the reaction was determined using the Ag-1 silver equivalence for the procedure. To test yields, internal standards of 1, 1, 2, and 2-tetrachloroethane (0.25 mmol) were employed. The approach for determining the yield using the initial concentration is as follows:

$$\text{NMR yield} = \frac{(\text{the integration of b}) \times \text{NC} \times \text{HC}}{(\text{the integration of c}) \times \text{N} \times \text{HB}} \times 100$$

Where b is the H signaling maximum in c is the H signals peaks in 1,1,2,2- tetra chloromethane, and d is the H pattern high in hydrocarbons. N is the nitrogen number for 2-methyl-3.

Applications for cellulose–MOF:

Water-related materials should be dechlorinated. The health of humans, plants, and animals is directly affected by human activities. Heavy metals, polyaromatic hydrocarbons, organophosphates, and organ hydrogen chloride are examples of anthropogenic pollutants that have natural sources for various commercial activities. Two of the most surface industries are textile manufacturing and dying. Synthetic dyes while useful and necessary for commercial production require the use of a variety of additives such as naphthols, nitrates, acids, soaps, enzymes, and heavy metals such as copper, as well as other auxiliary chemicals.

EXPERIMENTAL RESULTS:

The current study suggests that hydroxyl-rich cellulose fiber should establish ester linkages with 1, 4-benzene carboxylic acid in the presence of 1, 4-benzene carboxylic acid (BDC) the organic receptor of MOF crystals.

Table 1: On PCCP and PFP samples, the MOF precipitation ratios were measured.

Sample	W2(g)	W1(g)	Deposition ratio %
PCC MOF	0.2256	0.4456	345.0
PFF MOF	0.2243	0.3421	223.1

Table 1 shows MOF modified PFP and PCCP cellulose paper. PCCP MOF and PFP MOF had different deposition ratios. The results of the water contact angle analysis corroborate this. After PCC was added to cellulose paper, the contact area reduced.

PCC MOF and PFF MOF

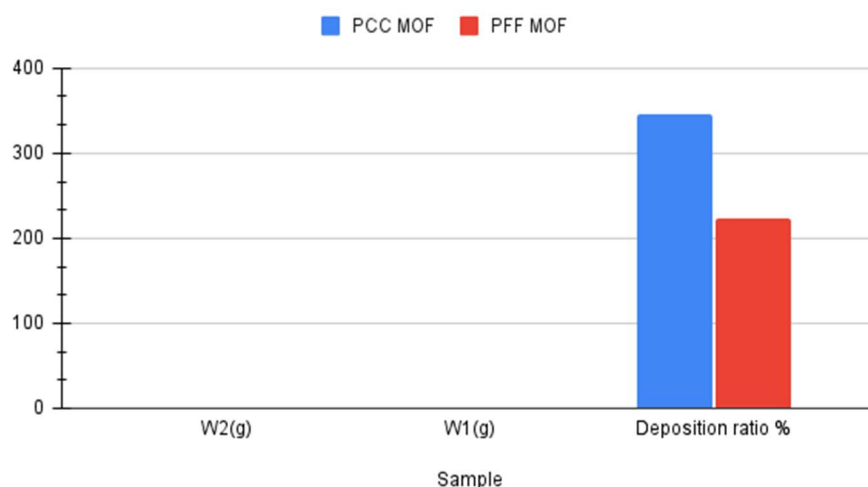


Figure: 2 The XRD patterns of MOF support the presence of the surface PCCP MOF sample

MOF rapidly absorbs moisture when exposed to air. As seen in Fig 2, the modification in crystal structure affected by water adsorption led to the creation of a new maximum. It's also possible to make a comparable observation. Because MOF is a porous material used for gas adsorption, humidity can affect its effectiveness.

Table 2: When compared to MOF, PFPMOF, PCCP, and PFP samples, the PCCPMOF composite had outstanding surface porous characteristics.

Sample	$S_{BET}(m^2/g)$	$S_{Micro}(m^2/g)$	$S_{External}(m^2/g)$
PCC MOF	354.6	377.10	60.13
MOF	254.6	290.32	50.60
PFP MOF	2.34	6.65	1.89
PFP	0.88	0.55	0.15

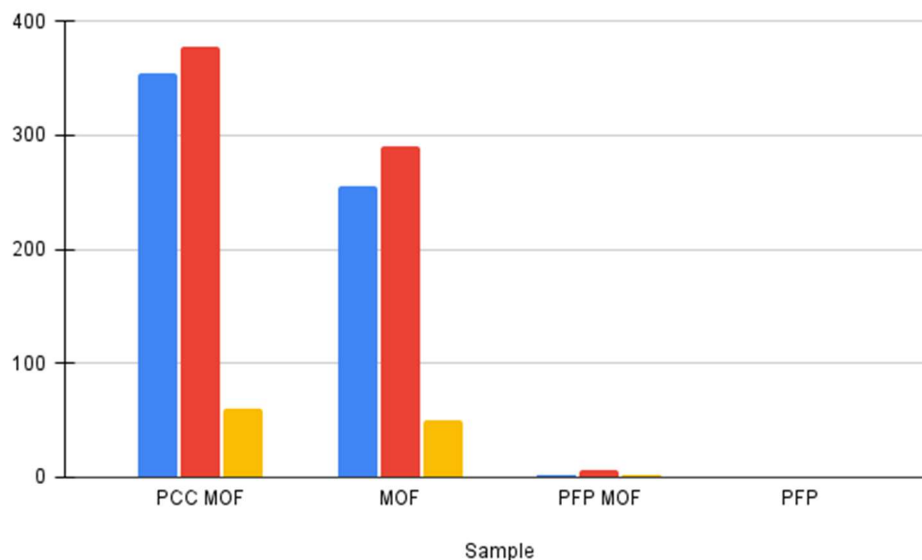


Figure 3: The N₂-adsorption isotherms of samples

Despite nearly identical circumstances, the PCCP MOF samples desorption of nitrate was significantly higher as seen in Fig. 3. This is due to the large of MOFs that formed on the surface of PCC-filled. The nitrogen adsorption of the PCCP and PFP MOF composite materials comparable (Fig. 3), implying that the PCCP MOF composite material's increased absorption capacity was due to technical differences in generated MOF as a result of the PCC additive sampling.

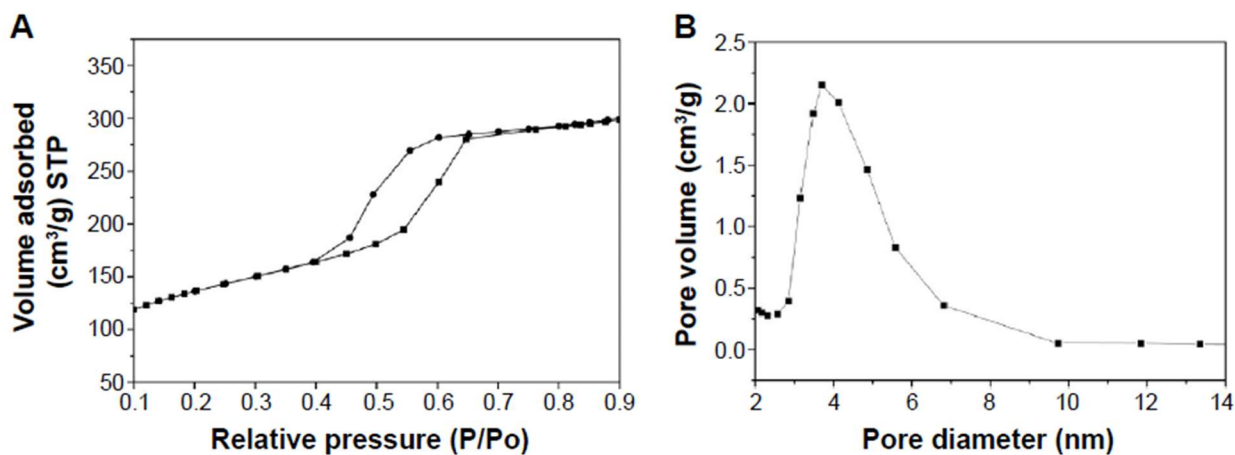


Figure 4: a) Equation of state of adsorption and desorption at 77 K, Ag-1 and Ag-1 .Based on N₂ isotherm models at 77 K, pore size distributions were calculated (b) Qst CO₂ adsorption

The density of 1 and Ag-1 was determined using N₂ adsorption-desorption isotherms. Ag-1 are depicted in Figure 4a. According to the micro porous measurement, the size of Ag-

1 were 0.99 and 0.96 in dimension, accordingly. The size of the particles ranges revealed that the post-synthesis modification technique kept the Ag-1 micro porous feature.

Table 3: Over based catalysts, modification of process variables is possible.

Entry	Substrate	catalyst	solvent	Field
1.	Benzylamine	Cu-BTC MOF	CH ₃ OH	15
2.	Benzylamine	Cu-BTC MOF	C ₂ H ₅ OH	14
3.	Benzyl amine	Cu-BTC MOF	DCM	21
4.	Benzylamine	Cu-BTC MOF	CHCL ₃	24
5.	Benzylamine	Cu-BTC MOF	Acetonitrile	25

Characterization of catalysts:

The crystal structure of the used MOF (retrieved after the second session) was identical to that of the fresh form, indicating that the XRD pattern was responsible for the catalyst's extended life and durability. Cu₃ is made up of two carboxylic acid molecules and three Cu²⁺ ions and is very crystalline (BTC). The thermal characteristics of the Cu-BTC MOF have been investigated, and the results are presented.

Phenol:H ₂ O ₂	Catalyst amount(g)	Induction period(min)	Phenol conv.	CAT	HQ
1:2	0.030	18	8.10	63.00	27.09
1:2	0.030	15	9.26	61.00	28.05
1:2	0.030	10	17.06	62.00	29.00

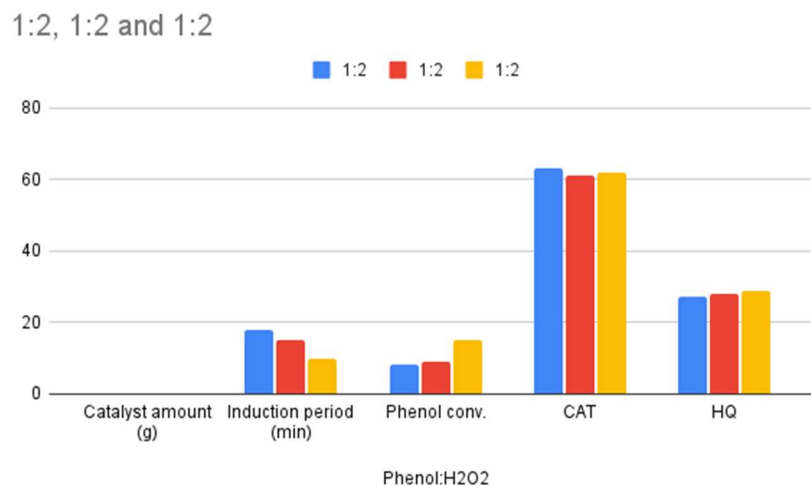


Figure 5: The effect of a 1:2 phenol-to-H₂O₂ ratio

Figure 5 demonstrates the oxidation of phenol as a function of hydrogen peroxide concentration when the methanol to hydrochloric acid mole ratio is changed from 1:5 to 1:2 at 50°C. Phenol engaged from 9.1 percent when the phenol mole ratio was adjusted from 1:0 to 1:1 and then leveled off at 17.06 percent.

CONCLUSIONS

Deposition of MOFs in situ on cellulose tissue produces MOF composite materials. Groups were exposed for engaging with the organic ligand because PCC fillers decreased hydrogen bond formation between cellulose fibers, resulting in MOF crystals with lower particles of different sizes. Because of the zeolite-like frameworks, the resulting paper MOF composite materials have huge specific surface areas. The highly variable level of organic acids revealed in this class of MOFs has been analyzed for the formation and showed one of the highest activities for glycerol acetalization polymerization observed to date, with a profitability frequency of 13 886 h¹, which is 90 significantly greater than that of its inorganic counterpart. Overall, the findings offer light on the flexible acidity and suggest future research in this area.

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