MOF-303-Supported Molecularly Imprinted Polymer for Selective Ketoprofen Capture from Multicomponent NSAID Mixtures

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BACKGROUND & OBJECTIVE

Environmental challenge

Ketoprofen can coexist with related NSAIDs (ibuprofen and diclofenac) in water. High uptake alone does not establish molecular selectivity.

Material strategy

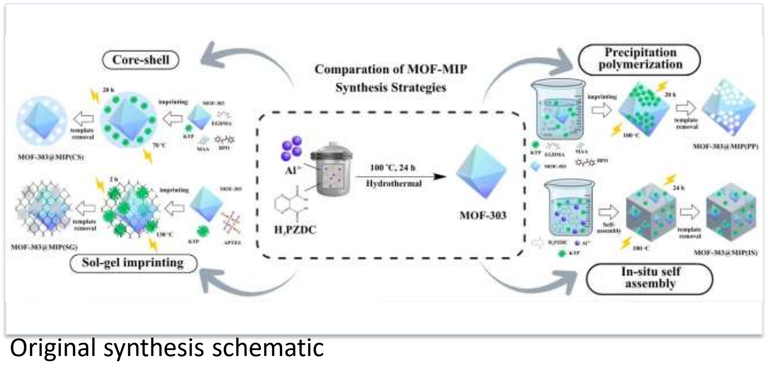
MOF-303 provides a porous Al-based framework; a ketoprofen-templated imprinted polymer is prepared to introduce recognition sites.

OBJECTIVE

Compare synthesis routes and assess uptake, selectivity and reuse of MOF-303@MIP(CS) against NSAID mixtures.

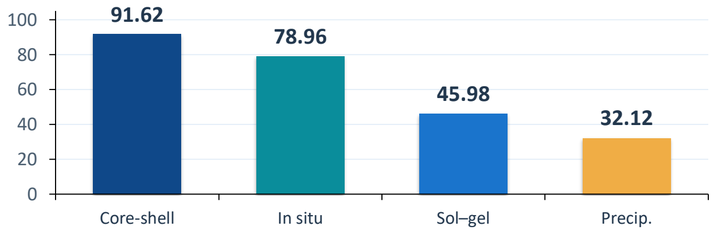
Compared materials: MOF-303 | MOF-303@MIP(CS) | MOF-303@NIP(CS)

SYNTHESIS STRATEGIES



Original synthesis schematic

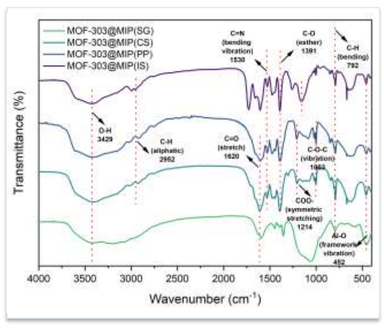
Product yield (%)



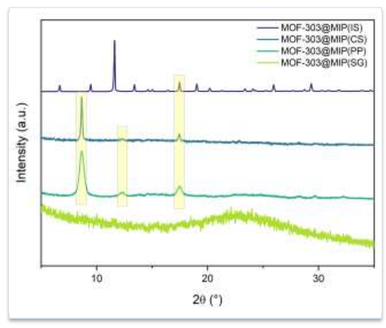
Core-shell selected for highest yield and retention of MOF crystallinity.

FTIR, PXRD & TEMPLATE LEACHING

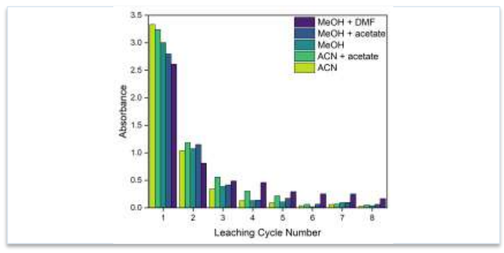
FTIR



PXRD



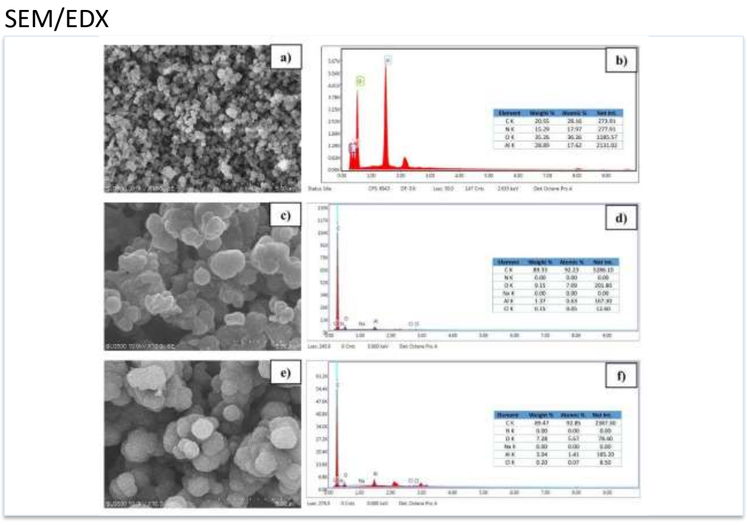
Leaching solvent comparison



Original experimental FTIR, PXRD, and leaching data.

MORPHOLOGY, POROSITY & THERMAL

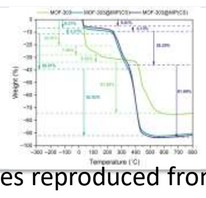
SEM/EDX



BET surface area (m²/g)

MOF-303: 823.58 | MIP: 736.71 | NIP: 413.33

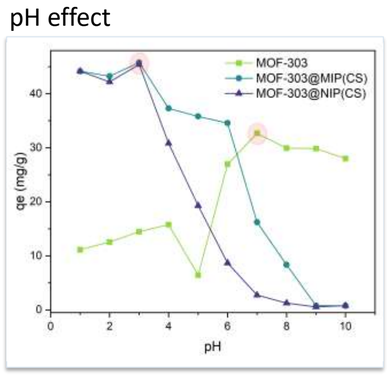
TGA



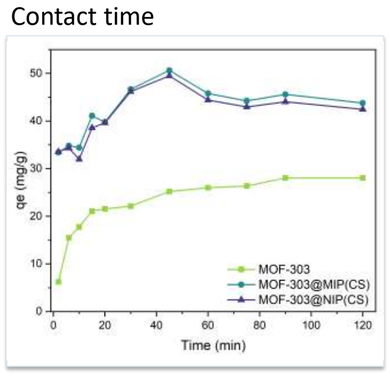
SEM/EDS and TGA images reproduced from the manuscript and supplementary information.

ADSORPTION OPTIMIZATION

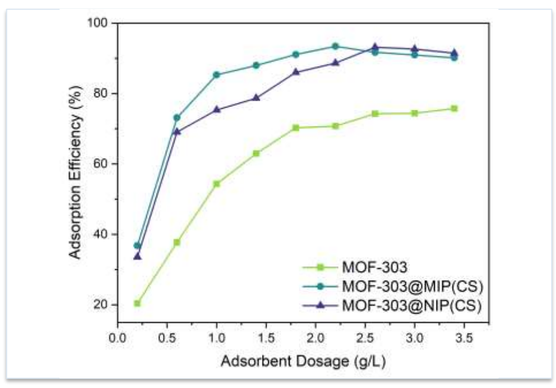
pH effect



Contact time



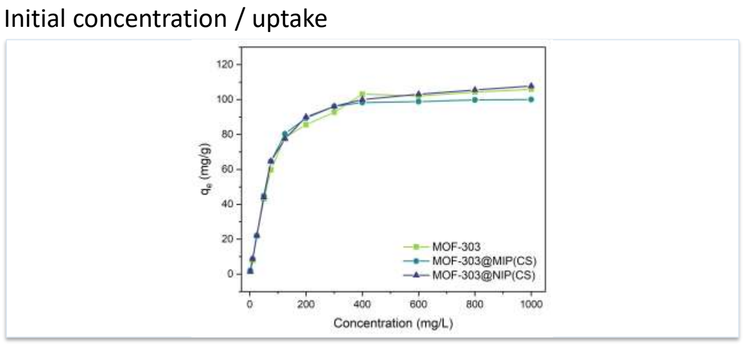
Dose vs removal



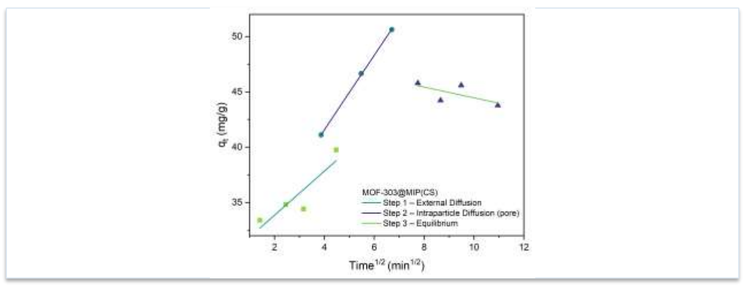
MIP: pH 3 · 45 min · 93.40% at 2.2 g/L (~55 mg/25 mL)

ISOTHERMS & ADSORPTION KINETICS

Initial concentration / uptake



Intraparticle diffusion



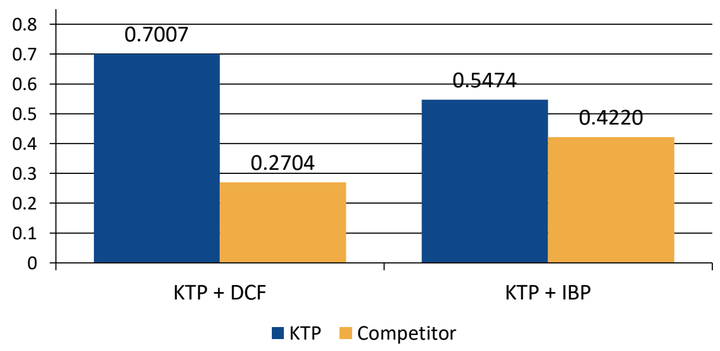
Model parameters

Langmuir q_{max} (MIP): 99.87 mg/g | NIP: 103.22 mg/g
PSO fit for MIP: R^2 = 0.9960 (fit is not proof of chemisorption)

At 45 min: q_t = 50.63 (MIP) and 49.50 mg/g (NIP)

COMPETITIVE NSAID ADSORPTION

Binary 1:1 mixtures



Distribution coefficient Kd (reported units: mL/g)

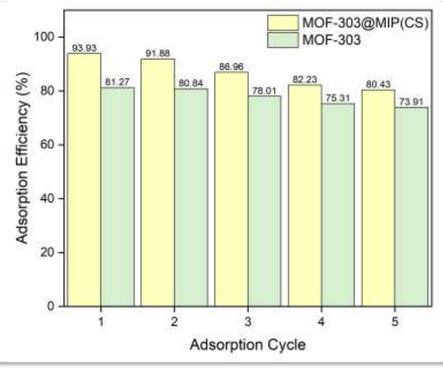
Selectivity factors α = Kd,KTP / Kd,competitor

Binary KTP/DCF	**2.5907**
Binary KTP/IBP	**1.2972**
Ternary 1:1:1 KTP/DCF	**9.7914**
Ternary 1:1:1 KTP/IBP	**9.9443**
Ternary 1:1:2 KTP/IBP	**16.3527**

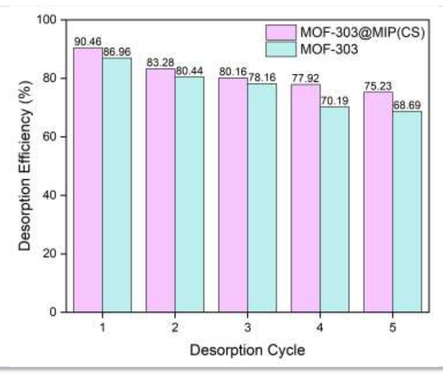
Higher Kd and selectivity factor (α) values indicate preferential ketoprofen binding over competing NSAIDs in the tested mixtures.

REUSABILITY: FIVE CYCLES

Adsorption efficiency



Desorption efficiency



Cycle 5: 80.43% adsorption | 75.23% desorption

CONCLUSIONS

Key findings

Best route	Core-shell, yield 91.62%
q_t after 45 min	MIP 50.63 / NIP 49.50 mg/g
Langmuir q_{max}	MIP 99.87 / NIP 103.22 mg/g
Preferred pH	pH 3 for MIP / NIP

Summary

- The core-shell route gave the highest recovered yield among the four synthesis methods.
- MOF-303@MIP(CS) showed preferential ketoprofen uptake in the tested binary and ternary NSAID mixtures.
- Adsorption–desorption performance was maintained over five cycles.

Potential application

MOF-303@MIP(CS) is a promising adsorbent platform for selective ketoprofen capture from multicomponent NSAID mixtures.