

Global scientific collaboration towards sustainable development goals

Prospect for collaboration and project application in EU and US

Engineering porous materials for sustainable chemical technologies

Dr Huan Doan

EPRSC Doctoral Prize Fellow
University of Bristol



9 July, 2021

Introduction



Huan DOAN

2004
2014



Hanoi University of
Mining and Geology

BSc + MSc + Lecturer in Petrochemical Engineering

2014
2015



UNIVERSITY OF
BATH

MRes in Sustainable Chemical Technologies

2016
2019



University of
BRISTOL

PhD in Mechanical Engineering

EPSRC

Engineering and Physical Sciences
Research Council

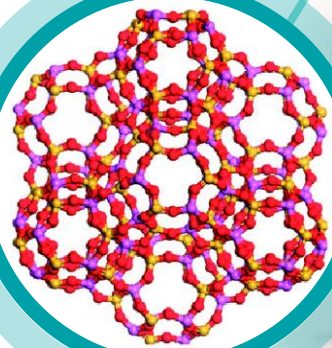
2020
2022



University of
BRISTOL

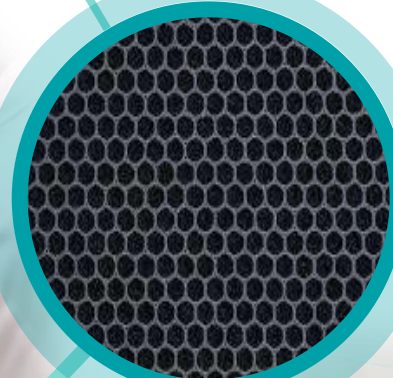
EPSRC Doctoral Prize Fellow
in Inorganic and Materials Chemistry

Zeolites



Gas
sensing

**Carbon
Nitrides**



Energy
storage

Gas separation

Hydrogen
storage

Porous Materials

Water
treatment

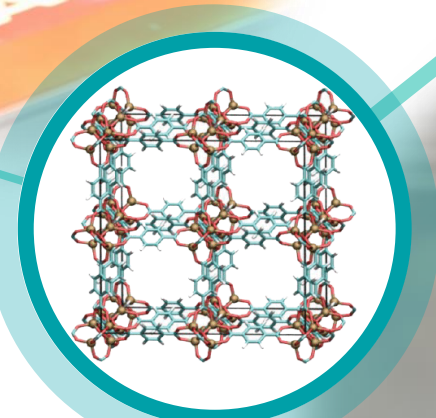
Catalysis

**Porous
Silicas**

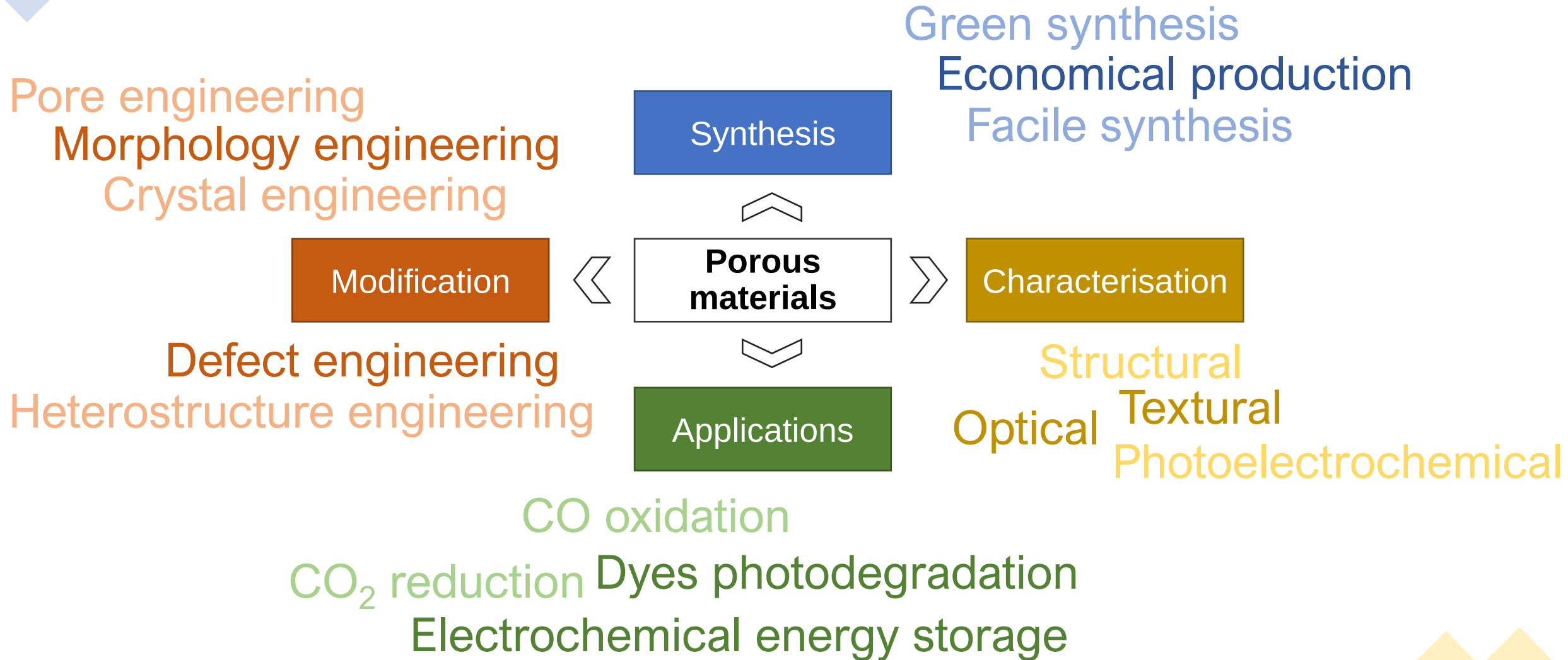


Drug
delivery

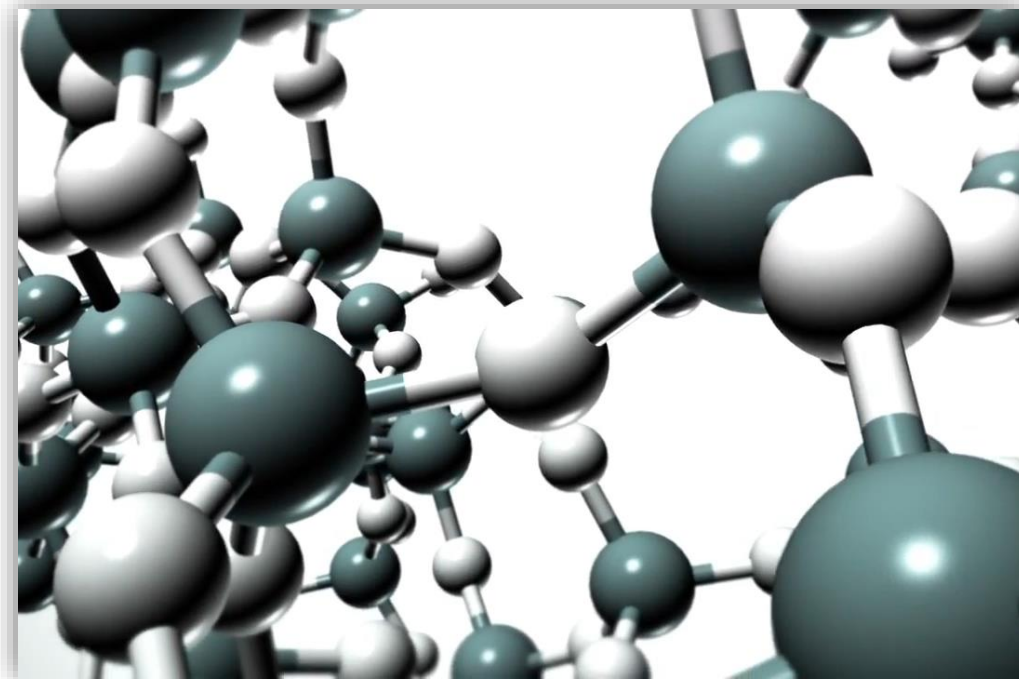
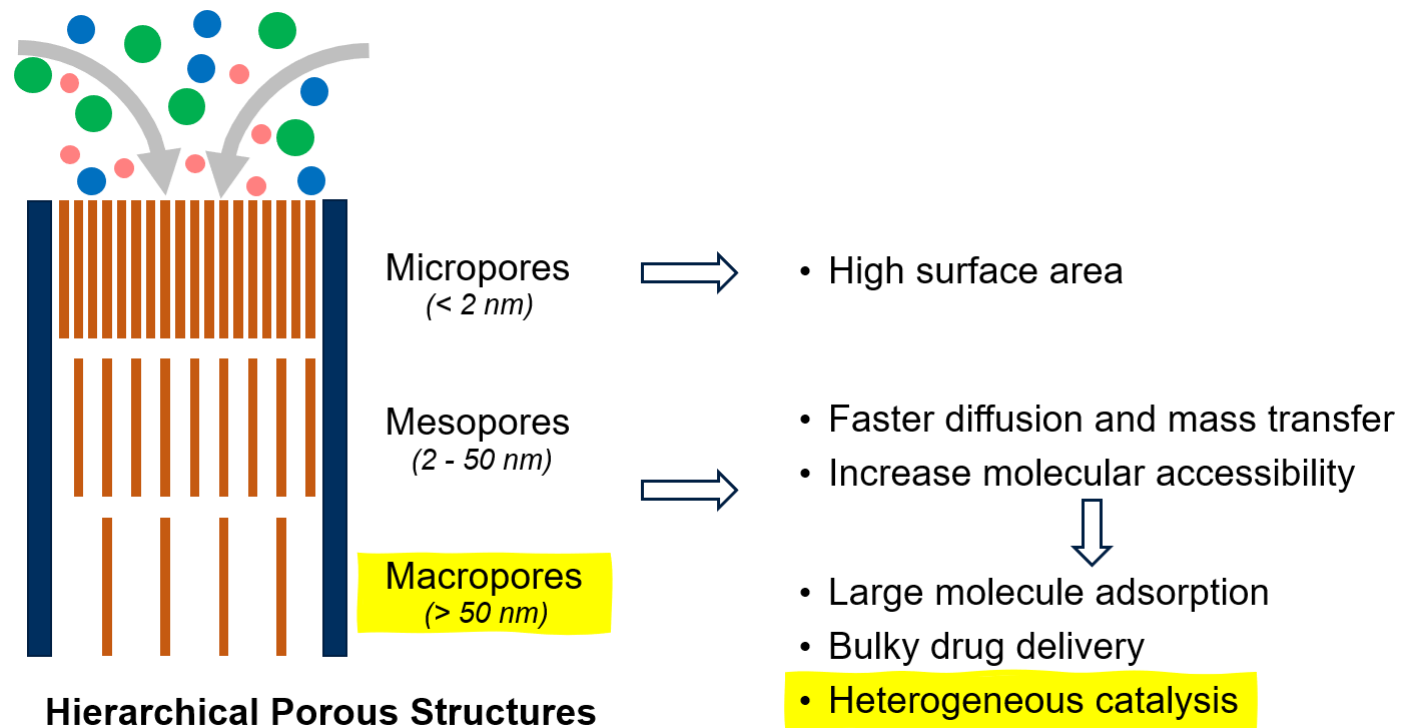
**Metal-Organic
Frameworks**



Research interests

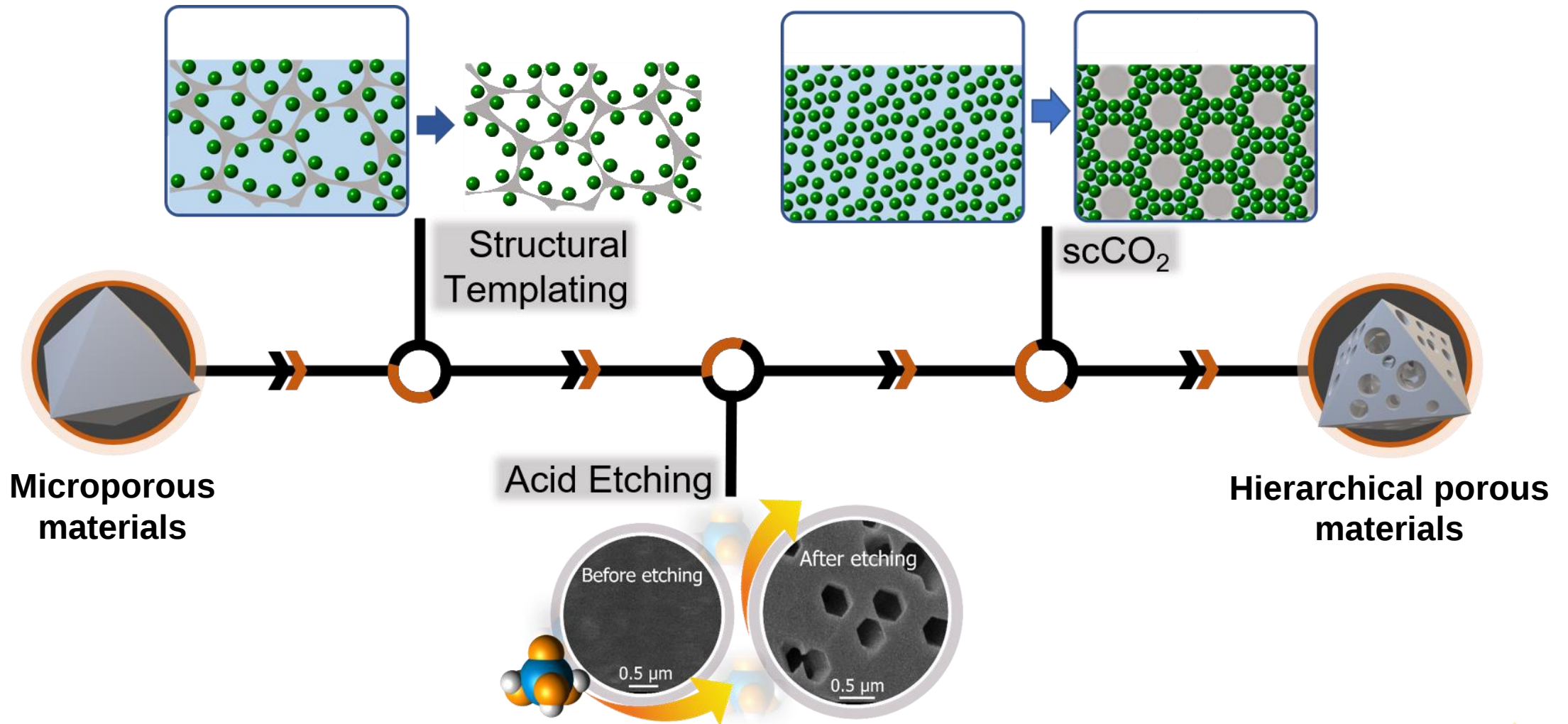


Research interests



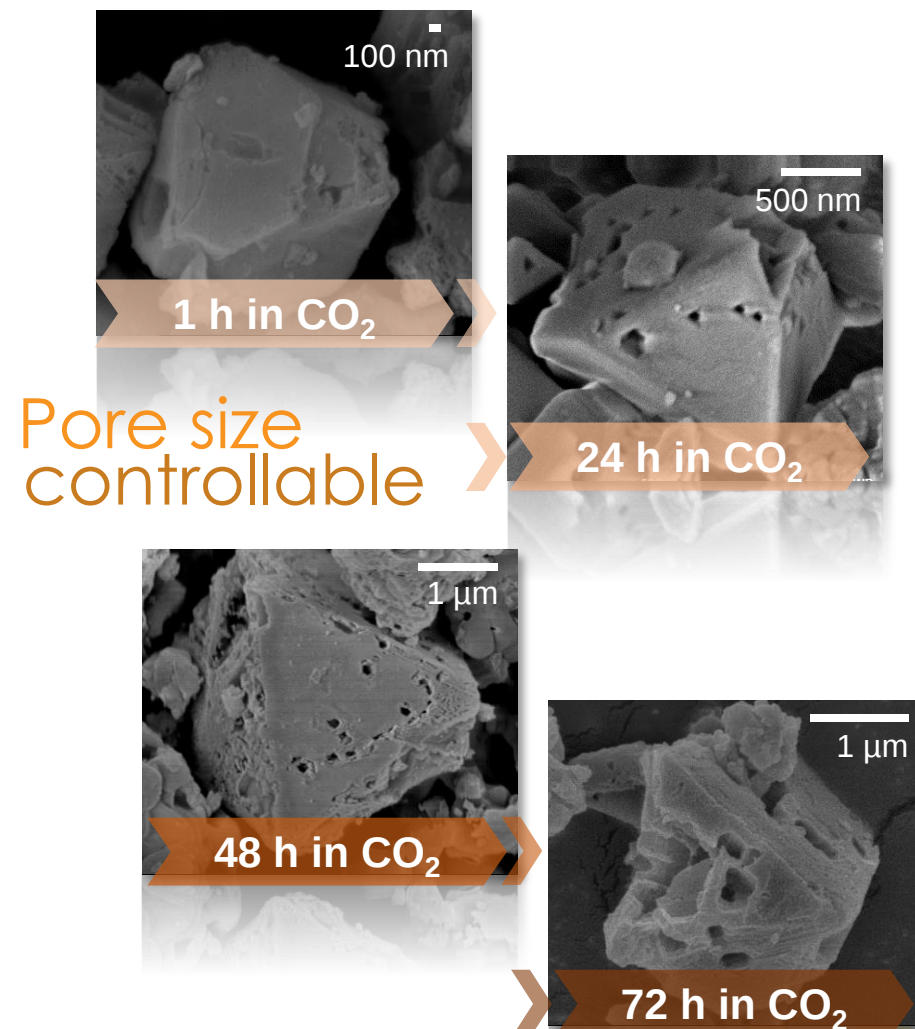
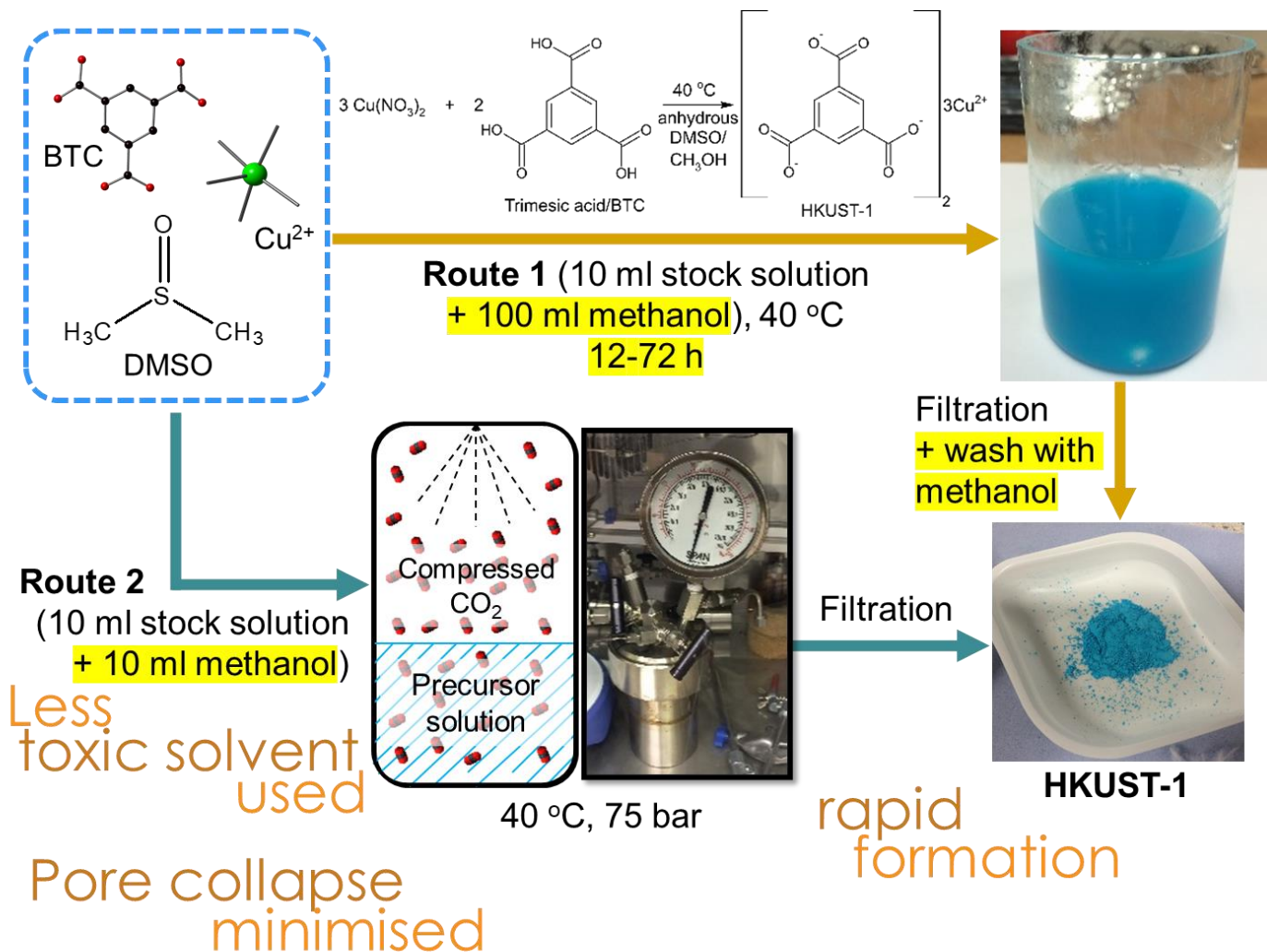
© Grace Catalysts Technologies

Research interests

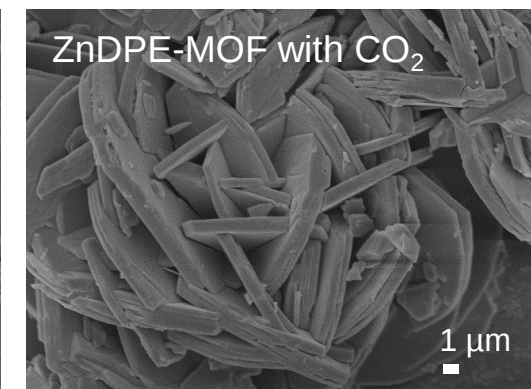
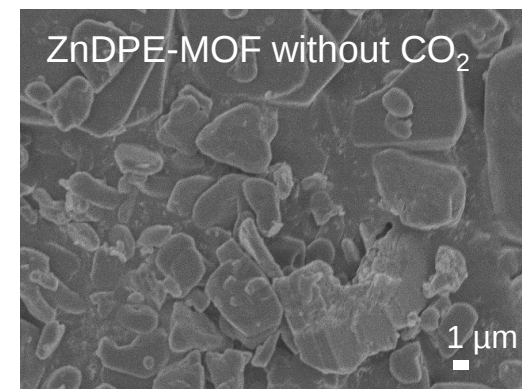
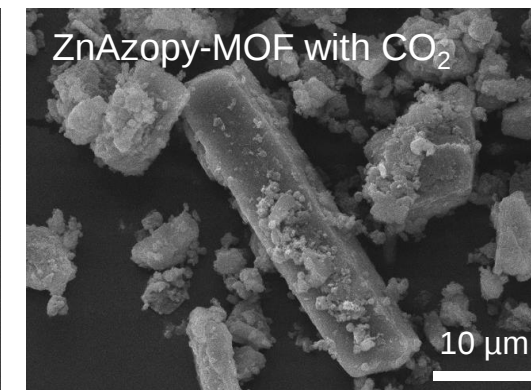
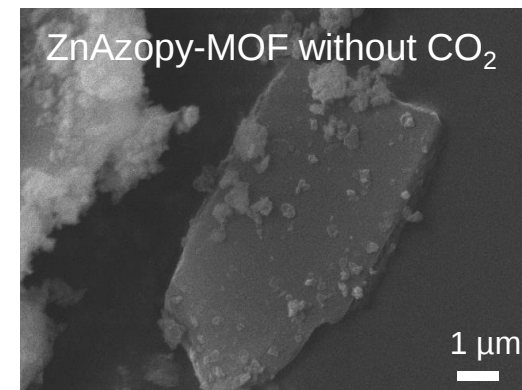
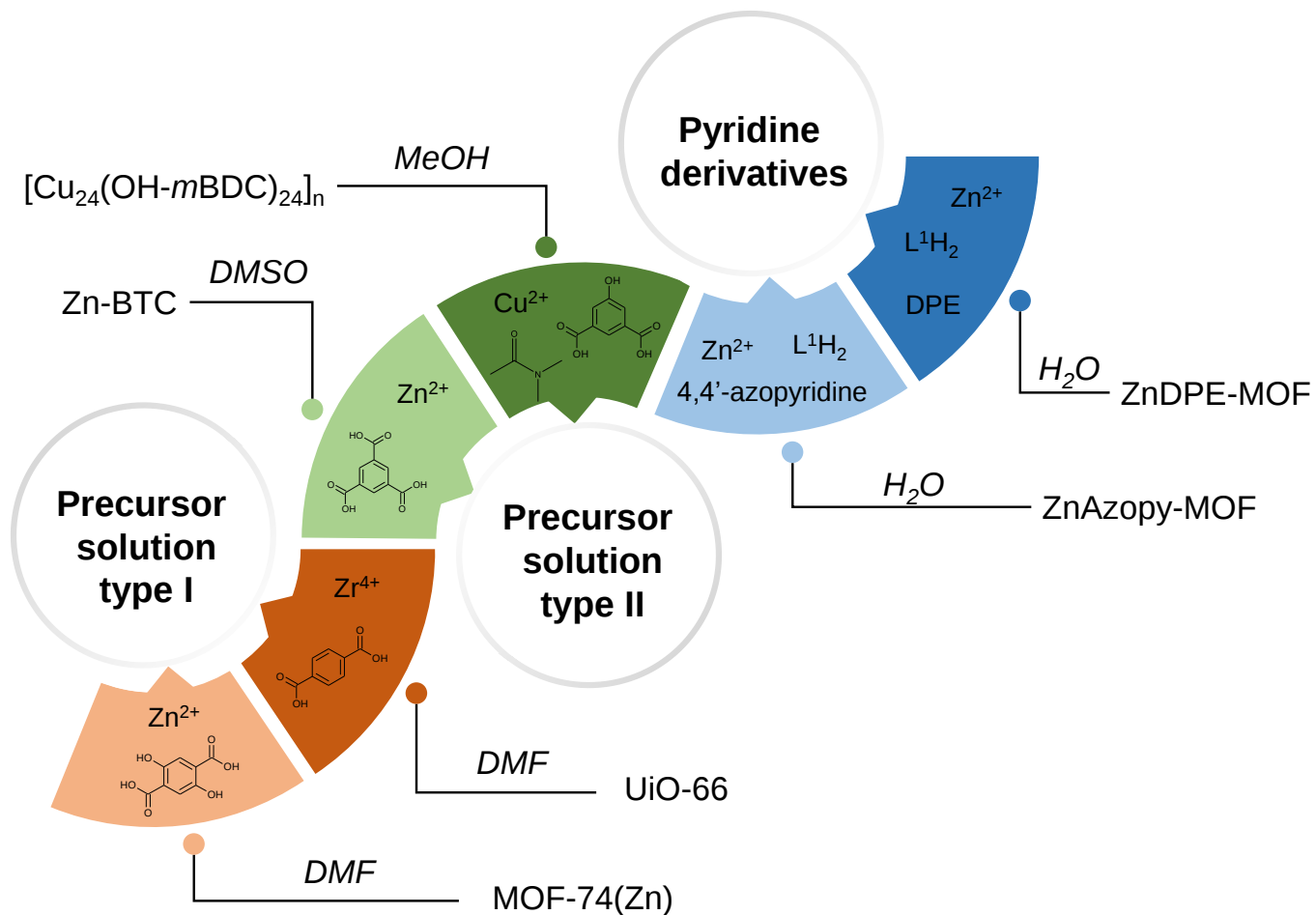


Morphology engineering under high CO₂ pressure

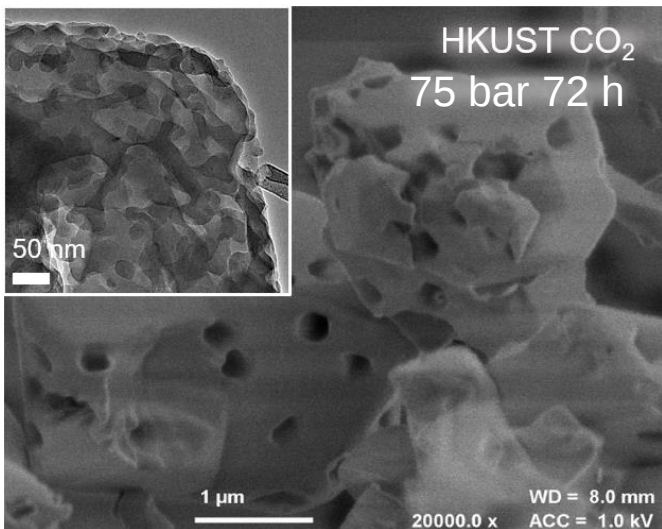
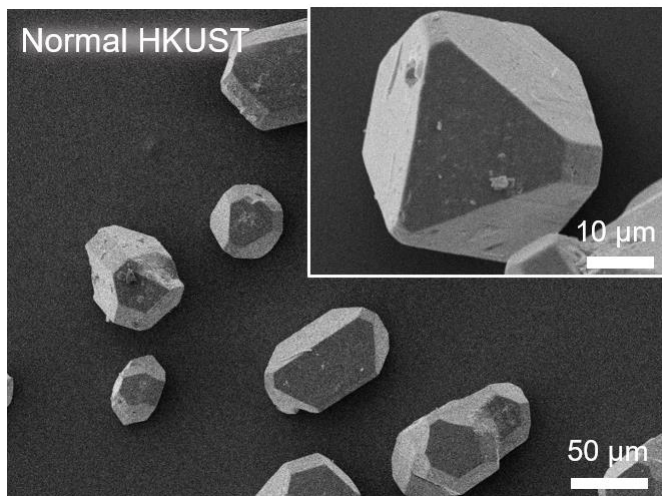
HKUST-1 (Copper benzene-1,3,5-tricarboxylate)



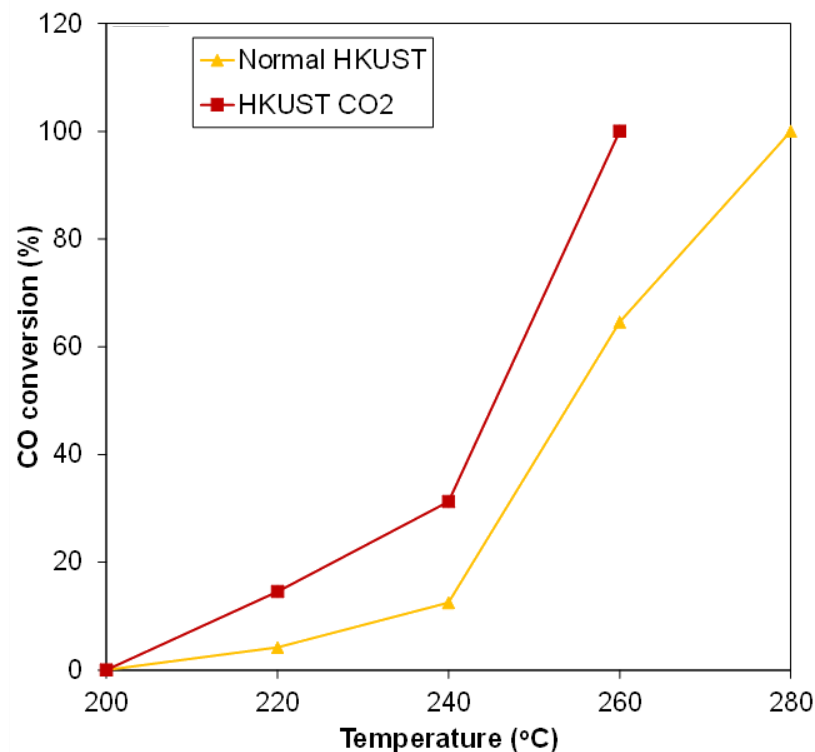
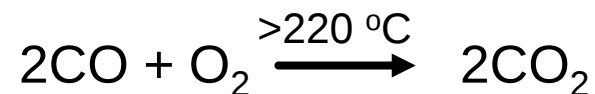
Morphology engineering under high CO₂ pressure



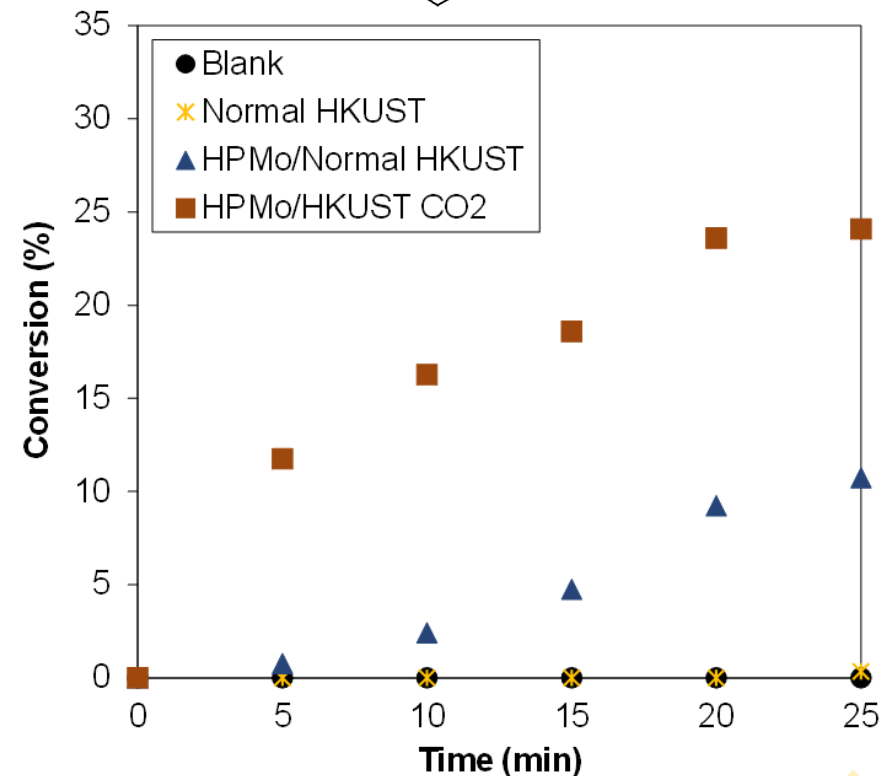
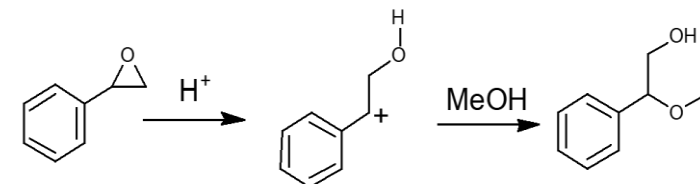
Morphology engineering under high CO₂ pressure



CO oxidation



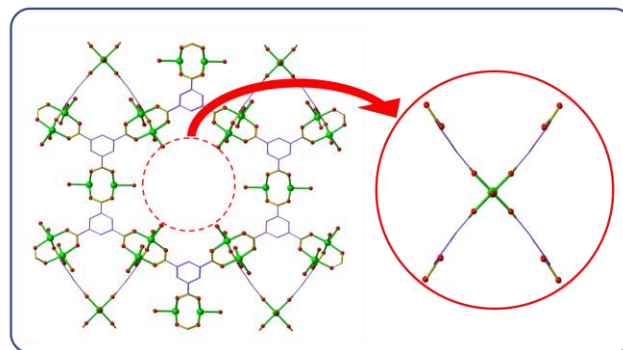
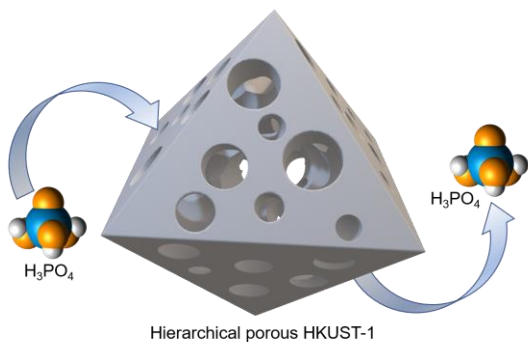
Methanolysis of styrene oxide



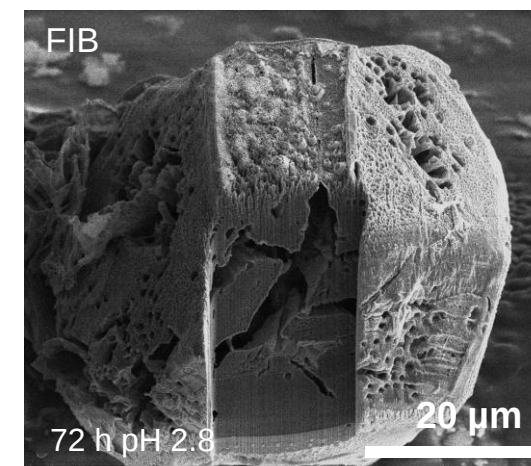
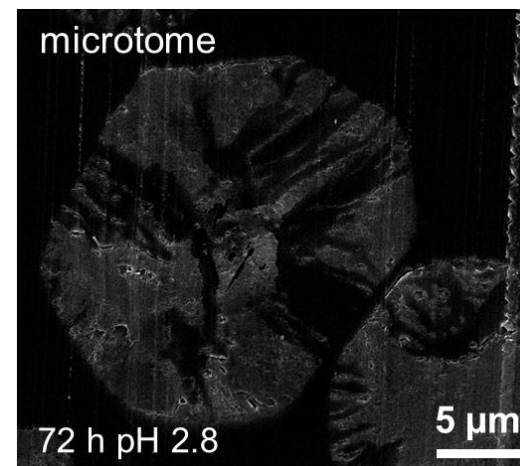
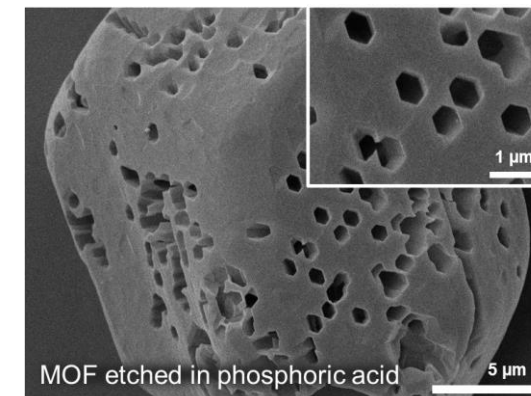
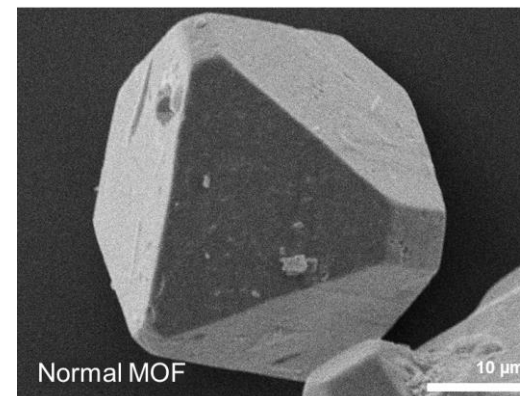
Overcoming
diffusional limitations

Morphology engineering in severe chemical environment

MOFs $\xrightarrow{\text{Etching in acid}}$
pH = 2 - 6
Time = 1 - 72h
Etching agents: H_3PO_4

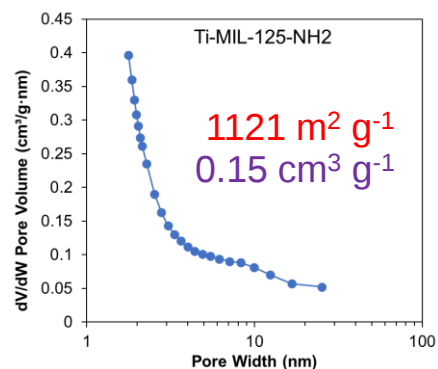
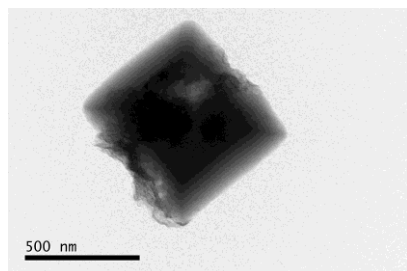


HKUST-1 (Copper benzene-1,3,5-tricarboxylate)

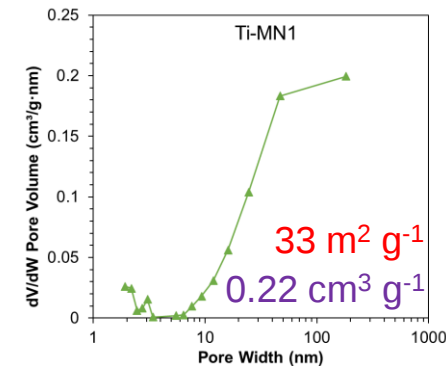
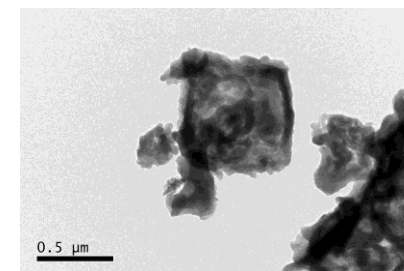
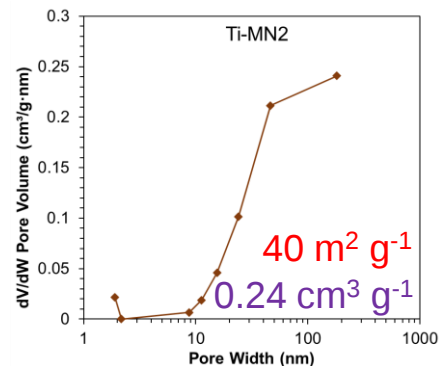
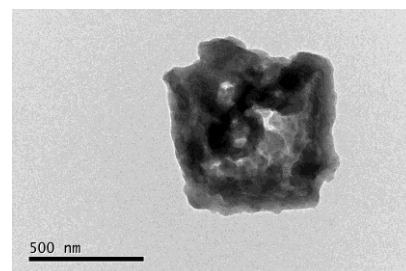
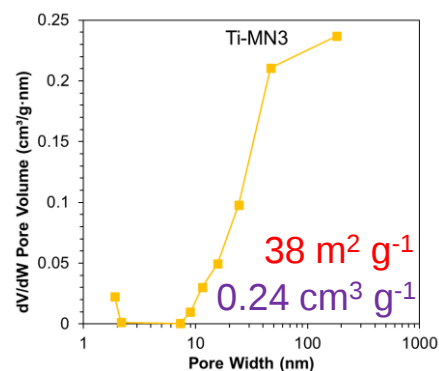
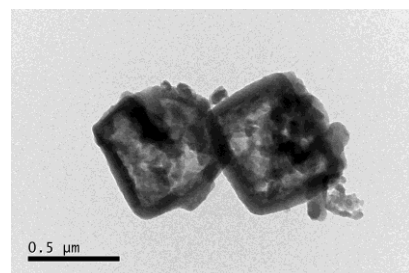


Morphology engineering in severe chemical environment

Ti-MIL-125-NH₂ (titanium 2-amino-1,4-benzenedicarboxylate)



BET surface area
BJH pore volume



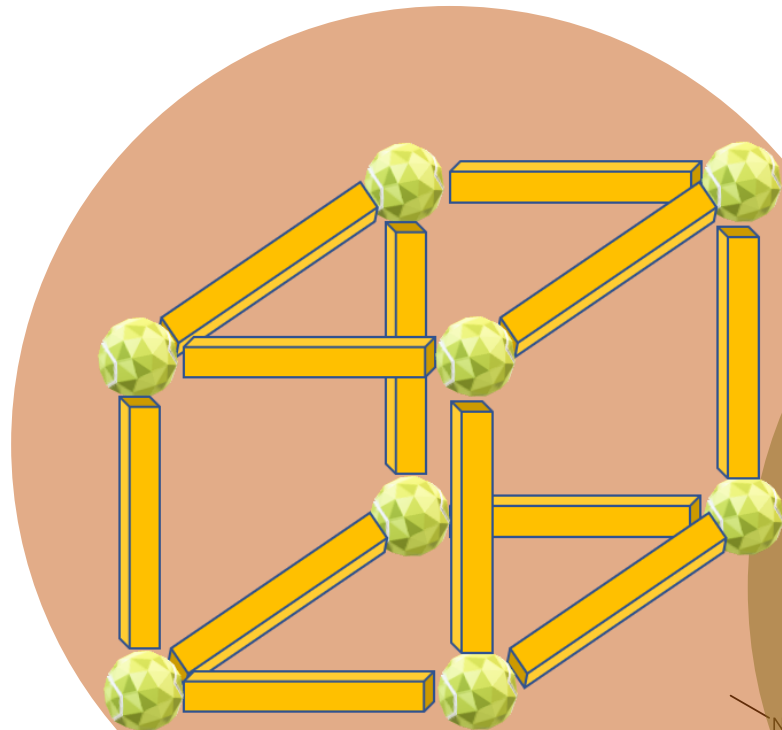
Original

0.4

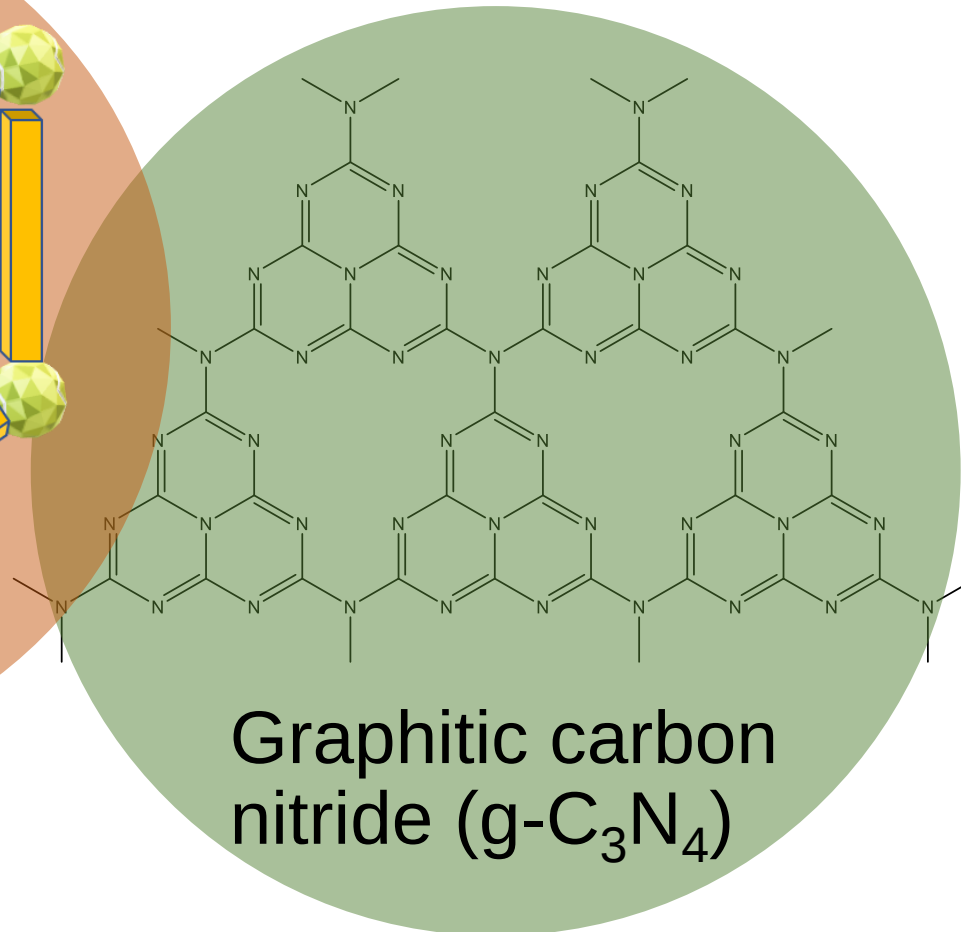
0.8

1 V_{H3PO4}(ml)

Heterostructure engineering for photocatalysis



Metal-organic
framework



Graphitic carbon
nitride ($\text{g-C}_3\text{N}_4$)

Defective
frameworks

Electron-hole
recombination

Heterostructure engineering for photocatalysis

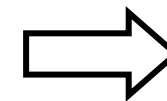


Plastic waste

+

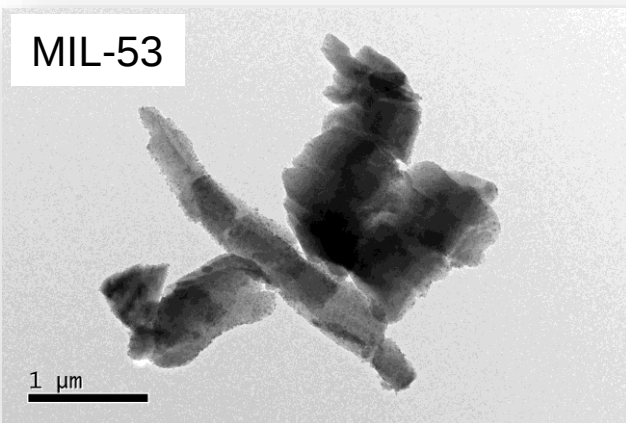


Urea



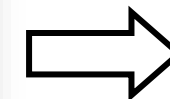
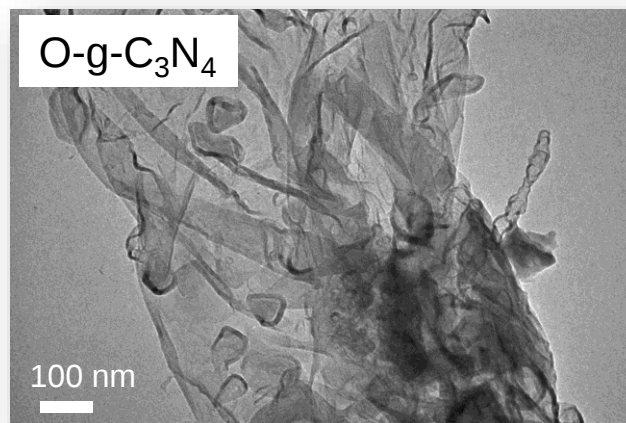
O-g-C₃N₄/MIL-53(Fe)

MIL-53

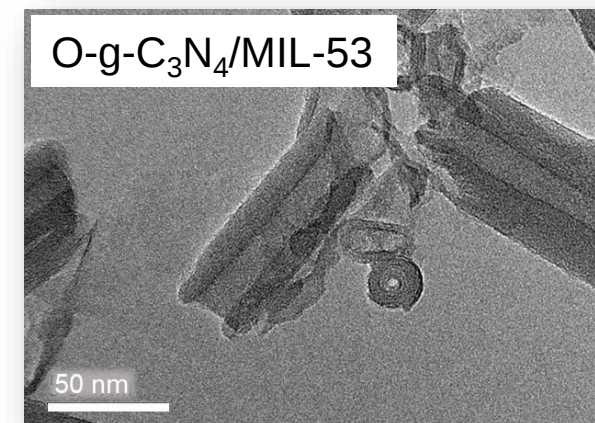


+

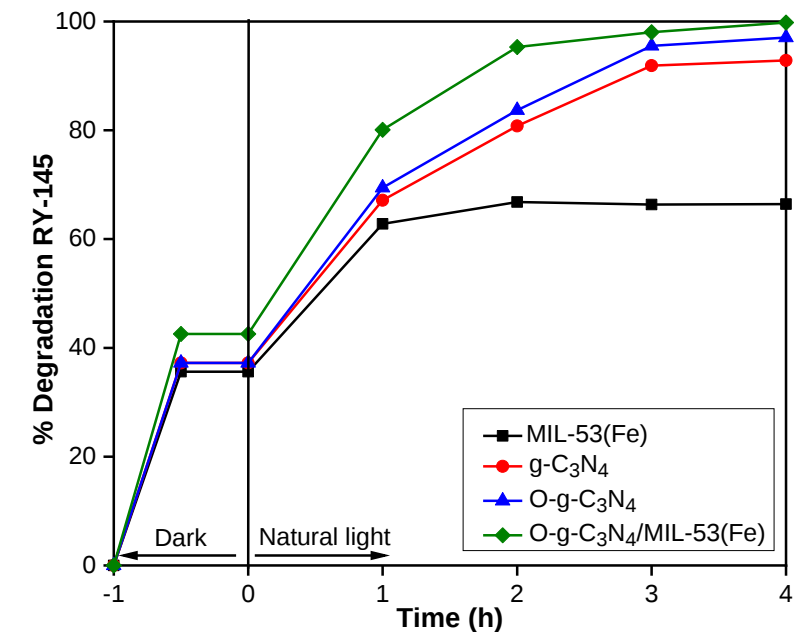
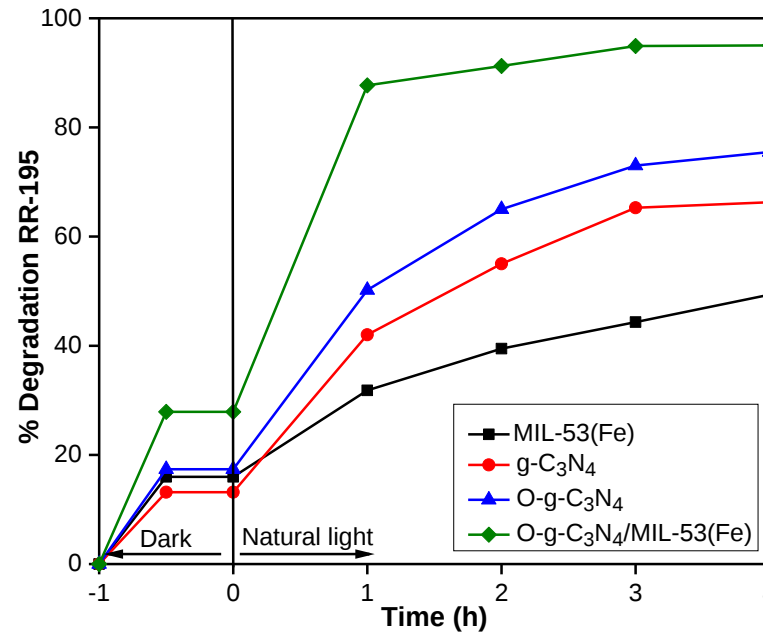
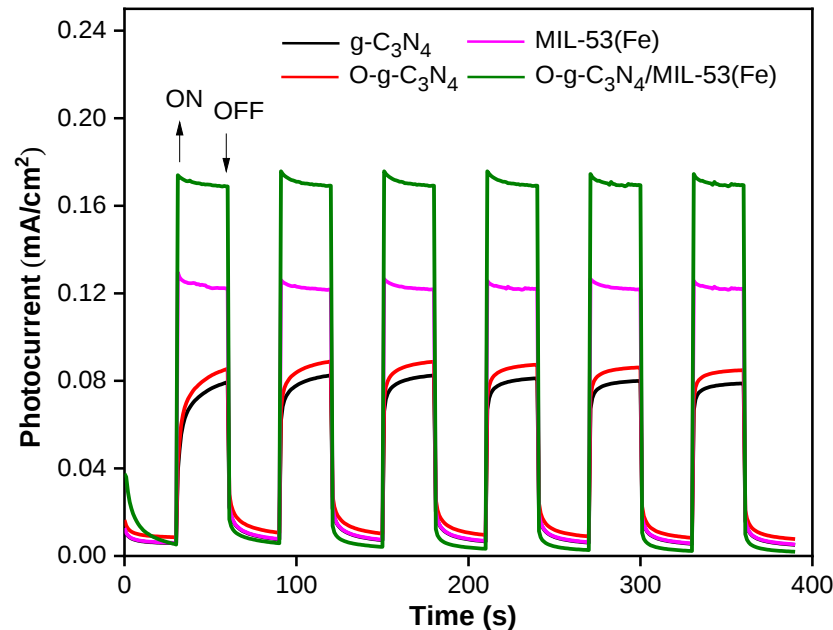
O-g-C₃N₄



O-g-C₃N₄/MIL-53



Heterostructure engineering for photocatalysis



Heterojunction

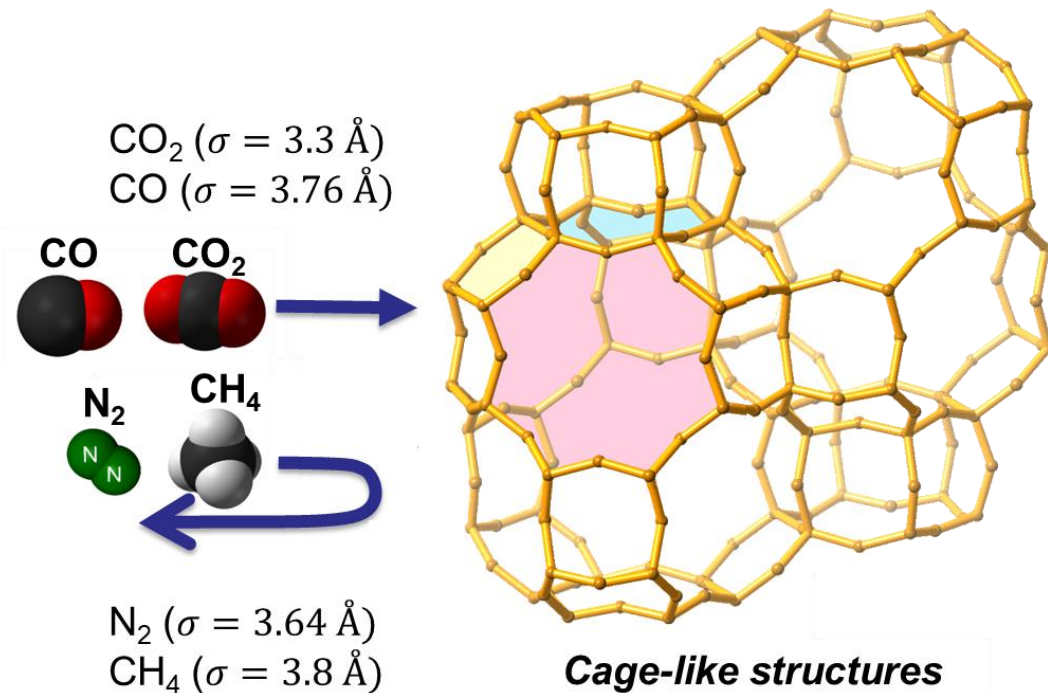
Multi-walled nanotube

Accelerate charge transfer

Shorten charge transport distance

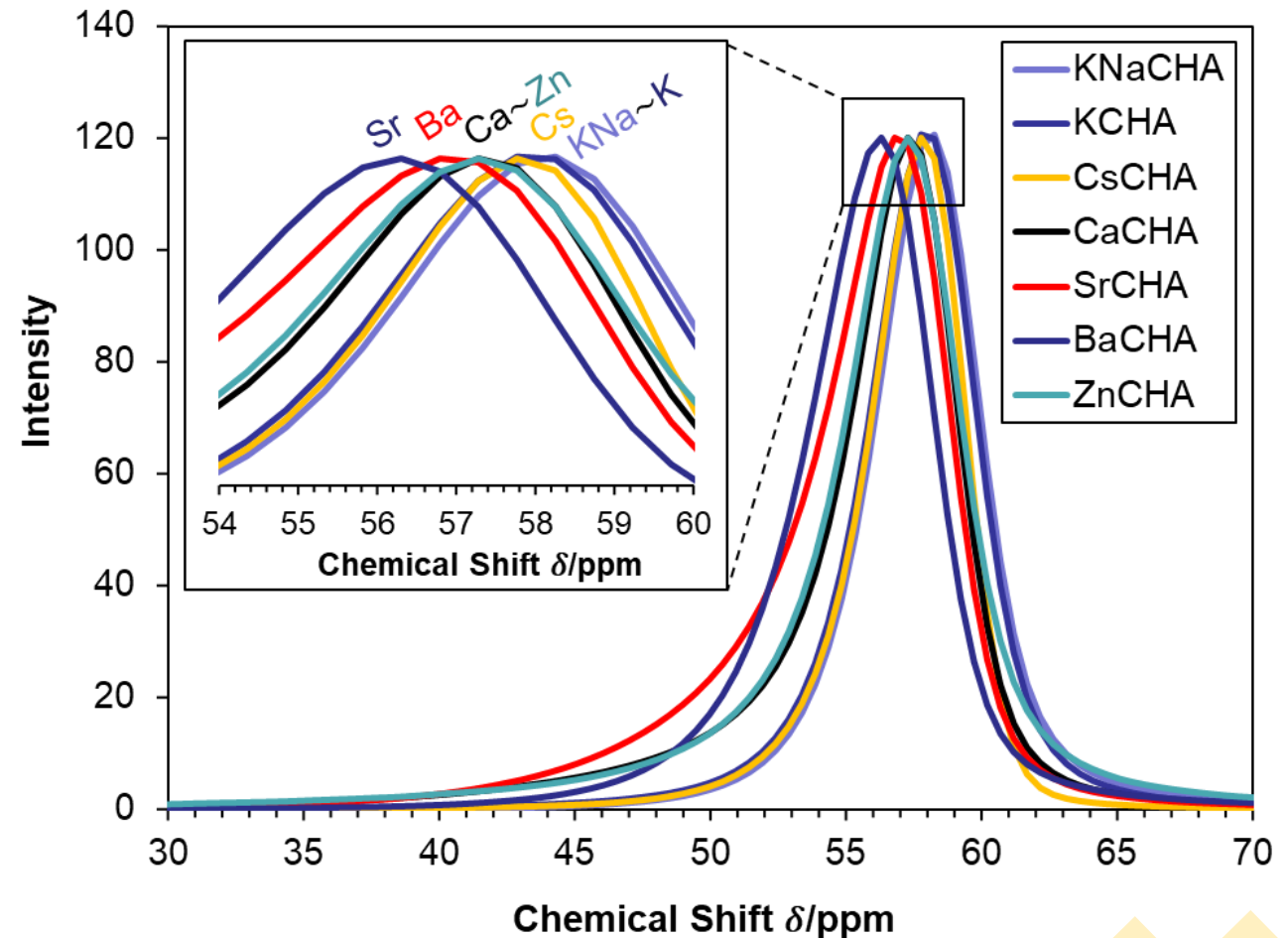
Enhance separation efficiency

Structure engineering for gas separation

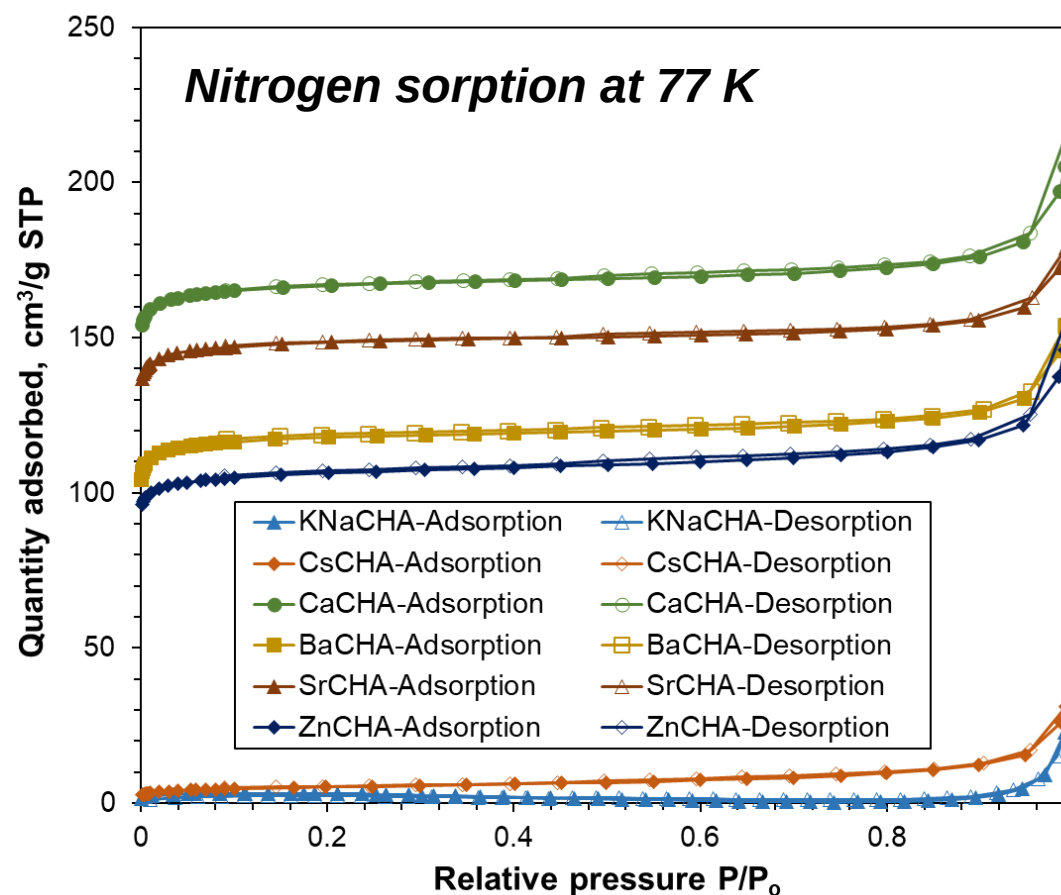
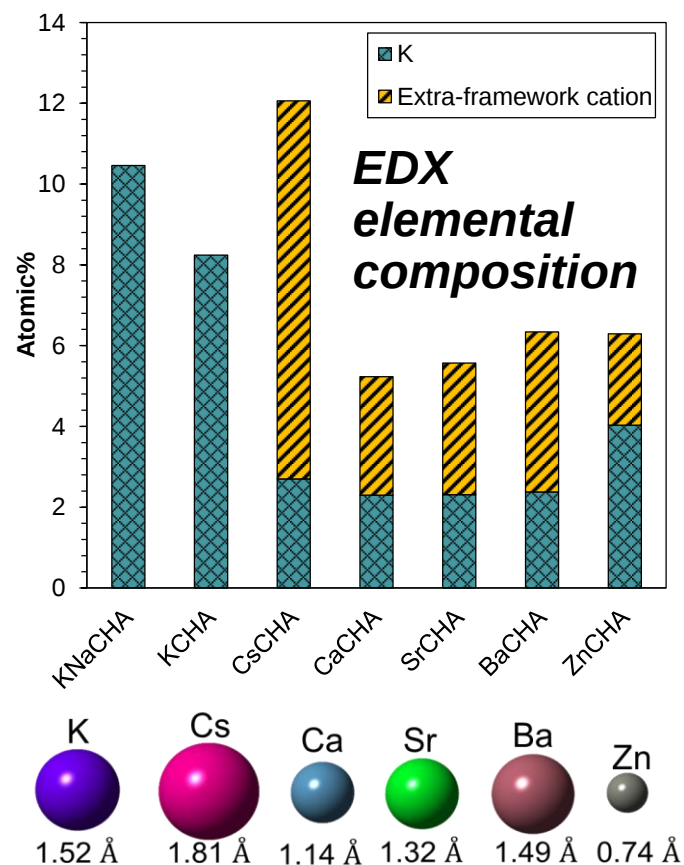


Chabazite and molecular trapdoor mechanism

^{27}Al Solid State NMR



Structure engineering for gas separation



Samples	KNa-CHA	K-CHA	Cs-CHA	Ca-CHA	Ba-CHA	Sr-CHA	Zn-CHA
BET surface area (m² g⁻¹)	7.6 ± 0.9	7.4 ± 0.6	17.4 ± 0.2	529.5 ± 12.0	376.0 ± 8.0	471.4 ± 11.0	337.1 ± 8.0

Acknowledgments

Academic hosts and collaborators



University of
BRISTOL



UNIVERSITY OF
BATH



NANYANG
TECHNOLOGICAL
UNIVERSITY



RMIT
UNIVERSITY



THE UNIVERSITY OF
WESTERN
AUSTRALIA

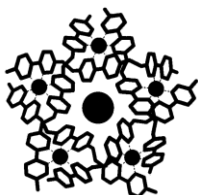
Research grants, Fellowships and Scholarships

EPSRC

Engineering and Physical Sciences
Research Council



Science & Technology
Facilities Council



Directed Assembly Network
BEYOND THE MOLECULE

IOP
Institute of Physics



Sources of accessible funding

From UK:

- UK Engineering and Physical Sciences Research Council (EPSRC): *EPSRC New Investigator*
- UK Natural Environment Research Council (NERC)
- Royal Academy of Engineering (RAEng)
- Royal Society

From EU

- European Research Council: *Starting Grant*

From Vietnam

- British Council: *Newton Fund*
- VinIF
- Nafosted



Idea for collaboration

Sharing facilities and expertise in

- X-ray photoelectron spectroscopy (XPS)
- High-resolution transmission electron microscopy (HR-TEM)
- Solid-state NMR (ssNMR) spectroscopy
- Temperature Programmed Analyses: TPD and TPR (with CO, H₂ and O₂)