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QUEEN'S UNIVERSITY IONIC LIQUID LABORATORIES

QUILL

Literature review

Mark Young
Dr Juan José Villora-Picó
Clare Rice
Emma McCrea
Sanskrita Madhukailya

QUILL meeting 25th -26th March

Gas Separations

How Do Deep Eutectic Solvents Form Porous Liquids? The Example of Methyltriphenylphosphonium Bromide: Glycerol and ZIF-8

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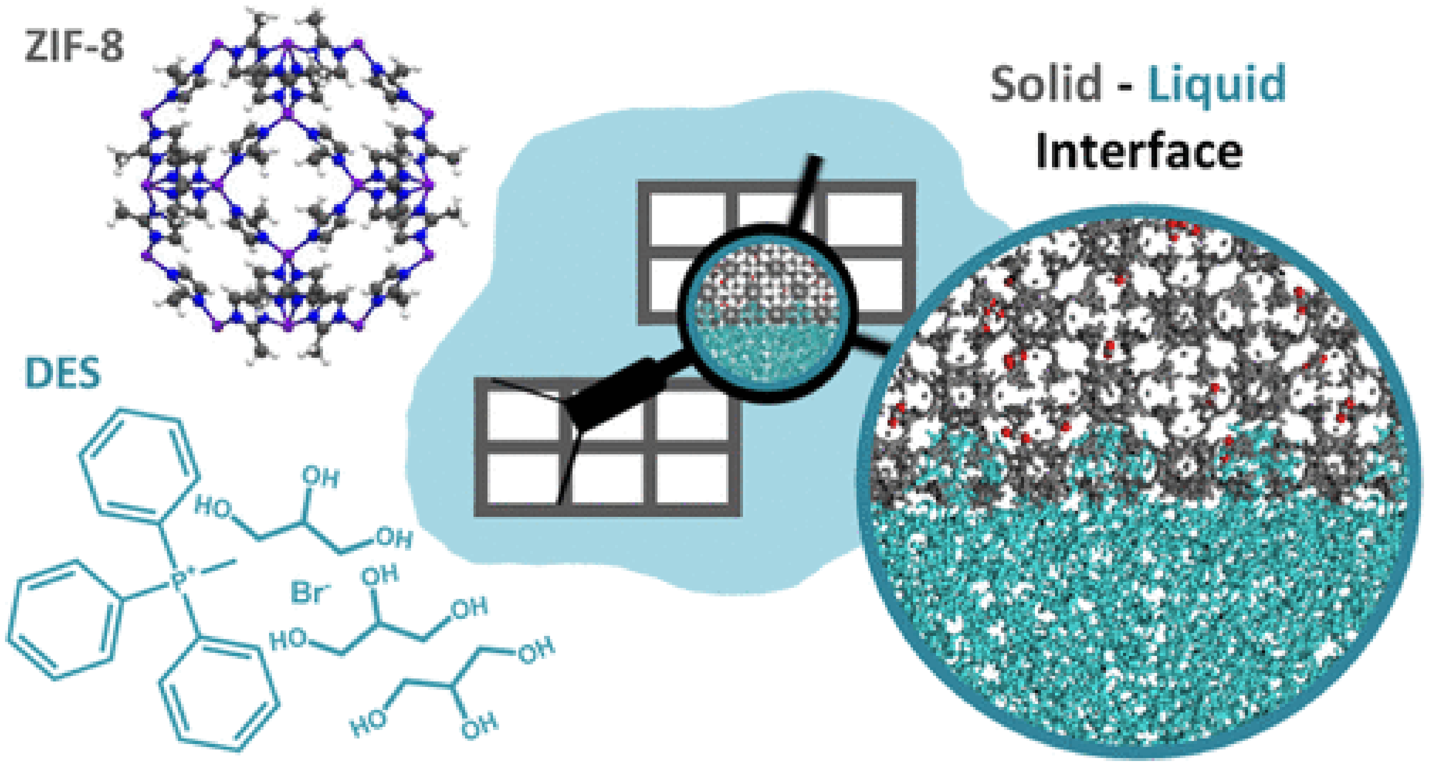
C. Corsini, C. M. Correa, N. Scaglione, M. Costa Gomes,* Agilio Padua**J. Phys. Chem. B,* 2024, **128**, 10, 2481–2489

- Porous liquids formed form dispersions of solids in liquids
- Generally formed from sterically hindered liquids and ionic liquids
- Glycerol "should" penetrate the pores but does not



Porous Ionic Liquids Go Green

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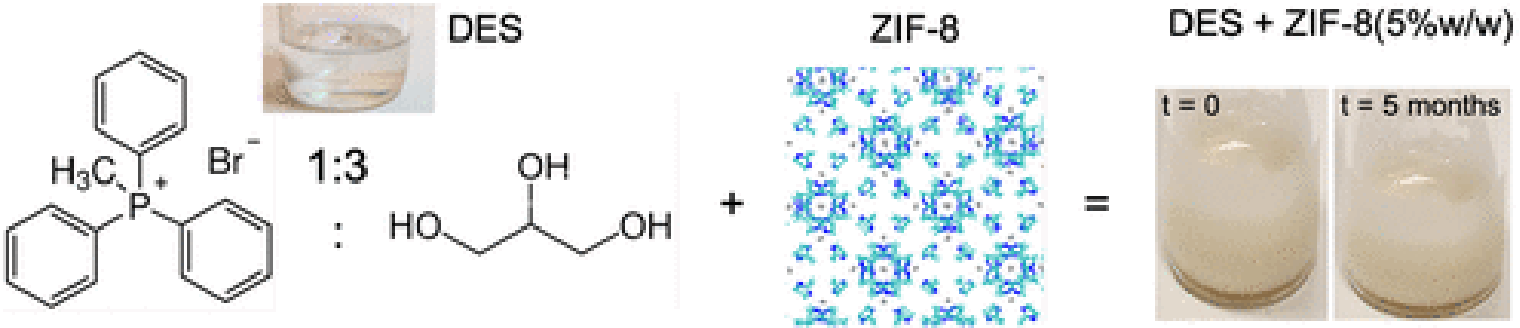
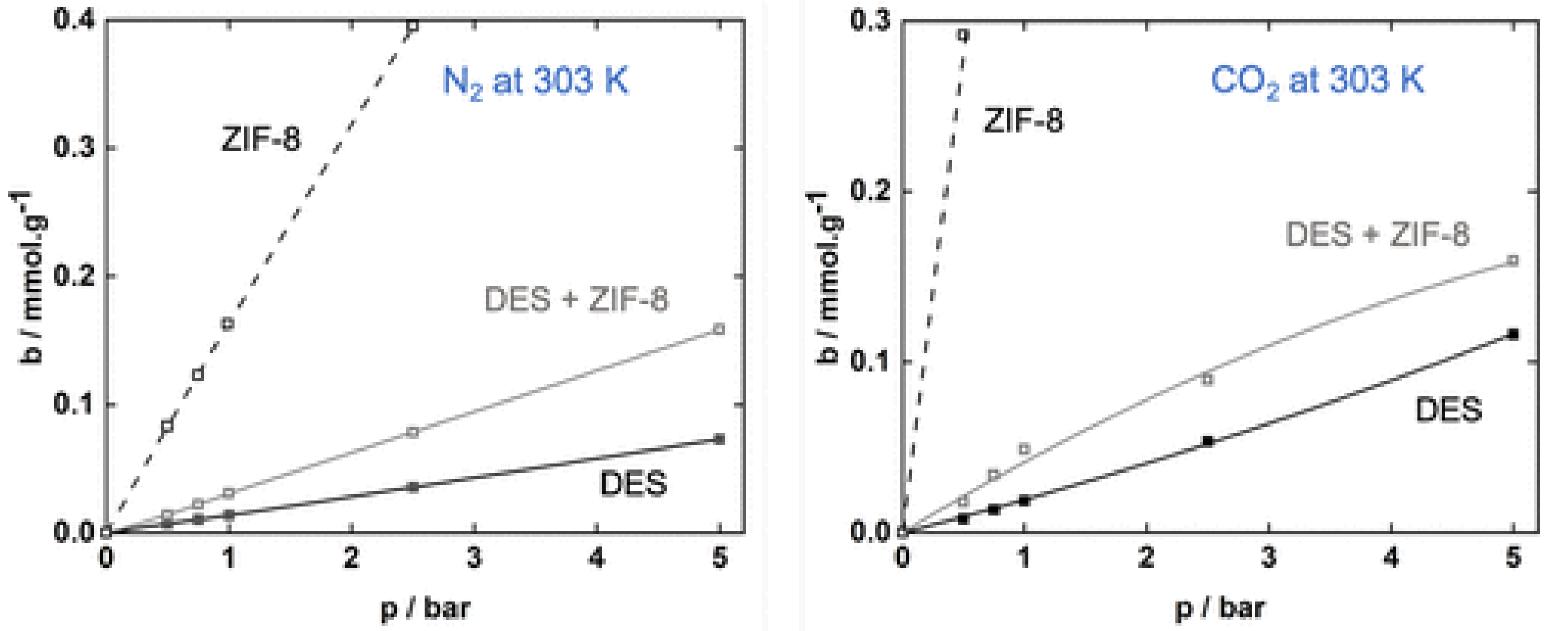
J. Avila, C. Corsini, C. M. Correa, M. Rosenthal, A. Padua, and M. Costa Gomes* *ACS Nano,* 2023**, 17**, 20, 19508–19513

- Stable dispersions of ZIF-8 formed
- Increased CO_2 and N_2 capacity of PL
- Various other application including electrochemistry and biocompatibility





Solvation Environments in Porous Ionic Liquids Determine Selectivity in CO_2 Conversion to Cyclic Carbonates

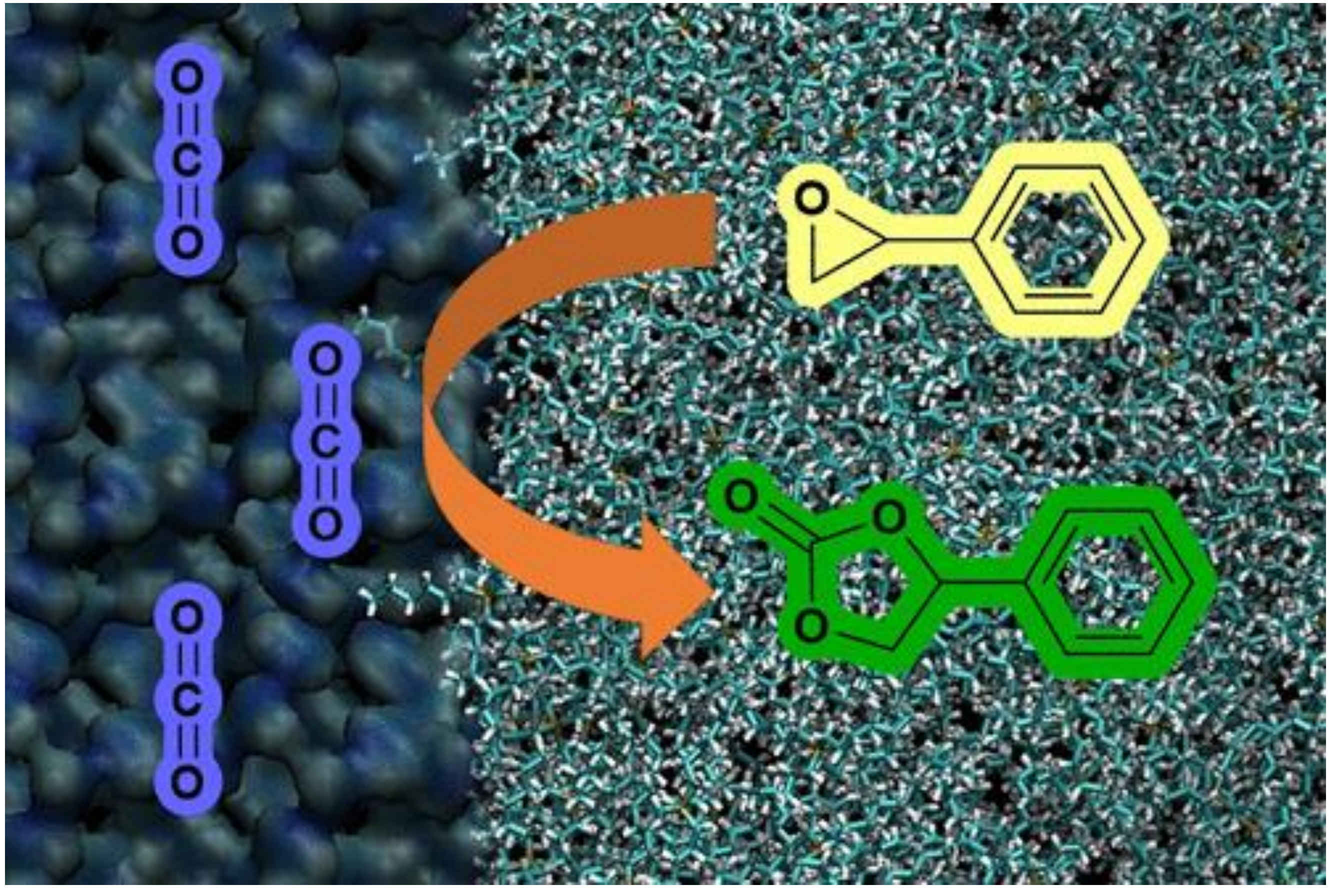
R. Clark J. Ávila M. Costa Gomes, A. A. H. Padua,* *J. Phys. Chem. B,* 2023, **127,** 14, 3266–3277

- Uses MOF as a gas reservoir ensuring good CO_2 supply too reaction

- Concept can be applied to many reactions using gas as a reagent

- ZIF-8 increases selectivity and catalyses reaction

- Has large applicability on a large scale



Low-Temperature Molten Salt Electrochemical CO_2 Upcycling for Advanced Energy Materials

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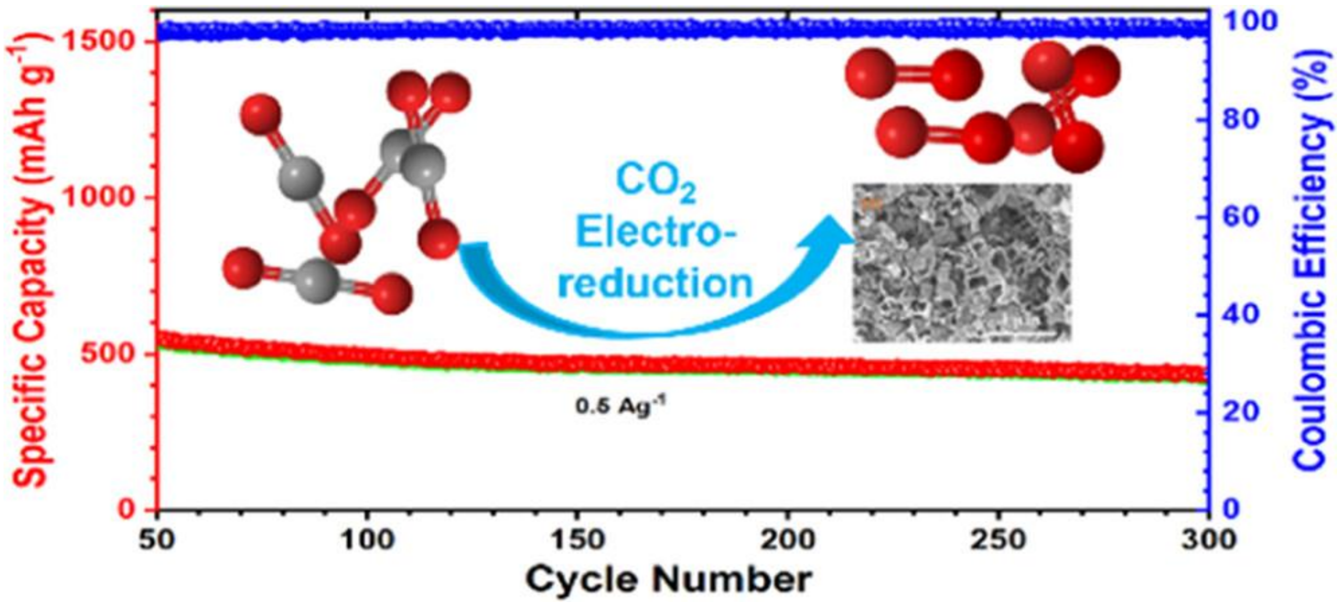
B. P. Thapaliya*, A. S. Ivanov, H. Chao, M. Lamm, H. M. Meyer III, M. Chi, X. Sun, T.Aytug, S. Dai*,S. M. Mahurin*
ACS Appl. Mater. Interfaces 2024, **16**, 2, 2251–2262

- Reduction of CO_2 to porous carbon
- Li_2CO_3–Na_2CO_3–K_2CO_3 eutectic mixture
- Uses molten salts at temperature as low at 450°C
- High coulombic efficiency



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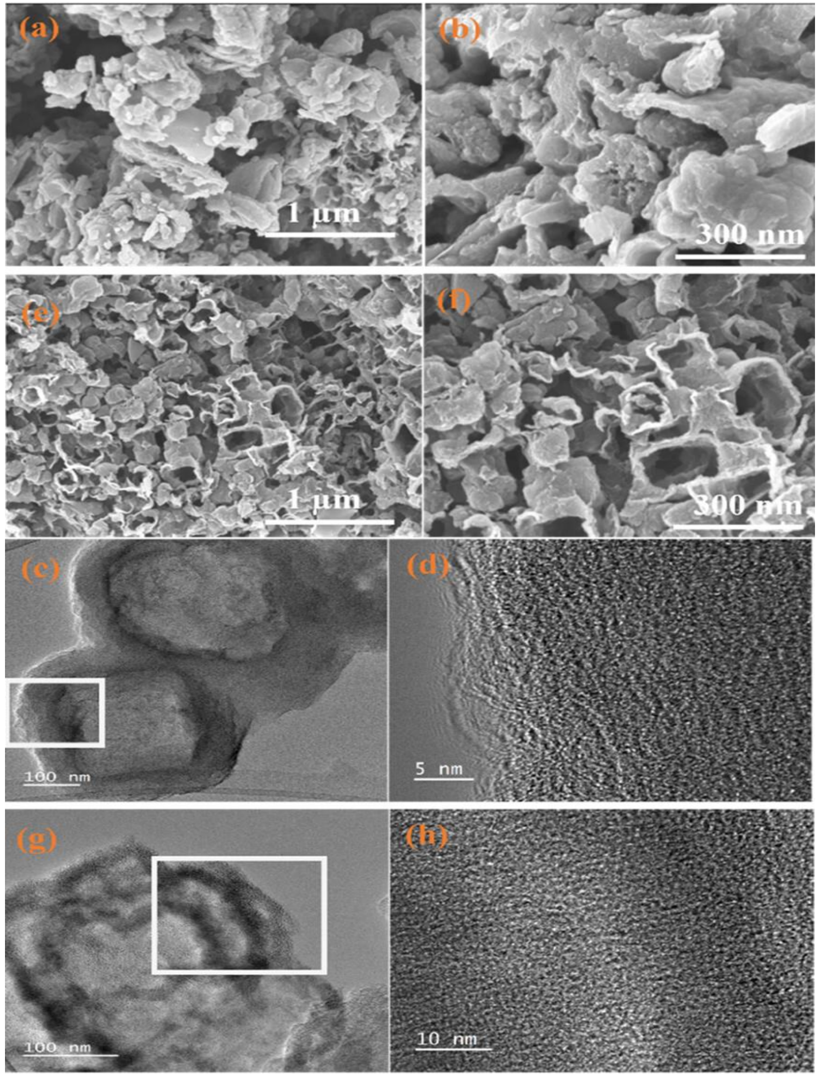
ACS Appl. Mater. Interfaces 2024, **16**, 2, 2251–2262

- Synthesised carbons have various architectures

- High BET surface areas up to 608 m^2/g

- Both amorphous and crystalline regions for Li^+ intercalation

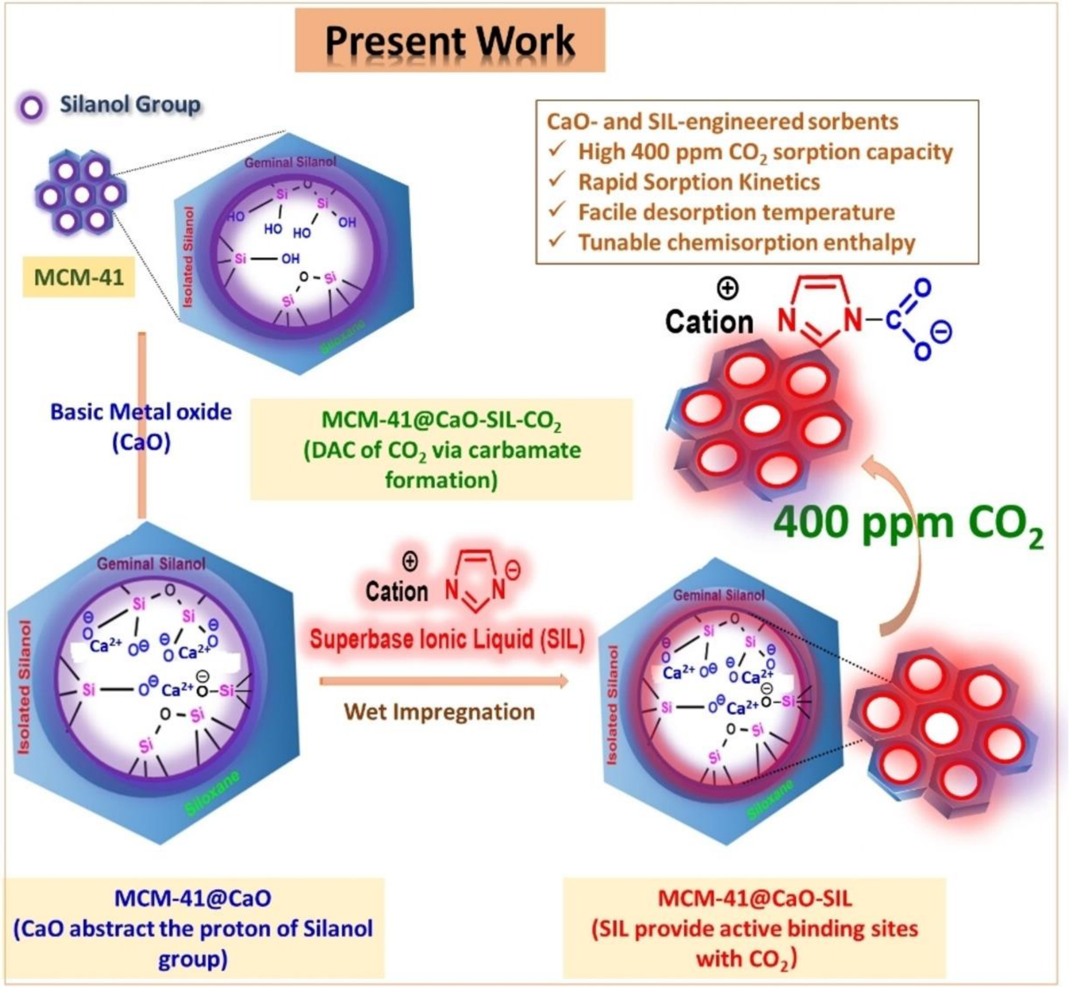
- Carbons had tuneable electrochemical properties



High-Performance CO_2 Capture from Air by Harnessing the Power of CaO- and Superbase-Ionic-Liquid-Engineered Sorbents

D. Moitra, N. Mokhtari-Nori, K. M. Siniard, L. Qiu, J. Fan, Z. Dong, W. Hu, H. Liu, De-en Jiang, H. Lin, J. Hu, M. Li, Z. Yang, S. Dai, *ChemSusChem,* 2023,**16,** e2023008

- Hybrid material for direct air capture
- High surface area and fast reaction kinetics
- Can strip CO_2 at low P_{CO2}(400 ppm)
- Reactive imidazole IL used for chemical sorption



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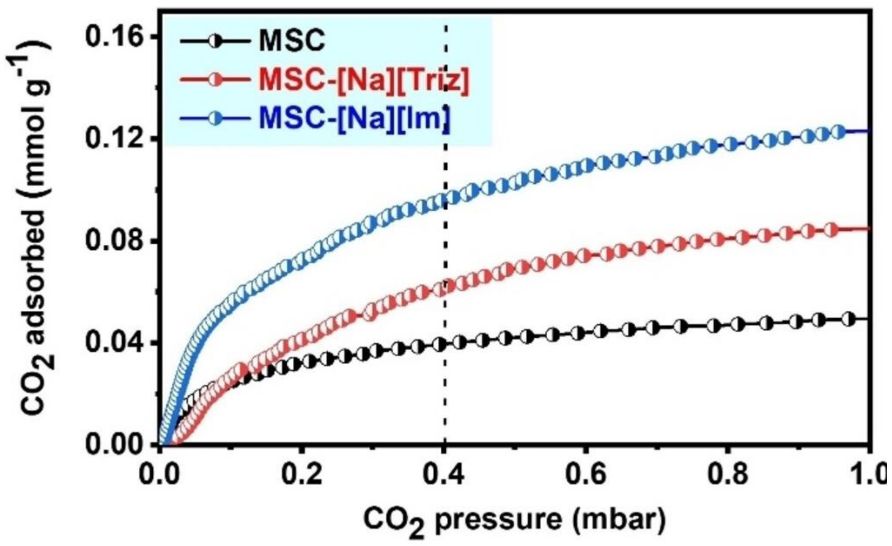
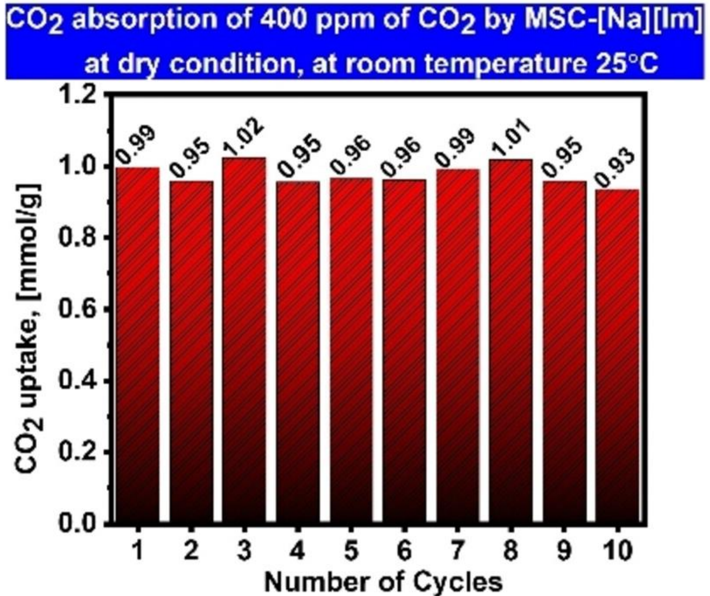
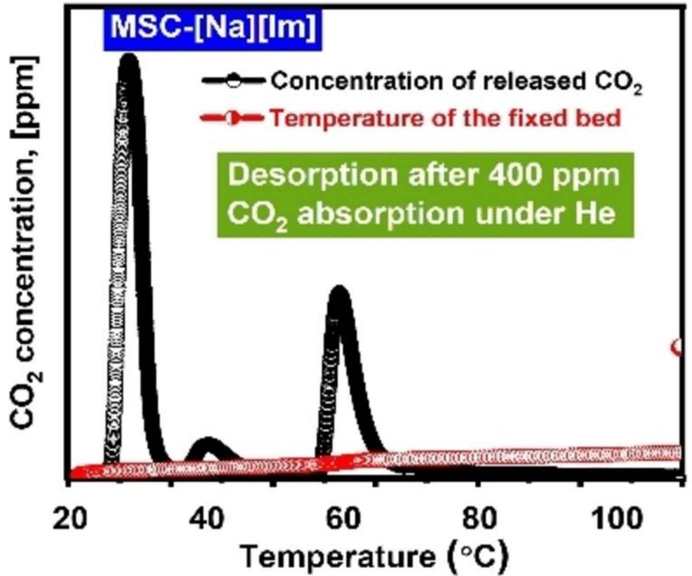
- Low temperature complete regeneration (70 ^{o}C)
- 3 step desorption (Adsorbed, CaO, Imidazolate)
- Gas sorption is more than doubled by addition of IL in MSC







Surpassing the Performance of Phenolate-derived Ionic Liquids in CO_2 Chemisorption by Harnessing the Robust Nature of Pyrazolonates

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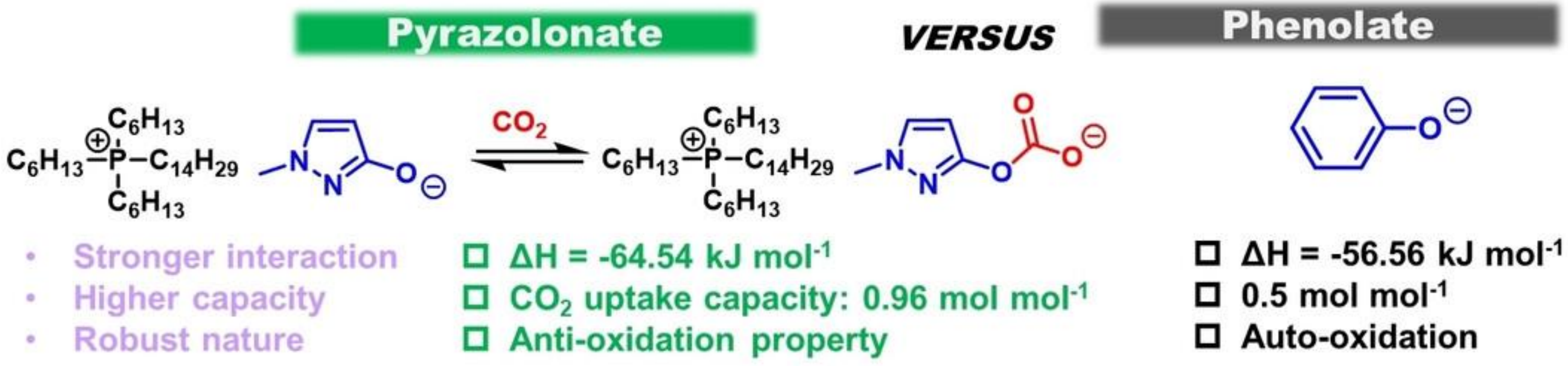
L. Qiu, Y Fu, Z. Yang, A. C. Johnson, C. Do-Thanh, B. P. Thapaliya, S. M. Mahurin, L. He, De-en Jiang, S. Dai
ChemSusChem, 2023, e202301329

- New chemical sorption system for CO_2 capture
- Pyrazanolate replaces phenolate as anion
- Higher mole fraction uptake capacity
- No auto oxidation to quinones (problem with phenolate) or Ylide formation



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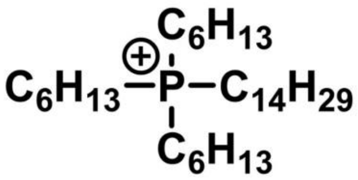
L. Qiu, Y Fu, Z. Yang, A. C. Johnson, C. Do-Thanh, B. P. Thapaliya, S. M. Mahurin, L. He, De-en Jiang, S. Dai, *ChemSusChem,* 2023, e202301329

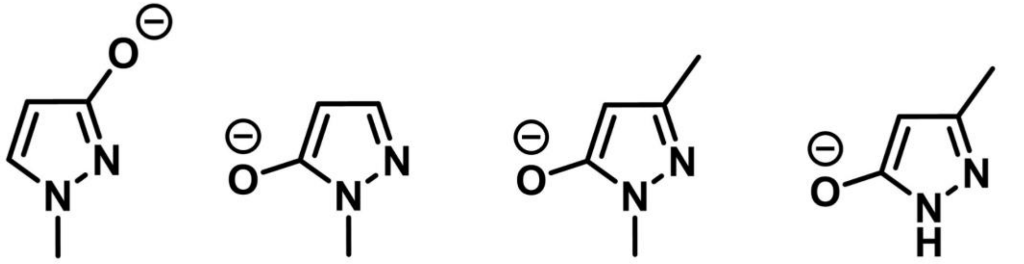
- Capacity greatly influenced by anion structure
- Can be fully regenerated over 10 times (60 °C)
- More negative ΔG for pyrazolate than phenolate

Cation

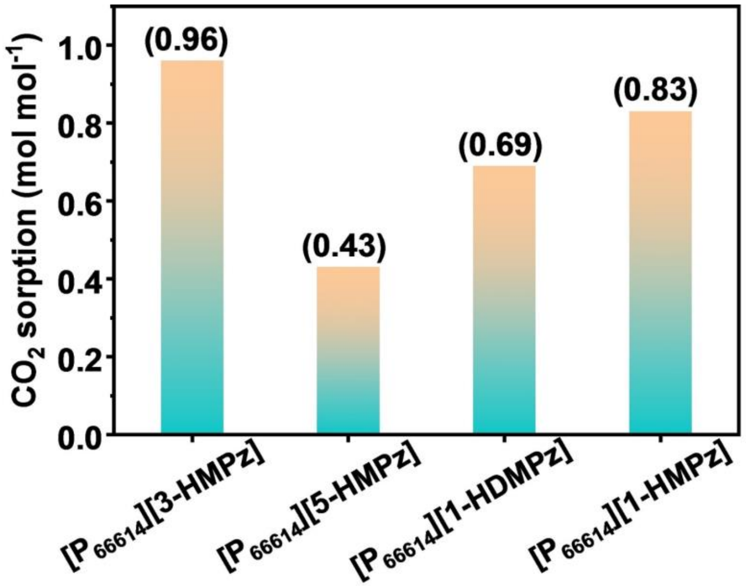


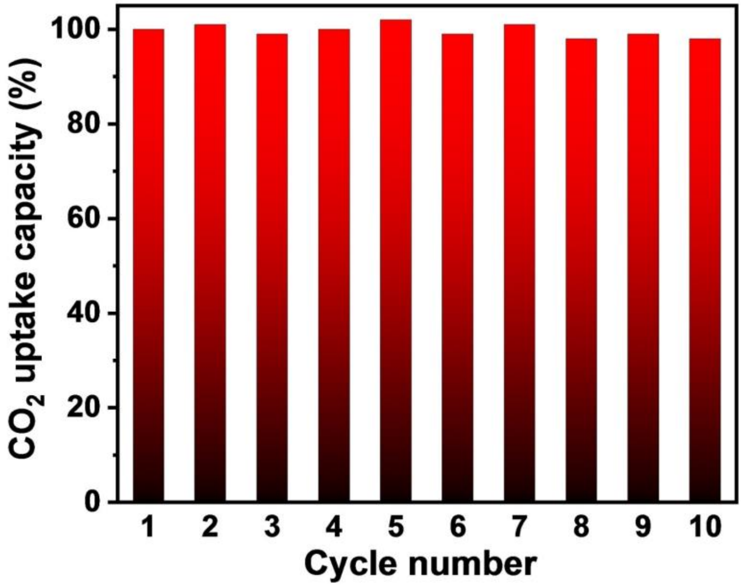
$[P_{66614}]$

Anion



[3-HMPz] [5-HMPz] [1-HDMPz] [1-HMPz]





Exploring the Effect of Different Anions and Cations on the Solubility of CO_2 in Nitrile Imidazolium-Based Ionic Liquids with Sulfonated-Based Anions

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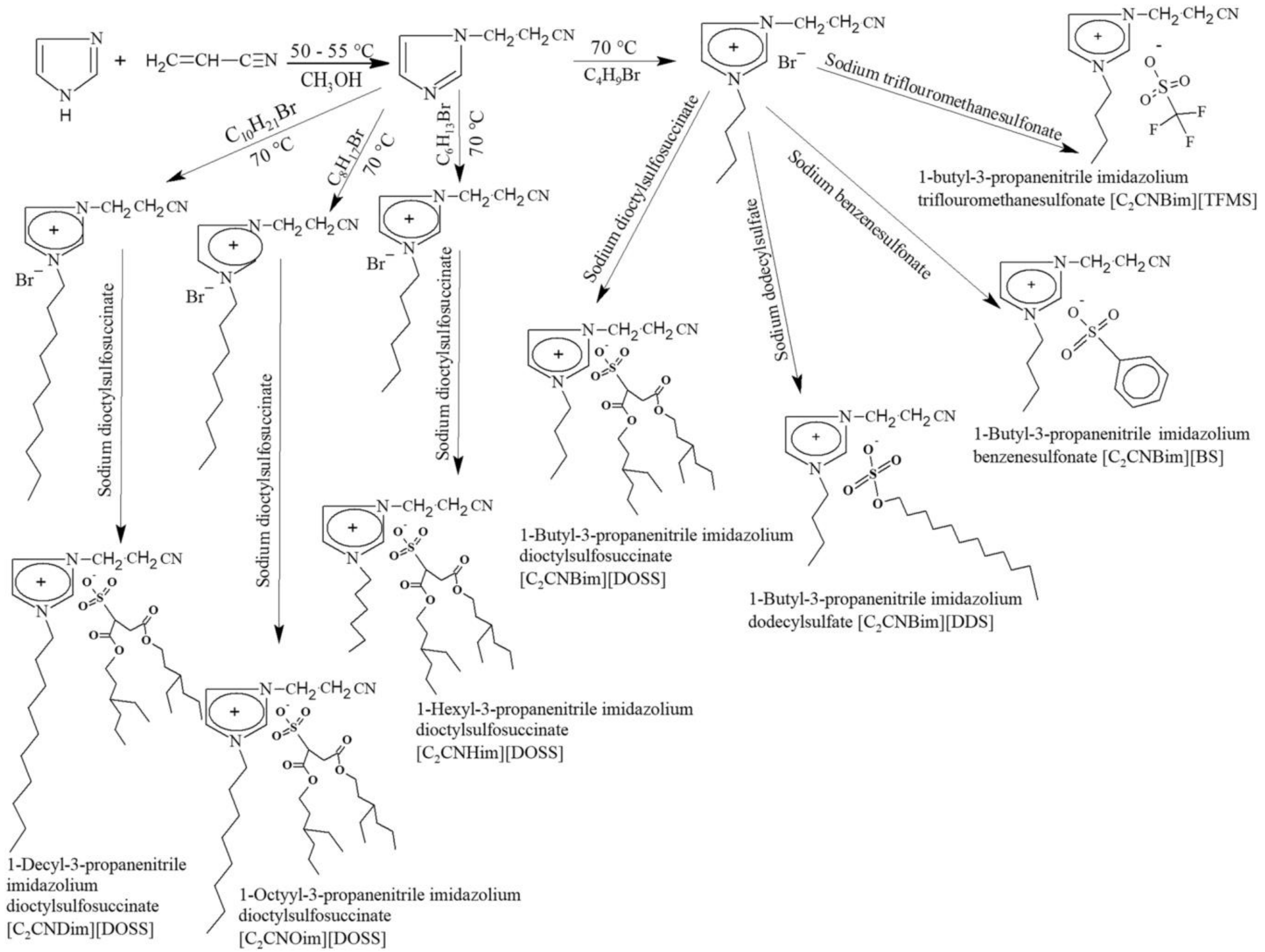
A. K. Ziyada, A. Osman, A. A. Elbashir, A. M. Khan, C. D. Wilfred, *J. Chem. Eng.* 2024

- Systematically studied structure relation to CO_2 capacity
- Experiments carried out using gravimetric apparatus
- Temperature effects on CO_2 solubility studied between 298-358 K



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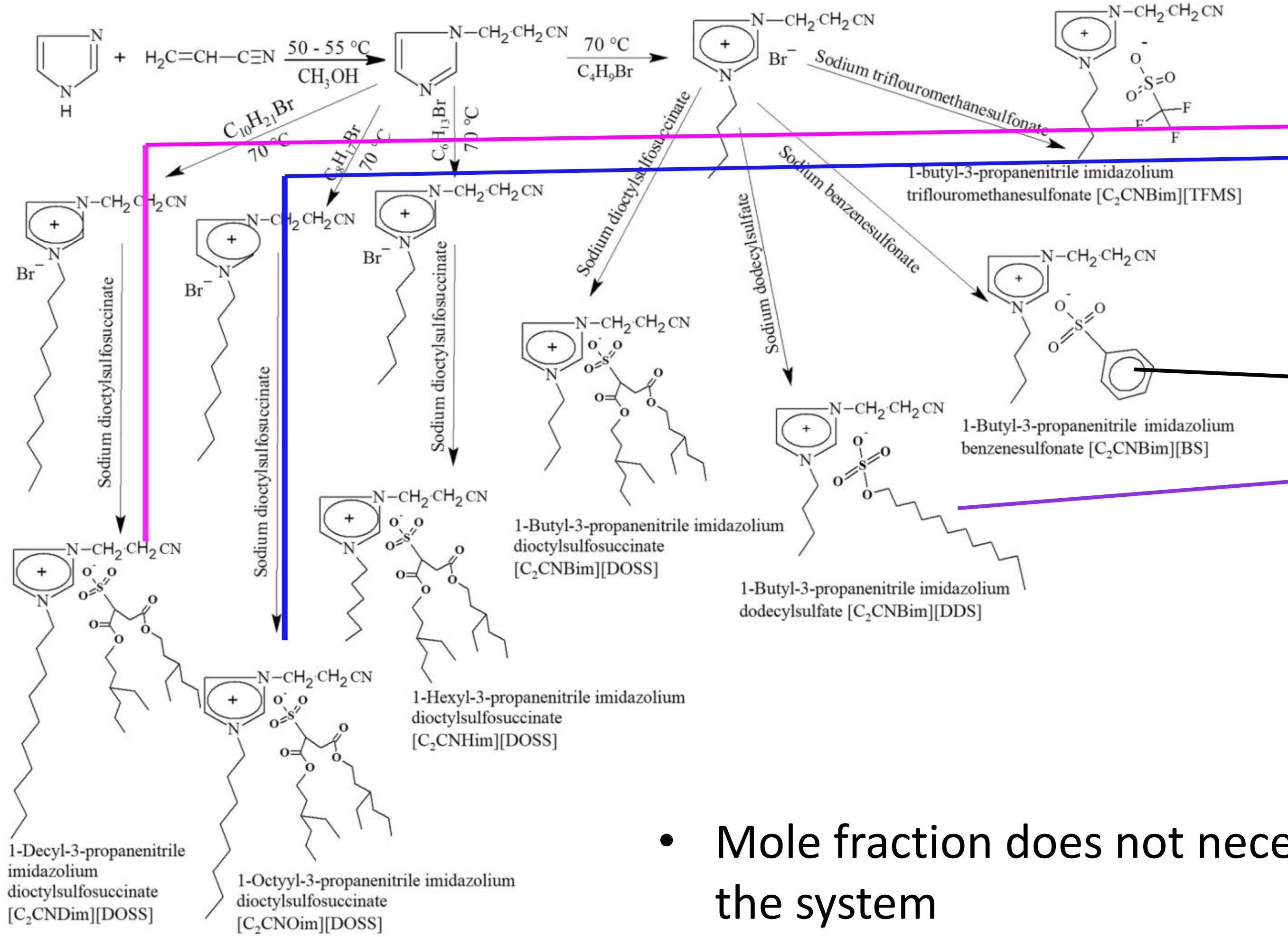
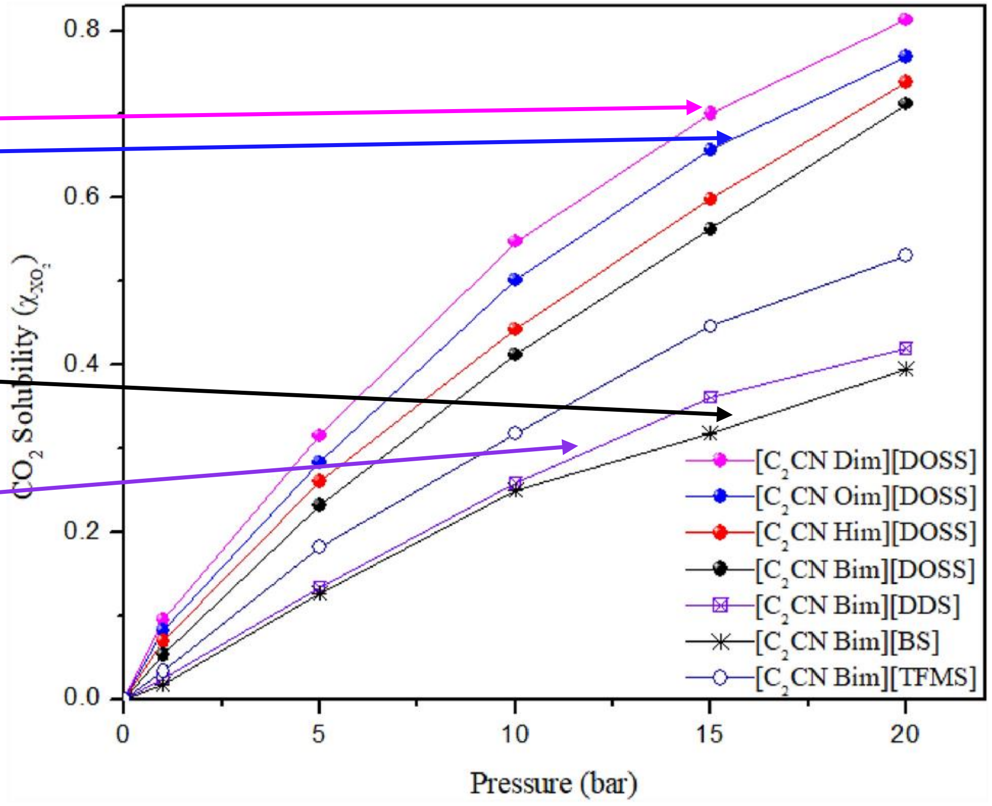




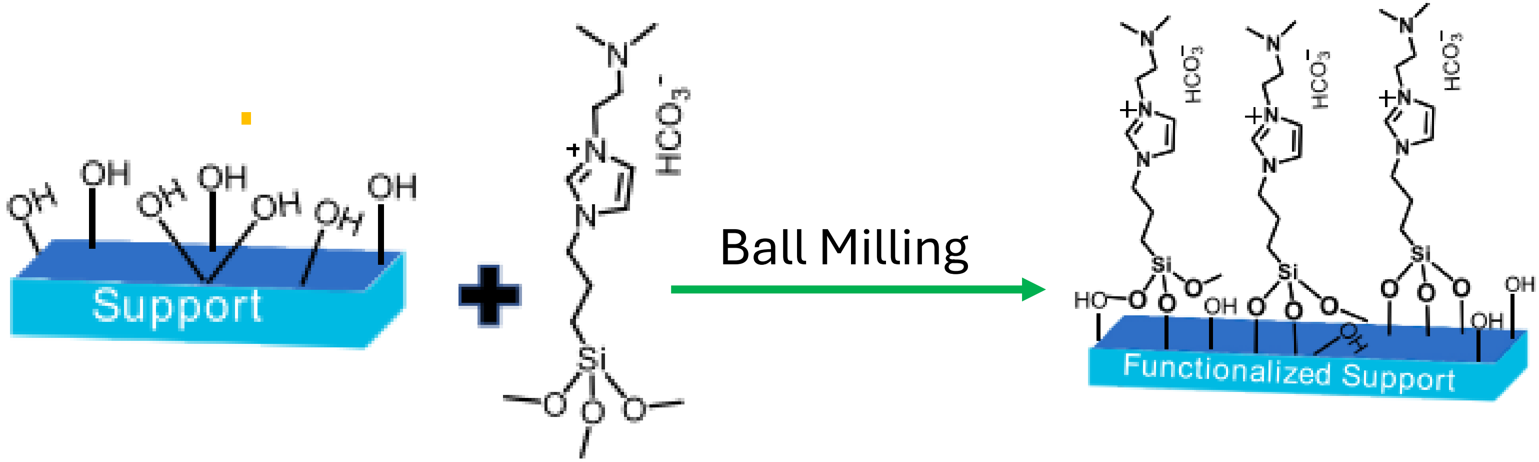
- Mole fraction does not necessarily equate to performance of the system

Heterogeneous Catalysis

One-pot synthesis of cyclic carbonates from olefins and CO_2 catalyzed by silica-supported imidazolium hydrogen carbonate ionic liquids

Zhao, T.; Long, G.; Liang, H.; Xiong, W.; Hu, X. *Microporous and Mesoporous Materials*, 2023, ***356***, 112576

4 catalysts

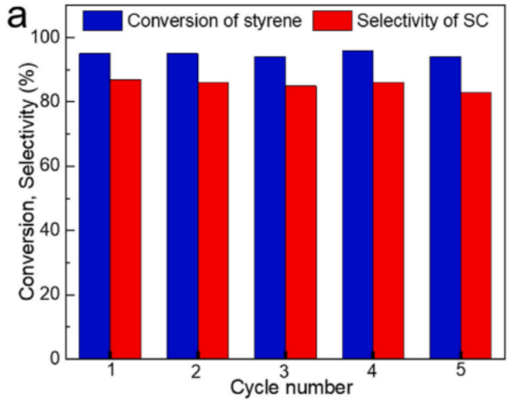


Silica **Imidazolium hydrogen carbonate IL**

$[Im][HCO_3]@SBA-15$

Catalytic results

	Catalyst	Con. (%)	Sel.(%) SC	SO	BA	Yield of SC (%)[a]	
1	None	13	0	45	55	0	
2	$[Im][HCO_3]@SBA-15$	78	72	10	7	56	
3	$NH_2-[Im][HCO_3]@SBA-15$	72	74	12	6	53	
4	$N(CH_3)_2-[Im][HCO_3]@SBA-15$	80	75	11	10	60	100 mg cat.
5	$N(Et)_2-[Im][HCO_3]@SBA-15$	70	76	8	12	53	
6[b]	$N(CH_3)_2-[Im][HCO_3]@SBA-15$	50	36	55	9	18	50 mg cat.
7[c]		92	77	6	9	70	150 mg cat.
8[d]		9	19	0	0	1.7	H_2O_2
9[e]		99	73	16	11	72	THBP
10[c,e]		98	80	6	9	78	
11[f]	$N(CH_3)_2-[Im][HCO_3]$	88	78	13	7	69	
12[j]	SBA-15	15	0	3	97	0	



Good recyclability

Post-synthetic modification of Zr-MOFs using guanidine for cyclic carbonate formation catalysis

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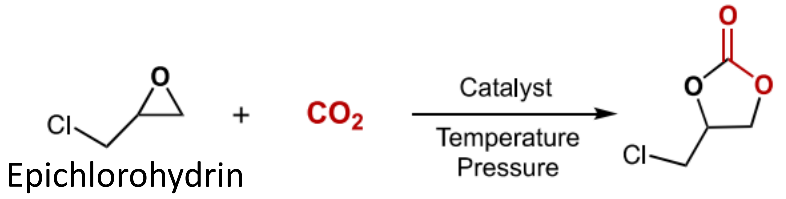
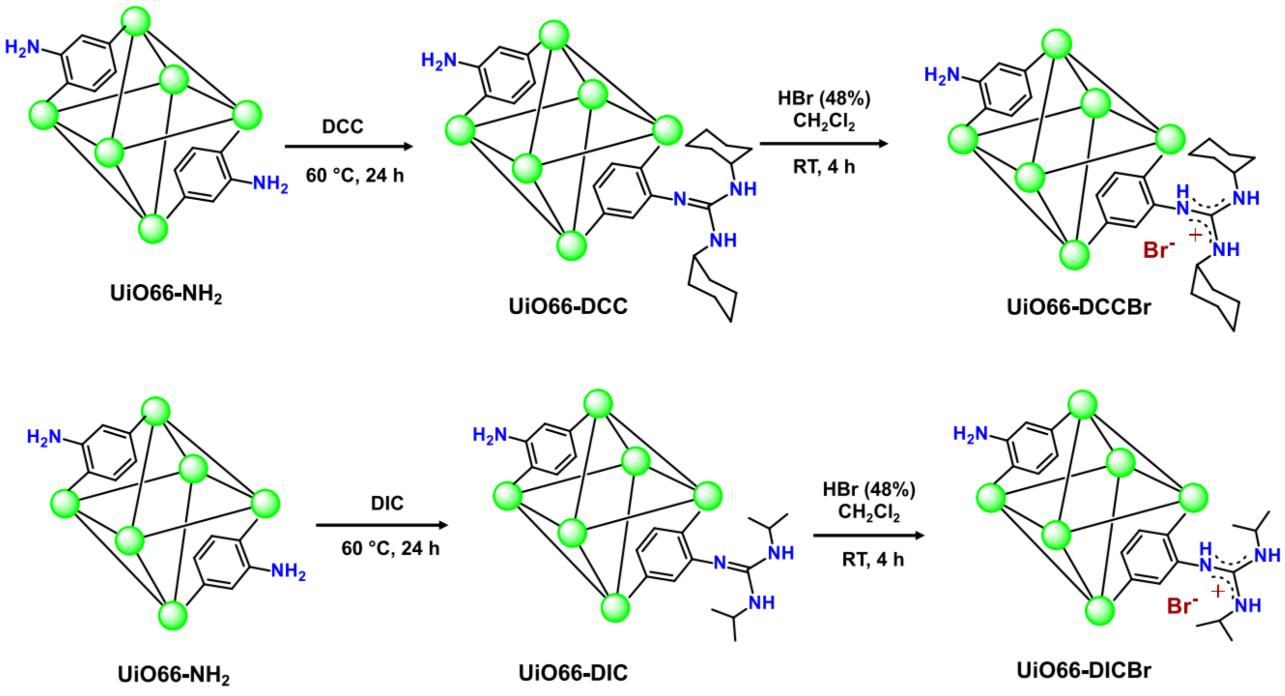
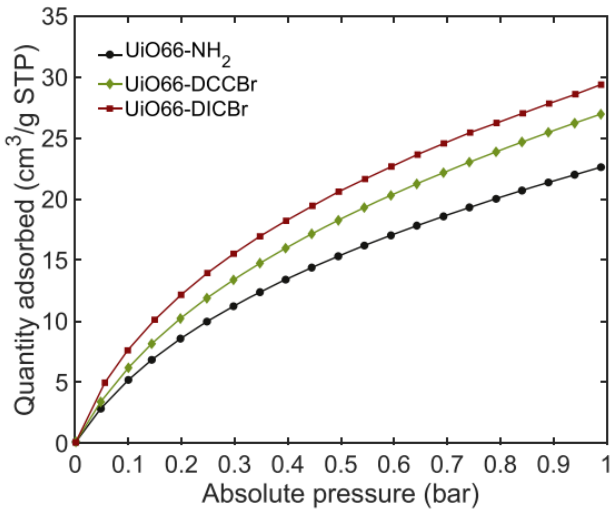
Nataj, S. M. M.; Kaliaguine, S.; Fontaine, F-G. *Catalysis Today*, 2023, ***422***, 114216





CO$_2$ adsorption isotherms 298K

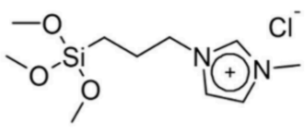


- The grafted materials show better CO_2 adsorption properties

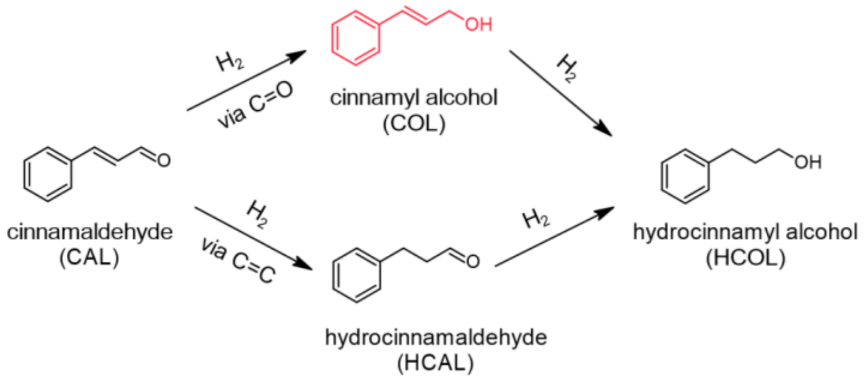
Entry	Catalyst	P (MPa)	T (°C)	time (h)	Yield (%)[c]
1	$ZrCl_4$	1.0	100	24	trace
2	UiO66-NH$_2$	1.0	100	24	12
3	UiO66-DCC	1.0	100	24	-
4	UiO66-DIC	1.0	100	24	-
5	UiO66-DCCBr	1.0	80	24	76
6	UiO66-DICBr	1.0	80	24	88
7	UiO66-DCCBr	1.0	90	24	96
8	UiO66-DICBr	1.0	90	24	> 99
9	UiO66-DCCBr	0.5	80	24	71
10	UiO66-DICBr	0.5	80	24	75
11	UiO66-DCCBr	0.5	90	16	95
12	UiO66-DICBr	0.5	90	16	> 99

Highly active Pt-Co bimetallic nanoparticles on ionic liquid-modified SBA-15 for solvent-free selective hydrogenation of cinnamaldehyde

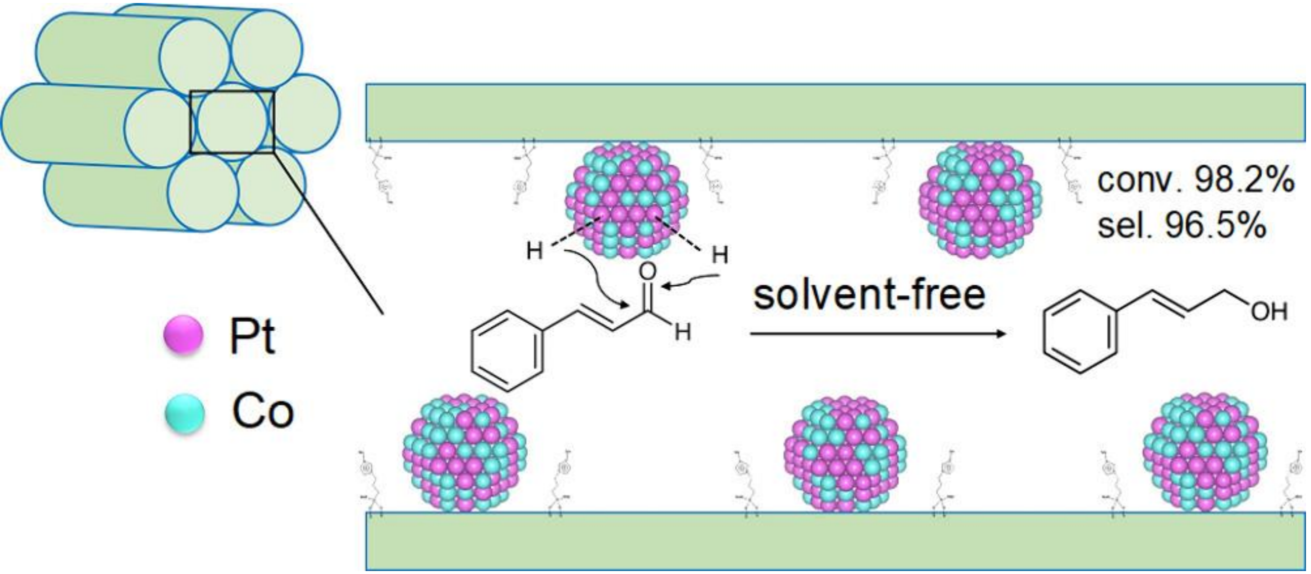
Kusumawati, E. T.; Sasaki, T.; Shirai, M. *ACS Appl. Nano Mater.* 2023, **6**, 17913-17923



1-methyl-3-(3-trimethoxysilylpropyl)-imidazolium chloride



	particle size (nm)	
	XRD	TEM
2Pt–2Co/IL@SBA-15	1.7	2.4
2Pt–2Co/SBA-15	5.5	6.2

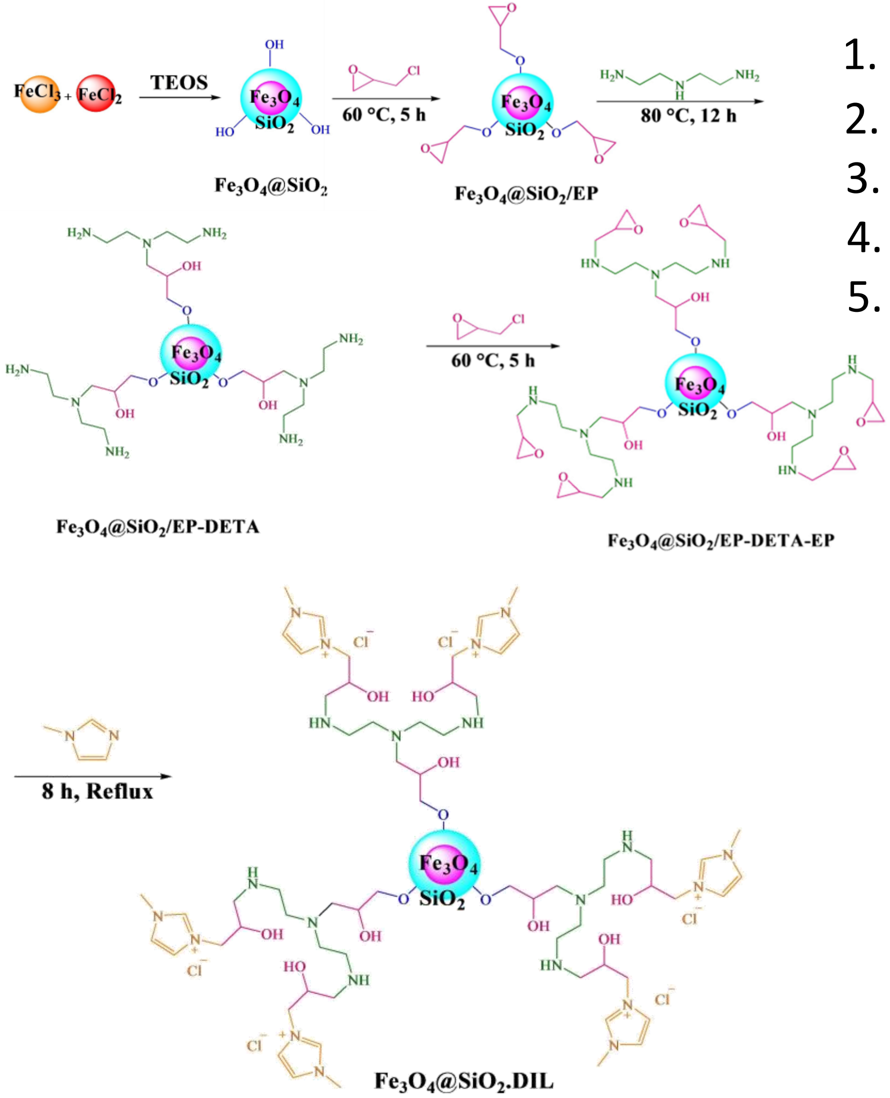


entry	catalyst	CAL conv. (%)	products sel. (%) COL	HCAL	HCOL
1	2Pt–2Co/IL@SBA-15	97.1	96.2	0	3.8
2	2Pt/IL@SBA-15 (A)	3.1	19.9	80.1	0
3	2Co/IL@SBA-15 (B)	trace	—	—	—
4	a mix of A and B	7.9	73.3	19.6	7.2
5	IL@SBA-15	trace	—	—	—
6	2Pt–2Co/SBA-15	20.7	97.9	2.1	0
7	2Pt–2Co/C	73.3	95.2	2.2	2.6

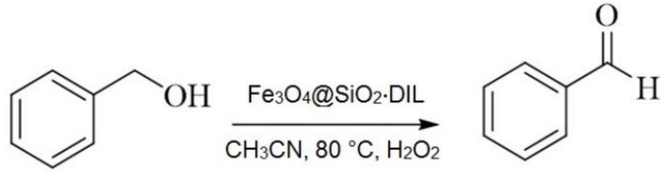
[a]Reaction condition: CAL 2 mmol, catalyst 20 mg, H_2 5 MPa, 50 °C, 6 h.

Preparation of dicationic ionic liquid immobilized on Fe_3O_4@SiO_2 and evaluation of its catalytic efficiency in the oxidation of alcohols

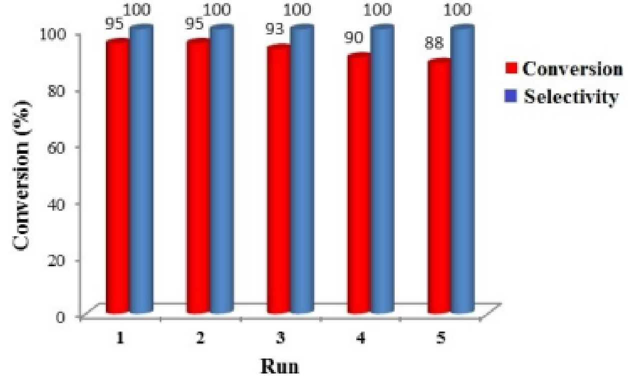
Ebadi, A.; Vadie, S.; Shojaei, S. *Chemistry Select,* 2023, ***8***, 1-8



1. Synthesis of the magnetic NPs
2. Addition of epichlorohydrin as a spacer
3. DETA grafted on the surface
4. Addition of epichlorohydrin
5. Preparation of Fe_3O_4@SiO_2·DIL



Reaction Condition	Time (h)	Conversion (%)	Selectivity of benzaldehyde (%)	Ref
Triple-shell hollow $CuNiFe_2O_4$ spheres, H_2O, 80 °C, H_2O_2	4	98	100	36
MnO_x/HAP-10, toluene, 80 °C, O_2	2	48	97	40
2 %V_2O_5/STO, acetonitrile, 80 °C, TBHP	3	70	88	41
5 %Co_3O_4/HCS_x, DMF, 110 °C, O_2	8	50	63	42
Pd/Co)OH)$_2$, Solvent-free, 160 °C, O_2	4	33	80	43
Au/TiO_2, Solvent-free, 80 °C, TBHP, MW irradiation	1	69.3	99.1	44
$La_{0.9}Ce_{0.1}CoO_3$, toluene, 88 °C, O_2	1	95	95	45
Fe_3O_4@SiO_2-DIL, CH_3CN, 80 °C, H_2O_2	5	95	100	This work



Sulfonated ionic liquid immobilized SBA-16 as an active solid acid catalyst for the synthesis of biofuel precursor 5-hydroxymethylfurfural from fructose

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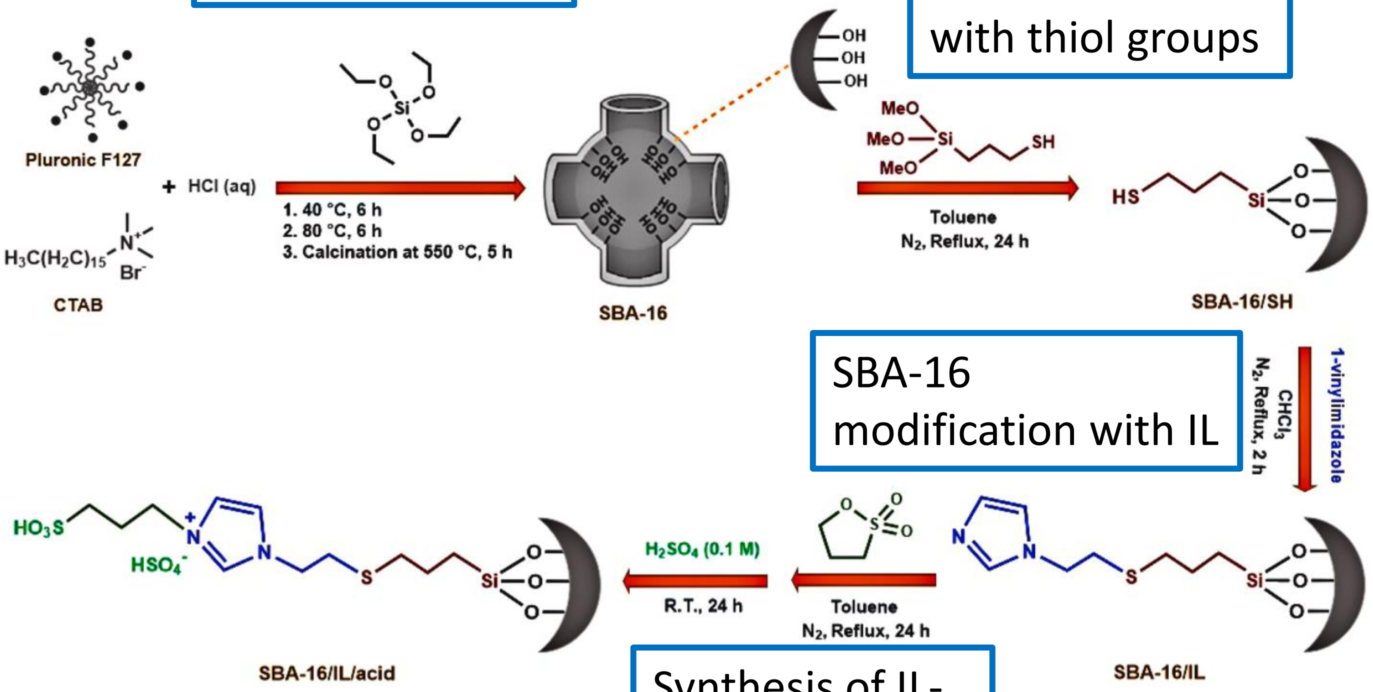
Niakan, M.; Masteri-Farahani, M.; Seidi, F. *Renewable Energy,* 2023, ***212***, 50-56

SBA-16 synthesis

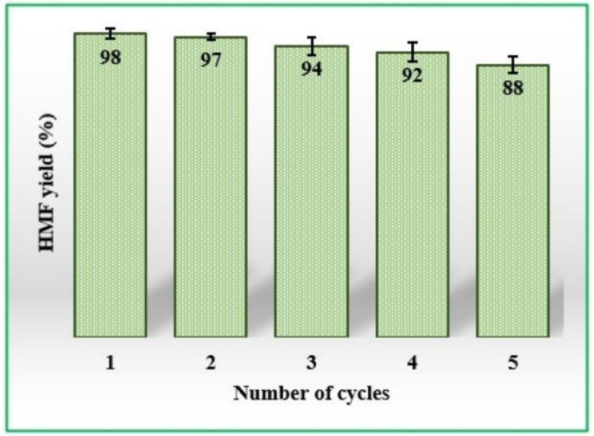
Functionalization with thiol groups

SBA-16 modification with IL

Synthesis of IL-based acidic catalyst



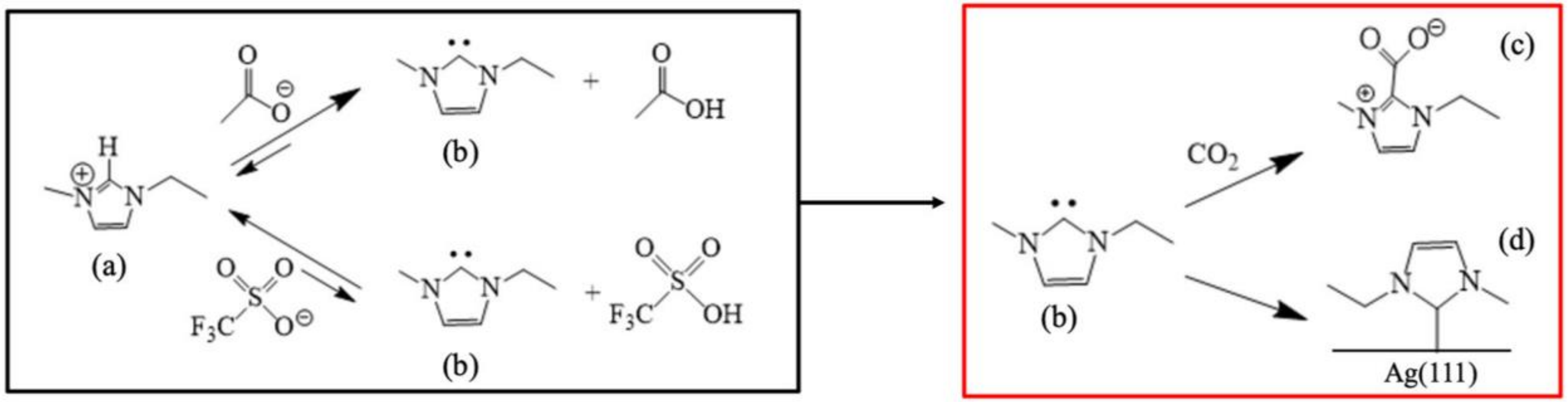
Fructose amount (mg)	Catalyst (mg)	Solvent	T (°C)	Time (min)	HMF yield (%)	Ref
50	Si-1-IL-HSO_4 (40)	DMSO	130	30	63	[24]
100	Cr(Salen)-IM-HSO4-MCM-41 (50)	DMSO	120	180	83.5	[25]
90	PW12-ILs-C4-HNS (60)	DMSO	100	120	93.7	[26]
50	PS-Tet-SO_3H (30)	DMSO	150	120	86	[27]
36	b-MPOS (25)	DMSO	135	20	86	[39]
100	$PrSO_3H$/GF (30)	DMSO	120	60	87	[10]
300	Aquivion@silica (163)	DMSO	90	120	85	[40]
100	SO_4^{2-}/TiO_2 (50)	DMSO	150	360	74.7	[41]
100	COP–SO3H/SB (55)	DMSO	120	60	78	[42]
150	SBA-16/IL/acid (15)	DMSO	120	30	98	[This work]

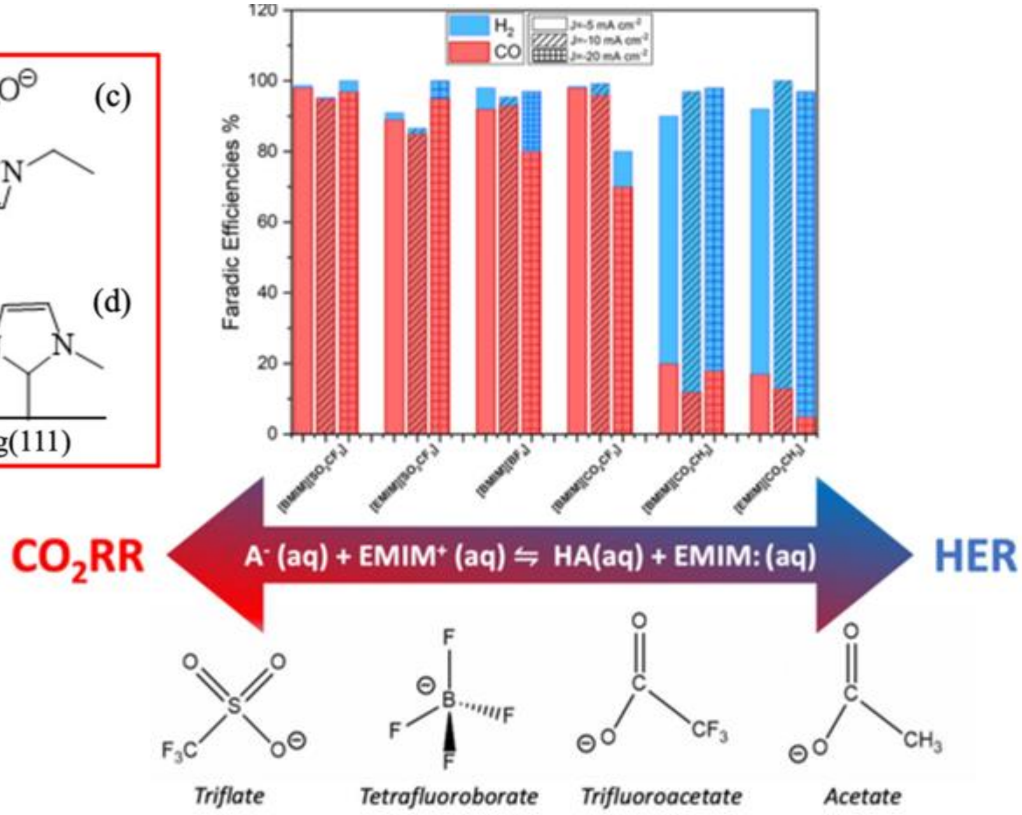


Electrocatalysis

Understanding the role of imidazolium-based ionic liquids in the electrochemical CO_2 reduction reaction

A. Fortunati, F. Risplendi, M. Re Fiorentin, G. Cicero, E. Parisi, M. Castellino, E. Simone, B. Iliev, T. J. S. Schubert, N. Russo, S. Hernández, *Communications Chemistry*, 2023, **6**, 84





The role of the anion:

- ILs with fluorinated anions favour the reduction reaction of CO_2 to CO

Understanding the role of imidazolium-based ionic liquids in the electrochemical CO_2 reduction reaction

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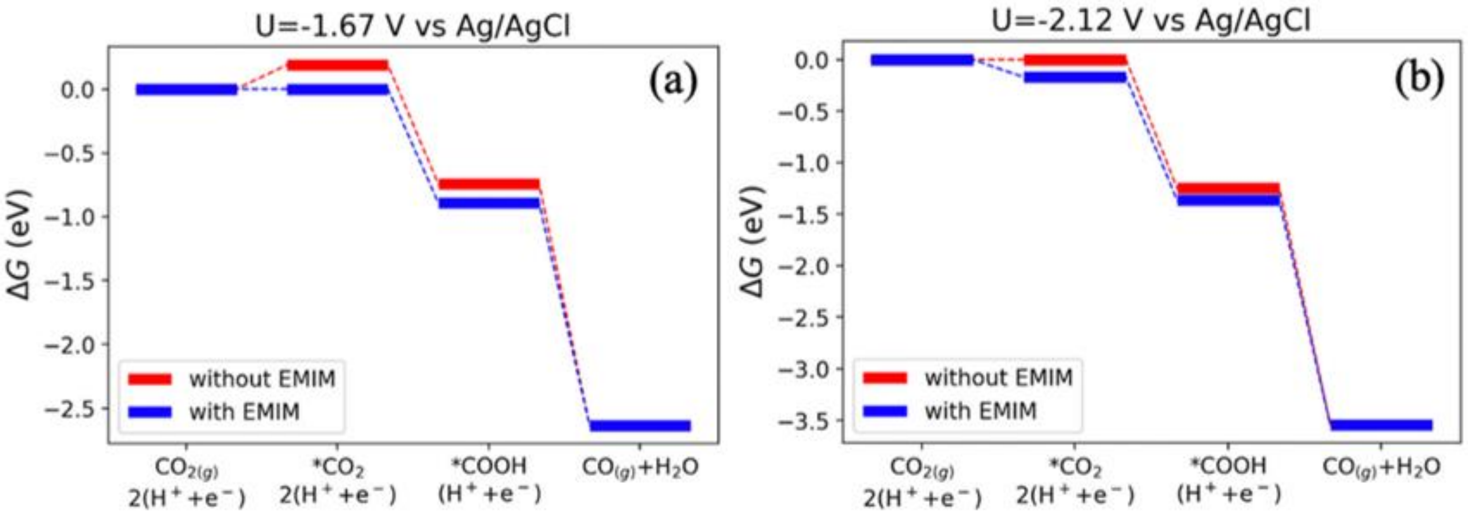
A. Fortunati, F. Risplendi, M. Re Fiorentin, G. Cicero, E. Parisi, M. Castellino, E. Simone, B. Iliev, T. J. S. Schubert, N. Russo, S. Hernández, *Communications Chemistry*, 2023, **6**, 84

$$CO_{2(g)} + 2H^+ + 2e^- + * \rightarrow *CO_2 + 2H^+ + 2e^- \rightarrow *COOH + H^+ + e^- \rightarrow CO_{(g)} + H_2O + *$$



The role of the cation:

- The presence of the IL cation in the form ($[EMIM]^+$ or $[BMIM]^+$) helps to stabilize the activation of the CO_2 at the interface of the Ag electrode
- Helps to decrease the overpotential of the first-rate determining step and of all the reaction intermediates involved in the electrochemical reduction of CO_2 to CO

A Bifunctional Ionic Liquid for Capture and Electrochemical Conversion of CO_2 to CO over Silver

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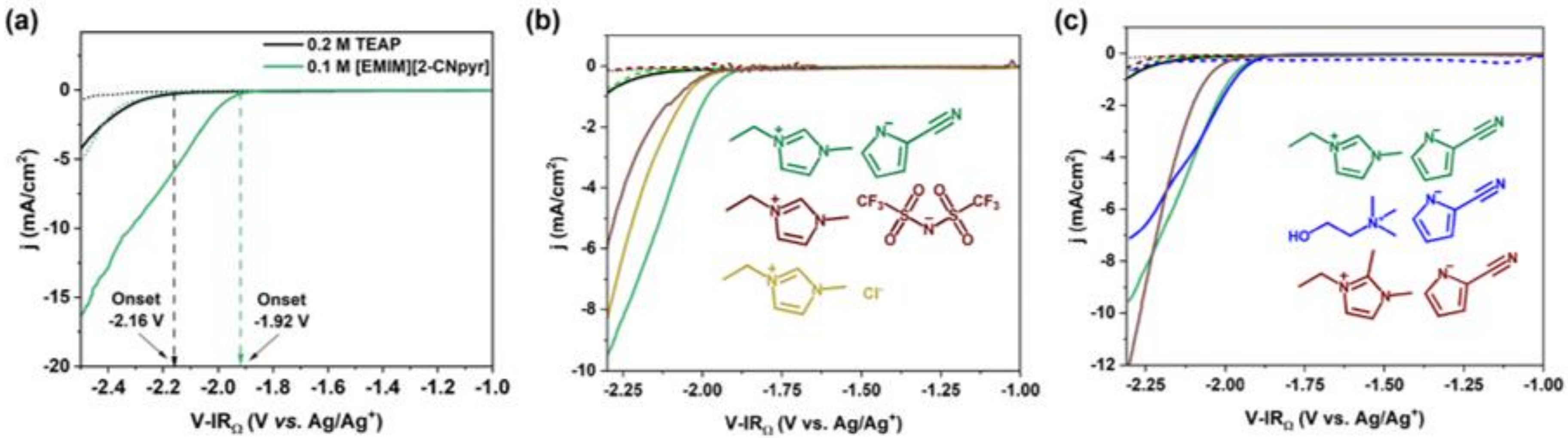
S. Dongare, O. K. Coskun, E. Cagli, K. Y. C. Lee, G. Rao, R. D. Britt, L. A. Berben, B. Gurkan*, *ACS Catal*. 2023, **13**, 12

- The exact mechanism by which ILs with imidazolium cations lower the activation energy was unclear



- The co-catalytic activity of the reactive IL [EMIM][2-CNpyr]was studied

- Investigated the roles of the carboxylate and carbamate species

- Identified reaction products – agreed with previous paper

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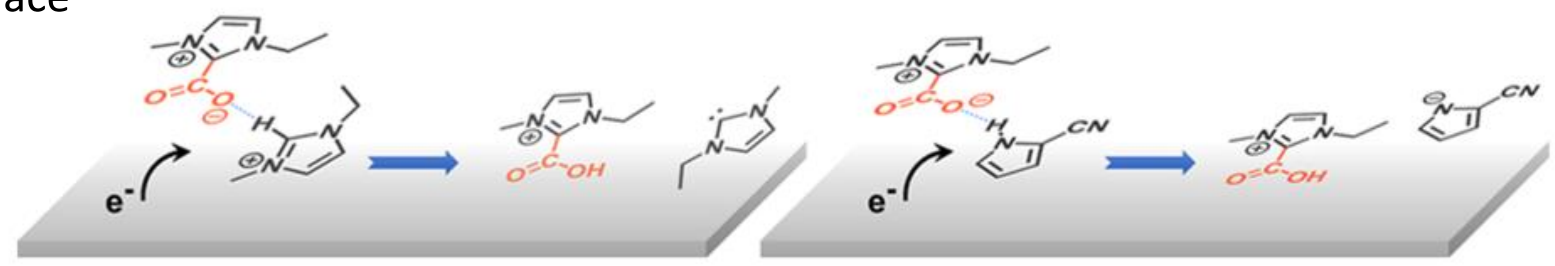
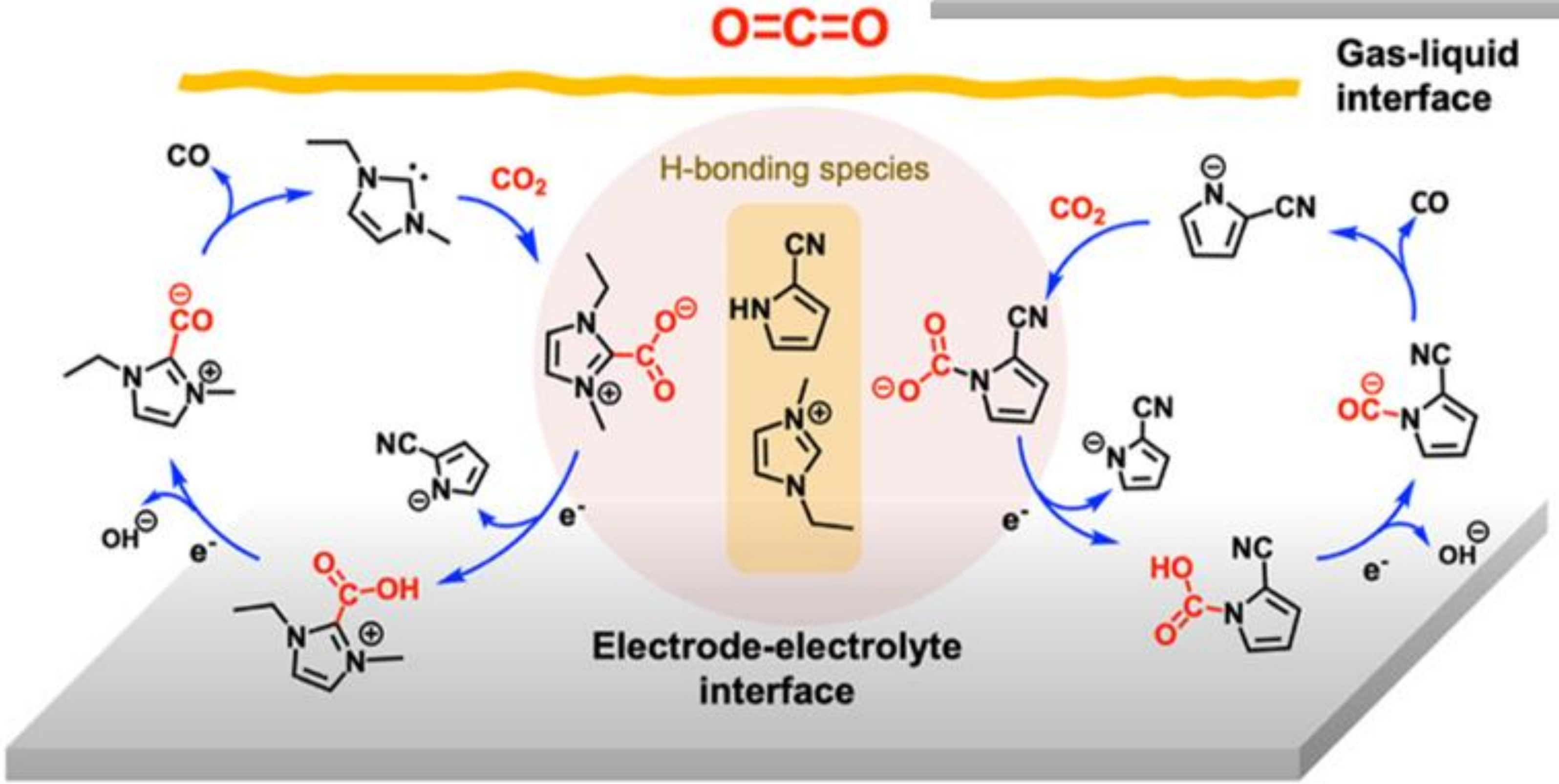
Two possible interactions on the electrode surface

- C2 proton of $[EMIM]^+$ ($pKa_{(H2O)}$~23)
- −NH proton of 2-CNpyrH ($pKa_{(H2O)}$~15)

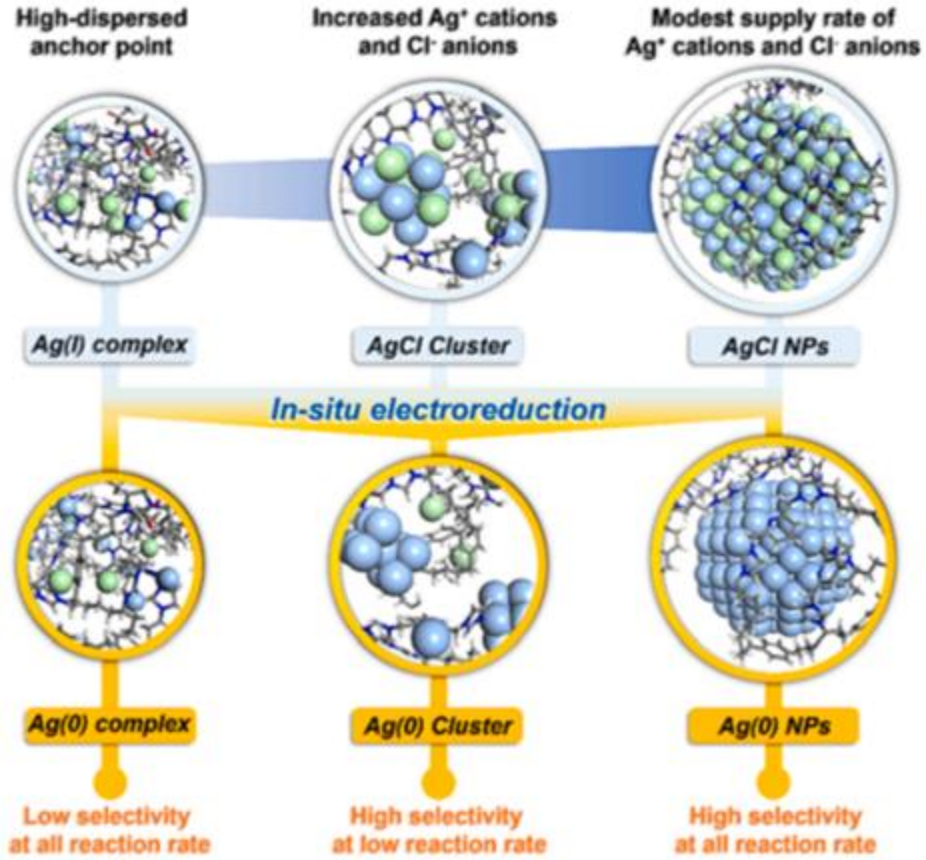


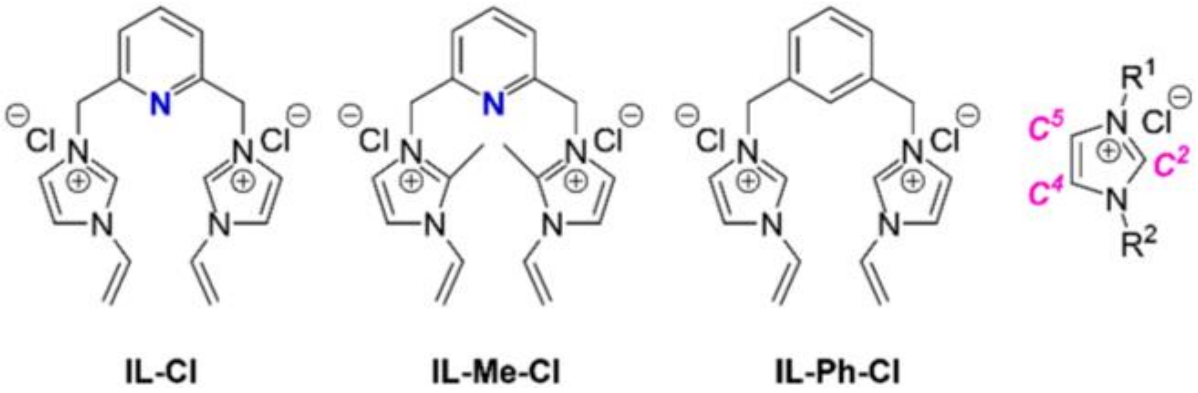


Efficient electrocatalytic reduction of CO_2 to CO on highly dispersed Ag nanoparticles confined by Poly(ionic liquid)

G. Duan, X. Li, Y. Du, B. Xu*, *ACS Catal*. 2023, **10**, 2

- Polyionic liquids (PILs) impregnated with silver salts
  - dosage and type of silver salt
  - structure of PIL





- Corresponding complexes, clusters, and nanoparticles were obtained in the inner domain.
- The distribution of Ag–Cl species in the PIL is highly correlated to both the microstructure of PIL and silver salts used.

Efficient electrocatalytic reduction of CO_2 to CO on highly dispersed Ag nanoparticles confined by Poly(ionic liquid)

G. Duan, X. Li, Y. Du, B. Xu*, *ACS Catal*. 2023, **10**, 2

- Polyionic liquids (PILs) impregnated with silver salts
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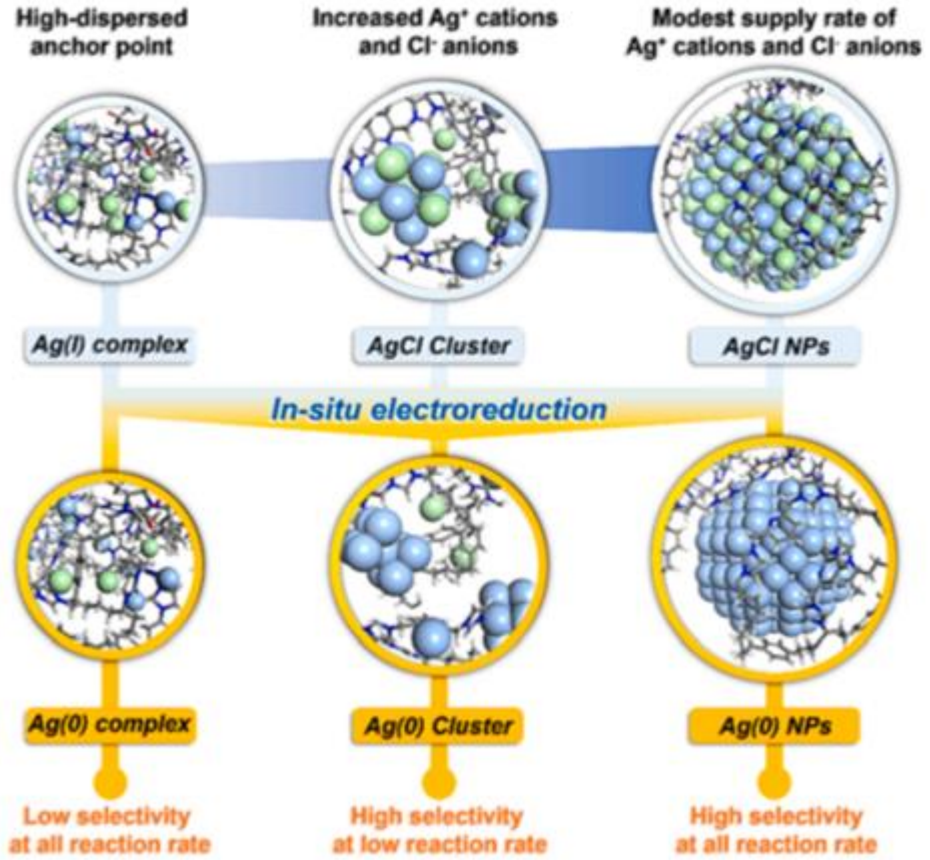

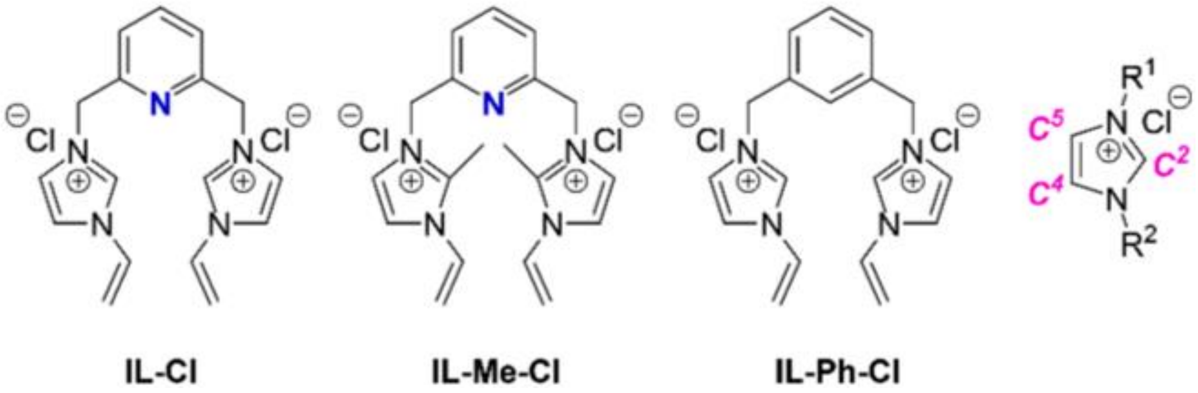

- Initial reduction of Ag–Cl species to Ag(0) mainly accounts for the CO_2 reduction activity
- The CO_2 reduction performance of PIL-Ag hybrids varies greatly
- PIL-Cl@AgOAc-1.0 mainly consisting of AgCl NPs was selected as the optimized electrocatalyst taking both reactivity and stability into account

Ionic liquid in-situ functionalized carbon nanotube film as self-supported metal-free electrocatalysts for oxygen evolution

T. Li*, Y. Wang, T. Chen, G. Wang*, C. Qiu*, W. Hu*, *Chemical Engineering Journal*, 2024, **484**, 149767

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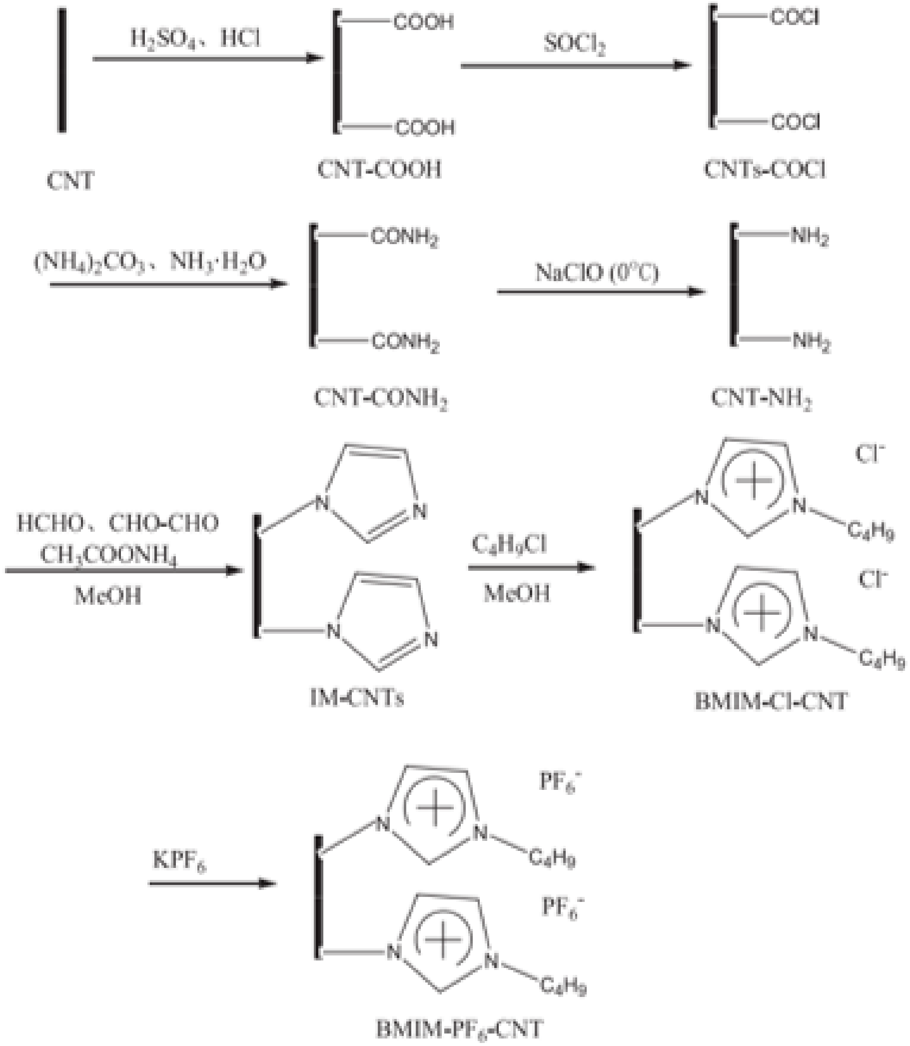

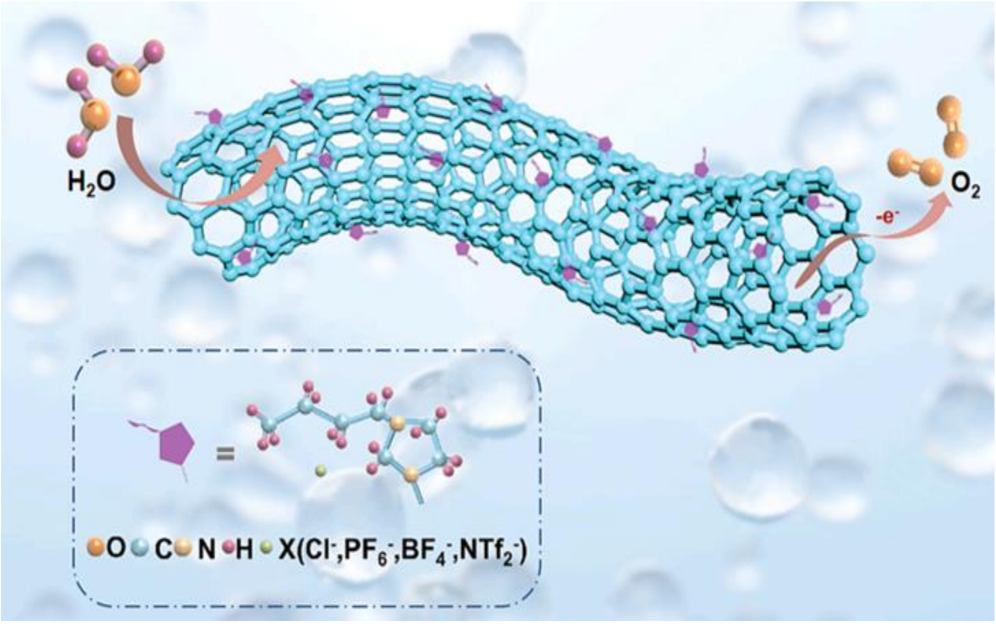

- An innovative organic functionalization strategy, where the imidazolium-based IL was in-situ synthesized and directly immobilized on the surface of CNT simultaneously
- Effective way to tune the structure of CNT and improve catalytic activity

Ionic liquid in-situ functionalized carbon nanotube film as self-supported metal-free electrocatalysts for oxygen evolution

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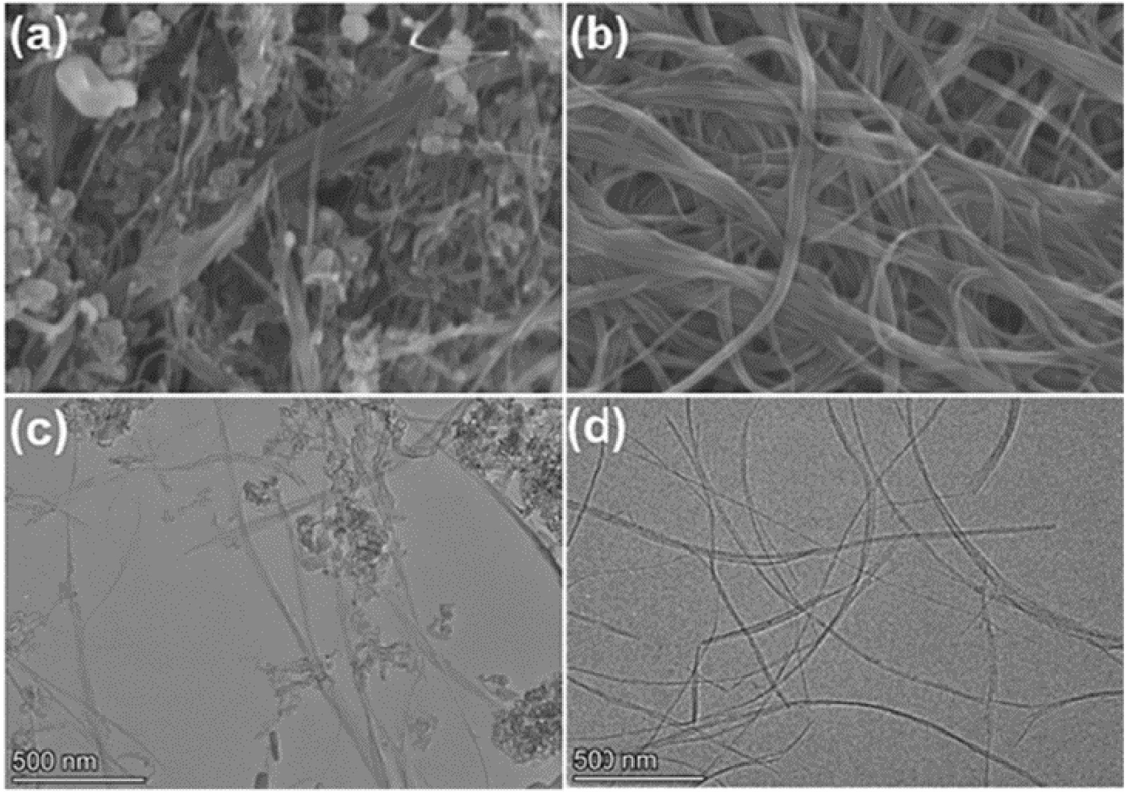
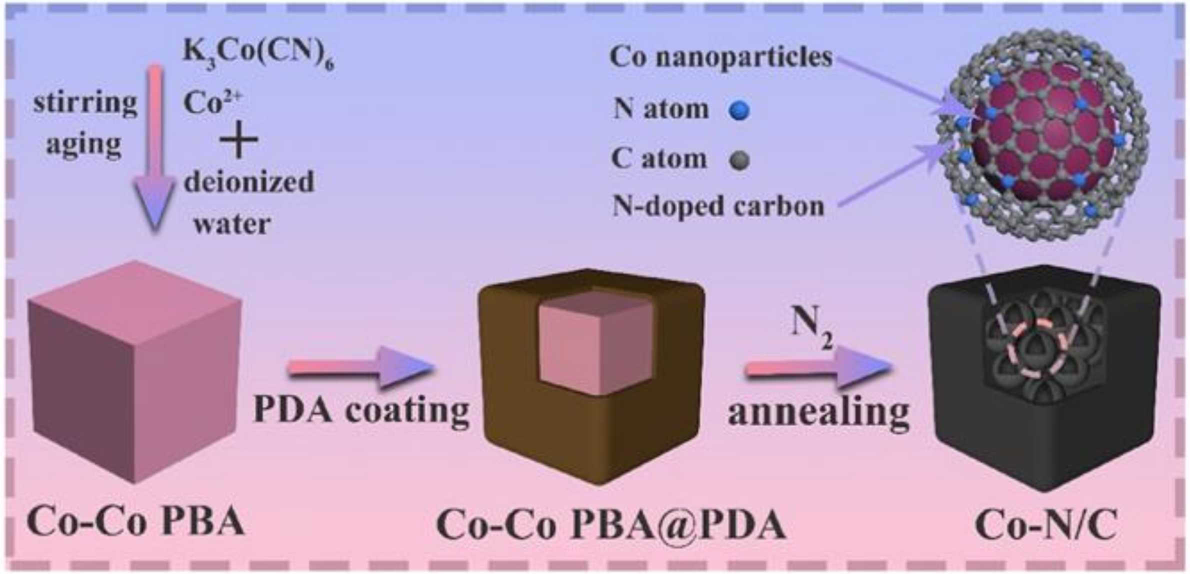
T. Li*, Y. Wang, T. Chen, G. Wang*, C. Qiu*, W. Hu*, *Chemical Engineering Journal*, 2024, **484**, 149767

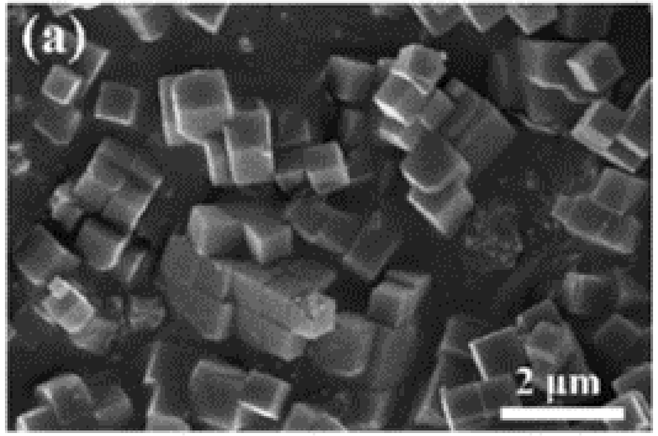
- IL-CNT exhibited excellent electrocatalytic performance for the oxygen evolution reaction
- IL-CNT powder material can also self-assemble to form a carbon film
- This IL cation direct bonding remarkably improved the oxygen evolution catalytic activity – great potential for practical applications



Double-Layer Carbon Encapsulated Co Particles Combined with Ionic Liquid for Enhancing Electrochemical Detection of Oxygen

W. Yin, J. Liu*, Q. Liu, J. Zhu, M. Zhang*, P. Liu, R. Li, J. Wang, *ACS Sustainable Chem. Eng.*, 2023, **11**, 7





- Synthesized the nitrogen-doped carbon encapsulated Co particles embedded in hollow square box microcubes derived from Prussian blue analogue precursors
- Explored the effects of carbon materials encapsulated with the metallic particle catalyst
- Ionic liquid [C4mpyrr][TFSI] and Co-N/C microcubes synthesized
- Co-N/C was introduced into [C4mpyrr][TFSI]
  – enhanced the sensor's electrochemical sensing performance.

Double-Layer Carbon Encapsulated Co Particles Combined with Ionic Liquid for Enhancing Electrochemical Detection of Oxygen

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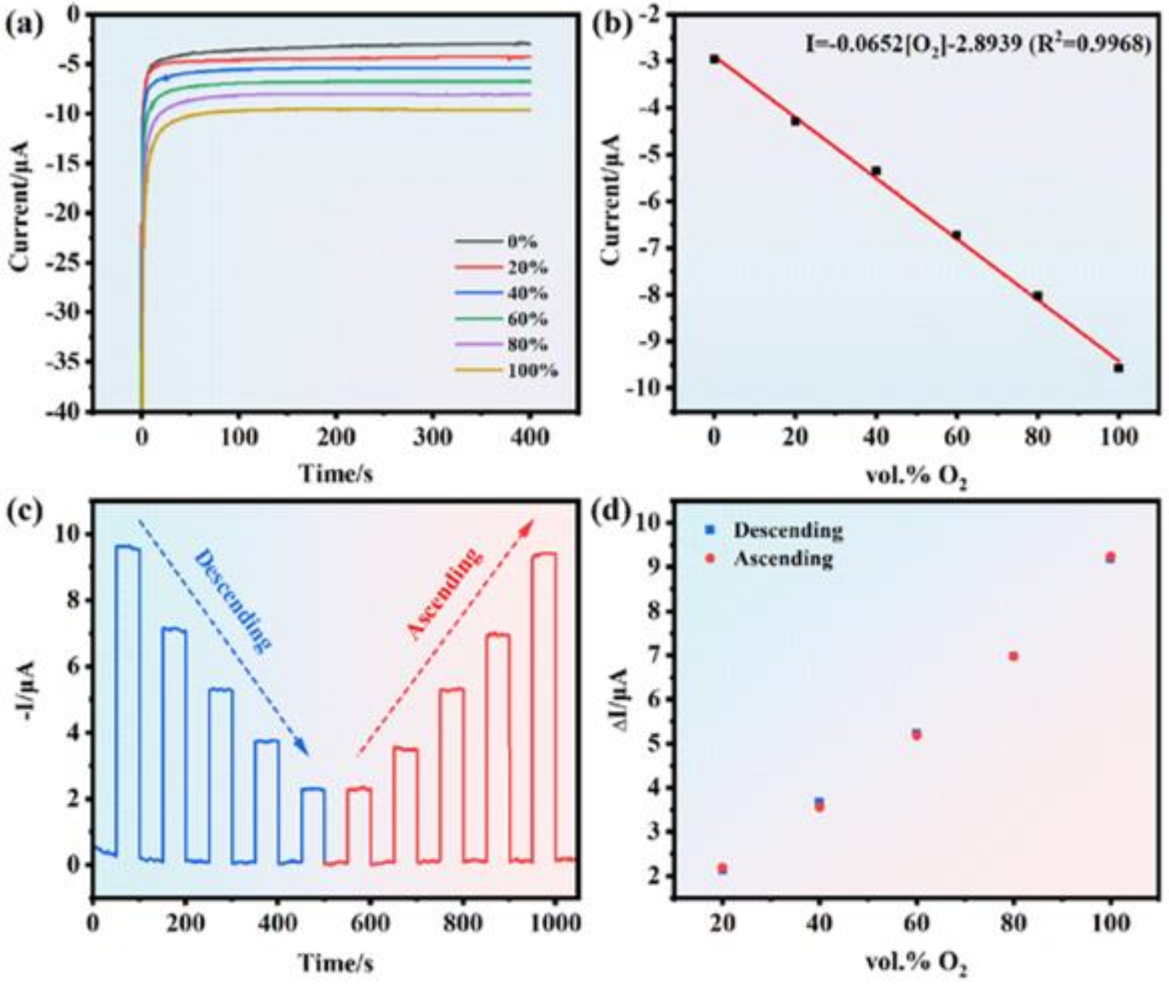
W. Yin, J. Liu*, Q. Liu, J. Zhu, M. Zhang*, P. Liu, R. Li, J. Wang, *ACS Sustainable Chem. Eng.*, 2023, **11**, 7

- Significant improvement in O_2 sensing when Co-N/C/[C4mpyrr][TFSI] used compared to [C4mpyrr][TFSI]
- The addition of Co-N/C improves oxygen reduction, enhancing the electrochemical O_2 sensor performance



Polymers

Understanding the important variables to optimize glycolysis of polyethylene terephthalate with lanthanide-containing ionic liquids

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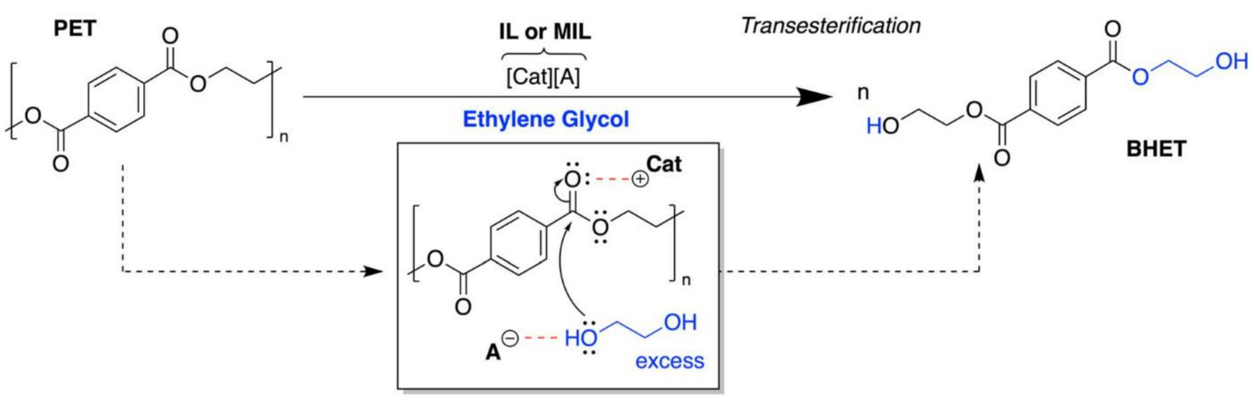
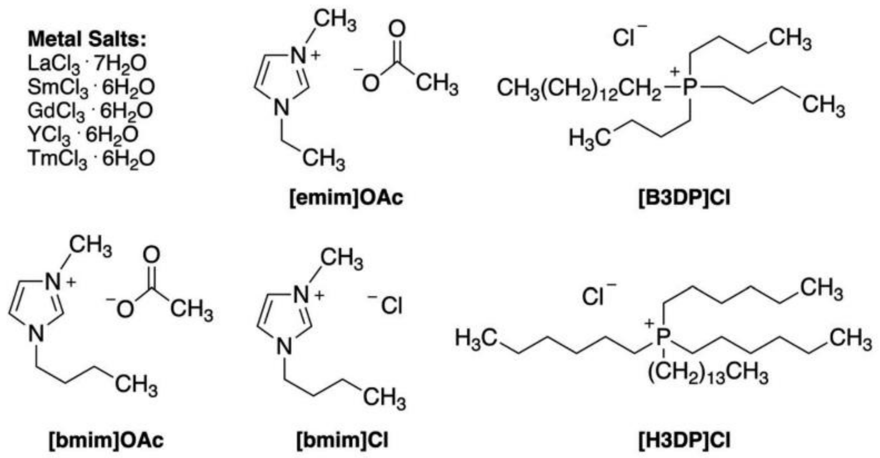
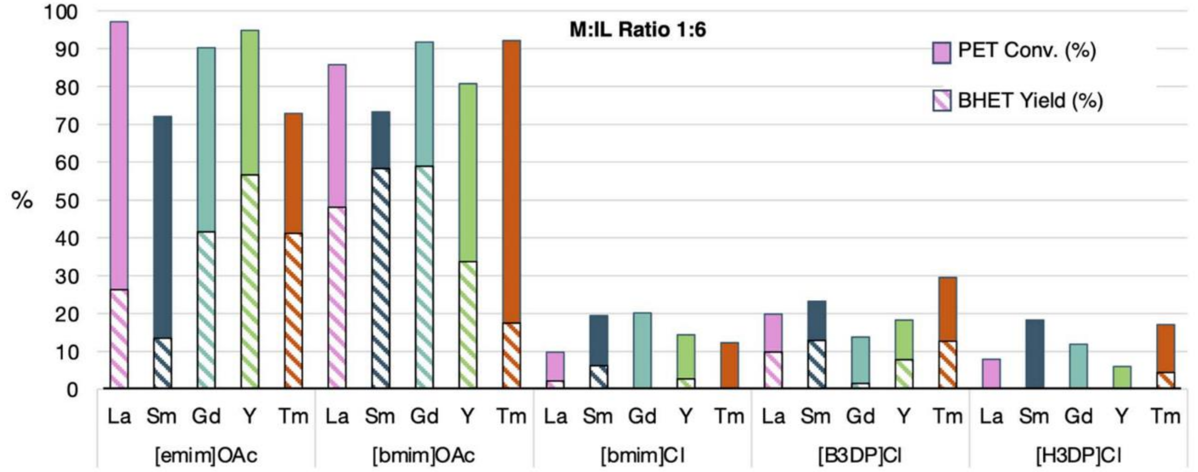
N.G. Bush, C. H. Dinh, C. L. Cattertona and M. E. Fieser, *RSC Sustainability*, 2023, **1**, 938





- Yttrium and gadolinium were identified to be the most promising metals to pursue further, as both showed high PET conversions with both ratios of metal salt to IL



Understanding the important variables to optimize glycolysis of polyethylene terephthalate with lanthanide-containing ionic liquids

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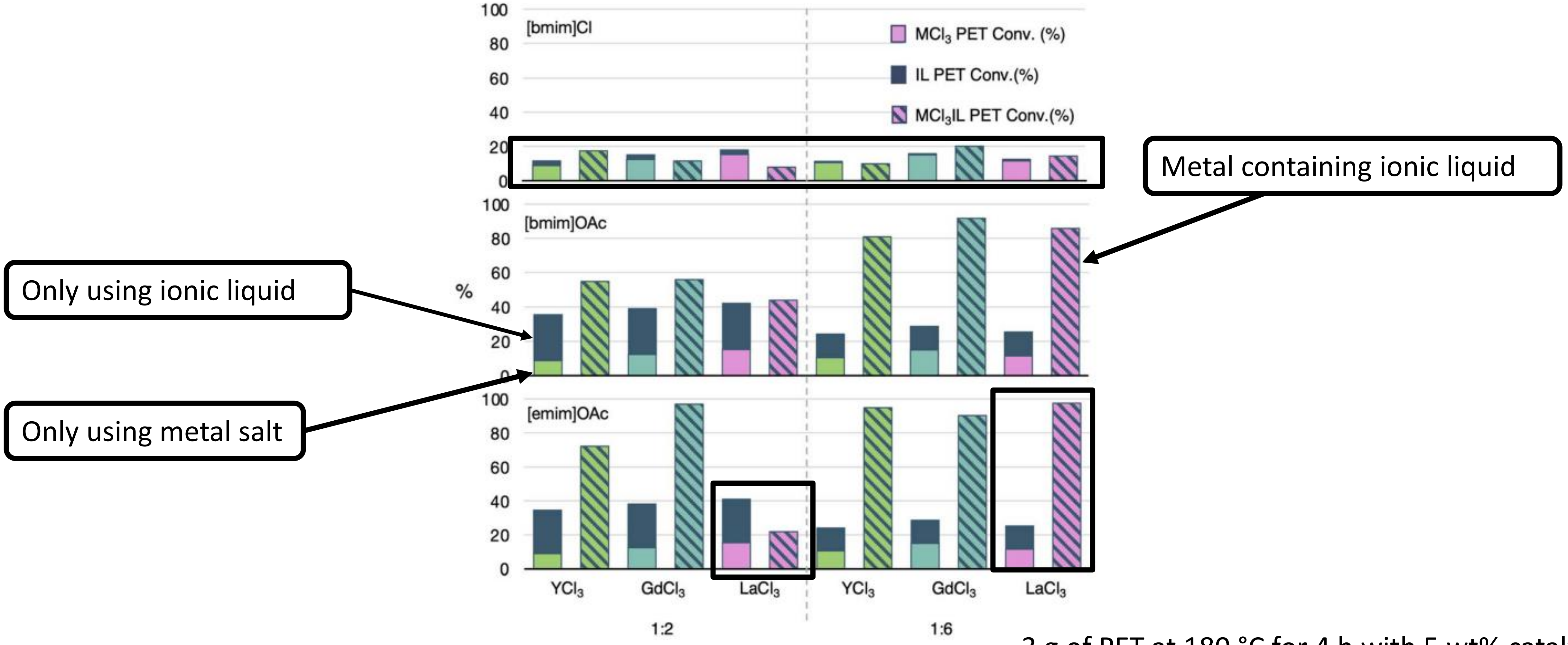
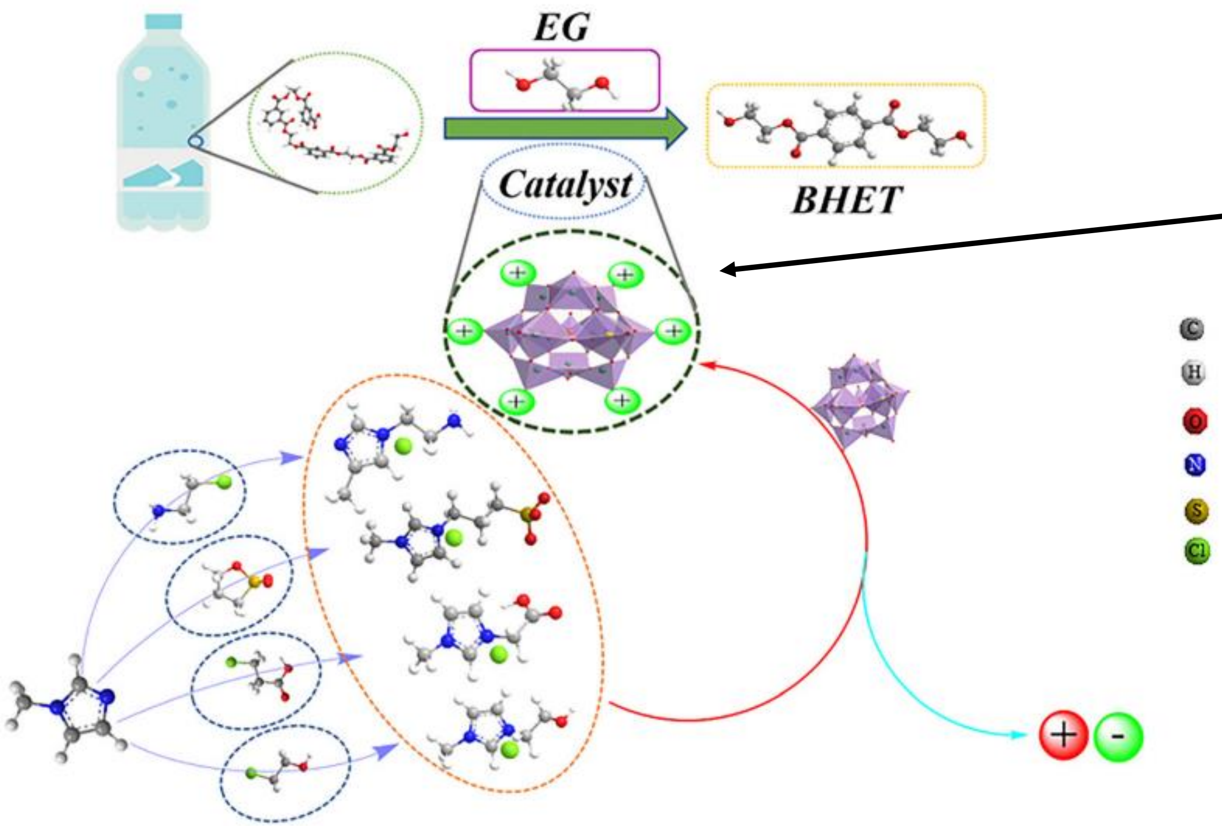


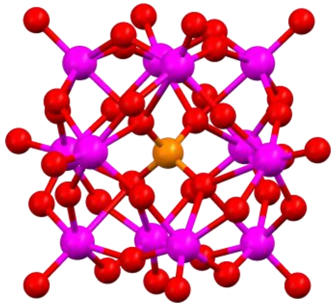
3 g of PET at 180 °C for 4 h with 5 wt% catalyst

Preparation of functionalised heteropolyacid ionic liquids and their application in catalytic degradation of bottle-grade polyester

B. Liu, B. Liu, Z. Liao, J. Zhang and L. Guo. *New J. Chem.*, 2023, **47**, 19943



Heteropolyacid



Ionic liquid components

$[HO_3S\text{-}(CH_2)_3\text{-mim}]_6$ $[HO\text{-}(CH_2)_2\text{-mim})]_6$

$[COOH\text{-}CH_2\text{-mim}]_6$ $[NH_2\text{-}(CH_2)_2\text{-mim}]_6$

Preparation of functionalised heteropolyacid ionic liquids and their application in catalytic degradation of bottle-grade polyester

QUEEN'S UNIVERSITY BELFAST | QUEEN'S UNIVERSITY IONIC LIQUID LABORATORIES QUILL

B. Liu, B. Liu, Z. Liao, J. Zhang and L. Guo. *New J. Chem.*, 2023, **47**, 19943

No	Catalyst	D/%	Y_B/%
1	$[HSO_3\text{-}(CH_2)_3\text{-mim}]_6[Fe(H_2O)FeMo_{11}O_{39}]$	100	85.26
2	$(COOH\text{-}CH_2\text{-mim})_6[Fe(H_2O)FeMo_{11}O_{39}]$	100	82.88
3	$[HO\text{-}(CH_2)_2\text{-mim}]_6[Fe(H_2O)FeMo_{11}O_{39}]$	100	77.34
4	$[NH_2\text{-}(CH_2)_2\text{-mim}]_6[Fe(H_2O)FeMo_{11}O_{39}]$	100	73.38
5	$Bmim_6[Cu(H_2O)TiMo_{11}O_{39}]$	100	72.3
6	$Bmim_6[Pb(H_2O)TiMo_{11}O_{39}]$	100	67.68
7	$Bmim_6[Fe(H_2O)FeMo_{11}O_{39}]$	100	65.38
8	$Bmim_7[Pb(H_2O)FeMo_{11}O_{39}]$	99.6	62.46
9	$Zn(OAc)_2$	94.17	60.35

Note: D—alcoholysis rate, Y_B—the yield of BHET

<u>Further reaction optimisation</u>

100 % conversion of PET
91.92 % yield of BHET
0.2 % catalyst loading at 196 °C for 3 h

Literature comparison

0.5% catalyst loading at 190 °C for 5 h

Catalytic tandem dehydrochlorination–hydrogenation of PVC towards valorisation of chlorinated plastic waste

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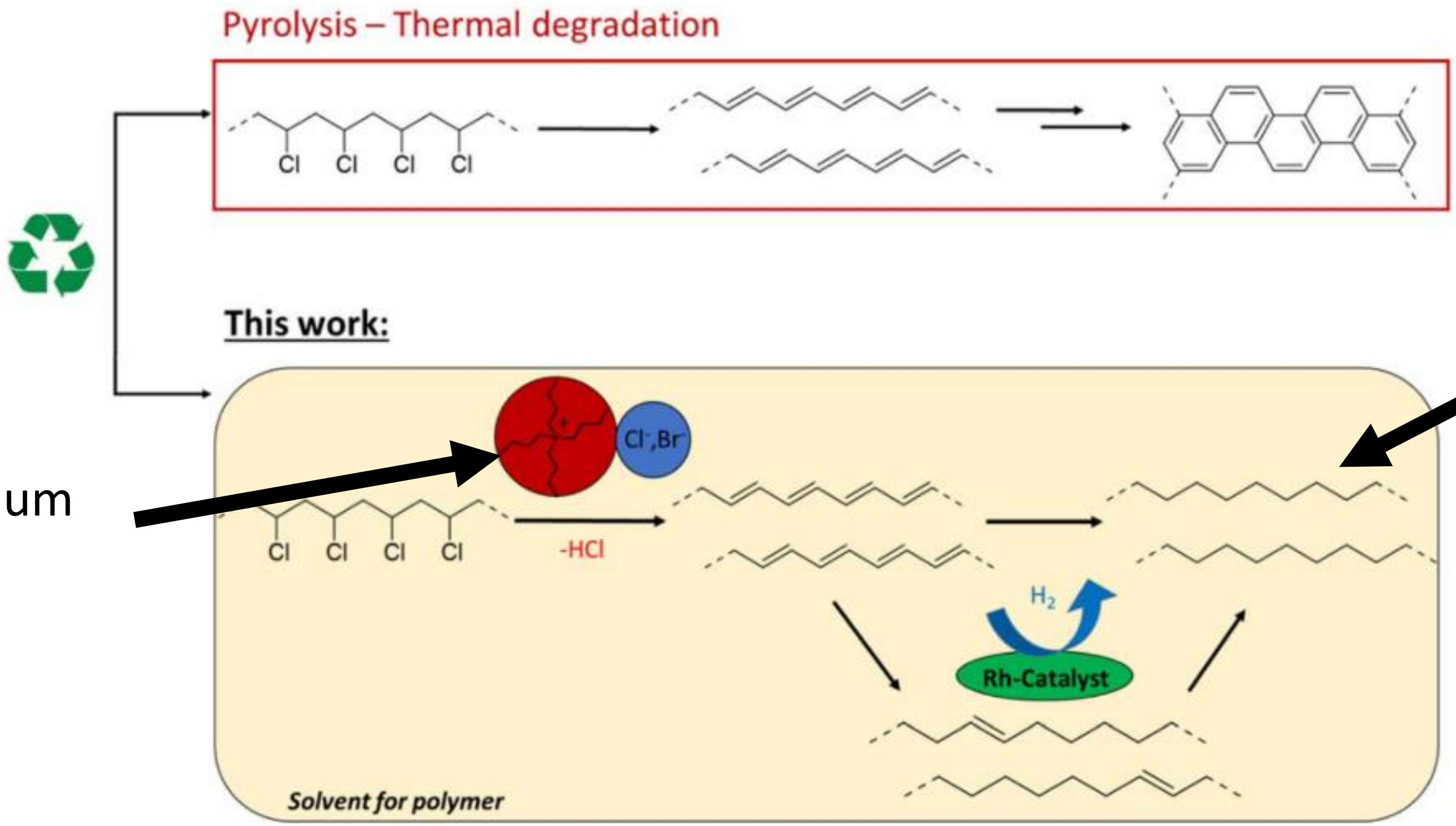
G. O'Rourke, T. Hennebel, M. Stalpaert, A. Skorynina, A. Bugaev, K. Janssens, L. Van Emelen, V. Lemmens, R. D. O. Silva, C. Colemonts, P. Gabriels, D. Sakellariou a and D. De Vos. *Chem. Sci.*,2023, **14**, 4401



Tetrabutylphosphonium ionic liquids

Products are soluble and without aromatic components

Catalytic tandem dehydrochlorination–hydrogenation of PVC towards valorisation of chlorinated plastic waste

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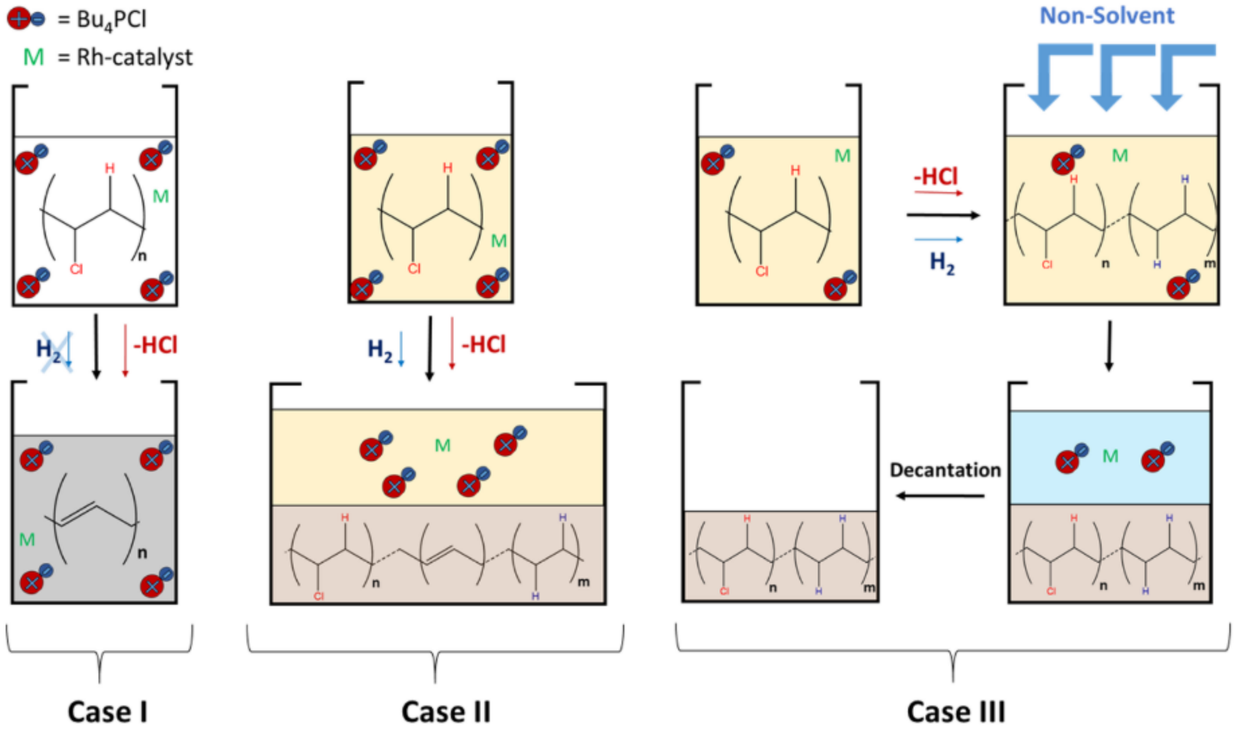

81% dehydrochlorination is reached in 2 h, with the hydrogenation proceeding smoothly with minimal catalyst use of 0.5–2.0 mol% Rh.

Case I : Reaction in pure ionic liquid only leads to dehydrochlorination

Case II: an excess of ionic liquid in a solvent, the polymer precipitates spontaneously during reaction

Case III : a limited amount of ionic liquid in a solvent, spontaneous precipitation is avoided, and largely saturated products are obtained

Low-temperature upcycling of polyolefins into liquid alkanes via tandem cracking-alkylation

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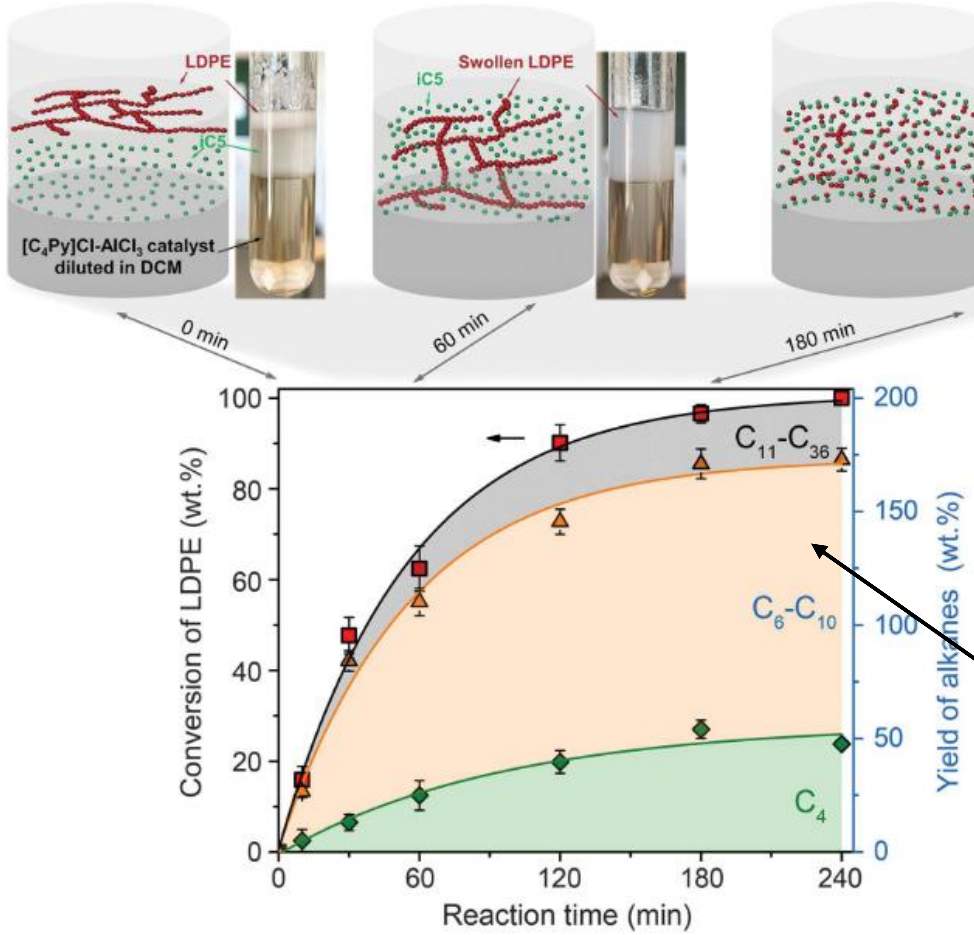
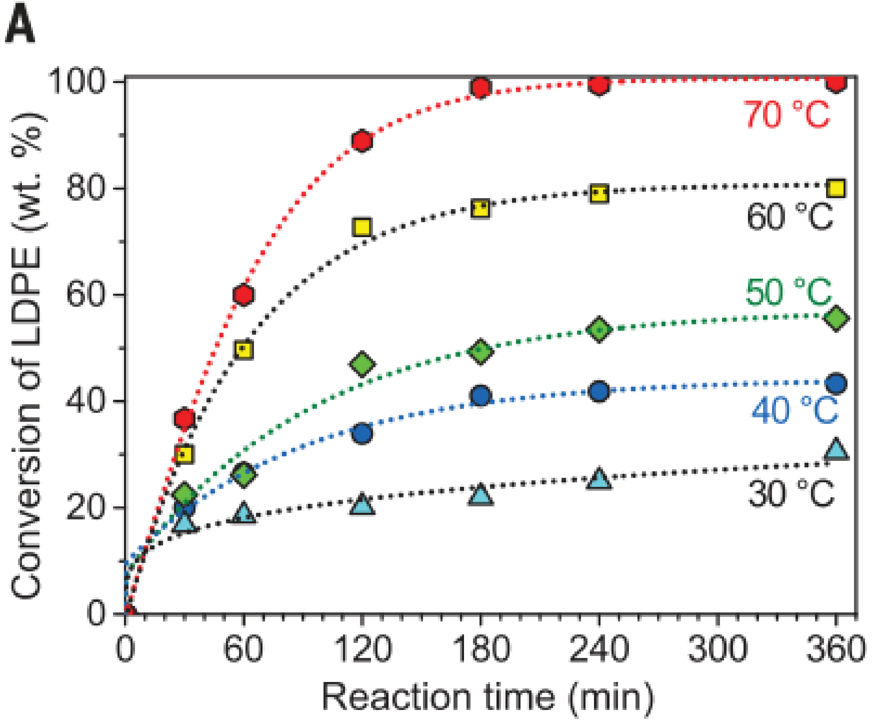
W. Zhang, S. Kim, L. Wahl, R. Khare, L. Hale, J. Hu, D. M. Camaioni, O. Y. Gutiérrez, Y. Liu, J. A. Lercher, *Science*, 2023, **379**, 807-811





Full conversion of polyolefin to produce a distribution of products

LDPE, 200 mg; iC_5, 800 mg; $[C_4Py]Cl\text{-}AlCl_3$, 3 mmol; TBC as an additive, 5 mg; DCM, 3 ml; and temperature, 70°C.

Low-temperature upcycling of polyolefins into liquid alkanes via tandem cracking-alkylation

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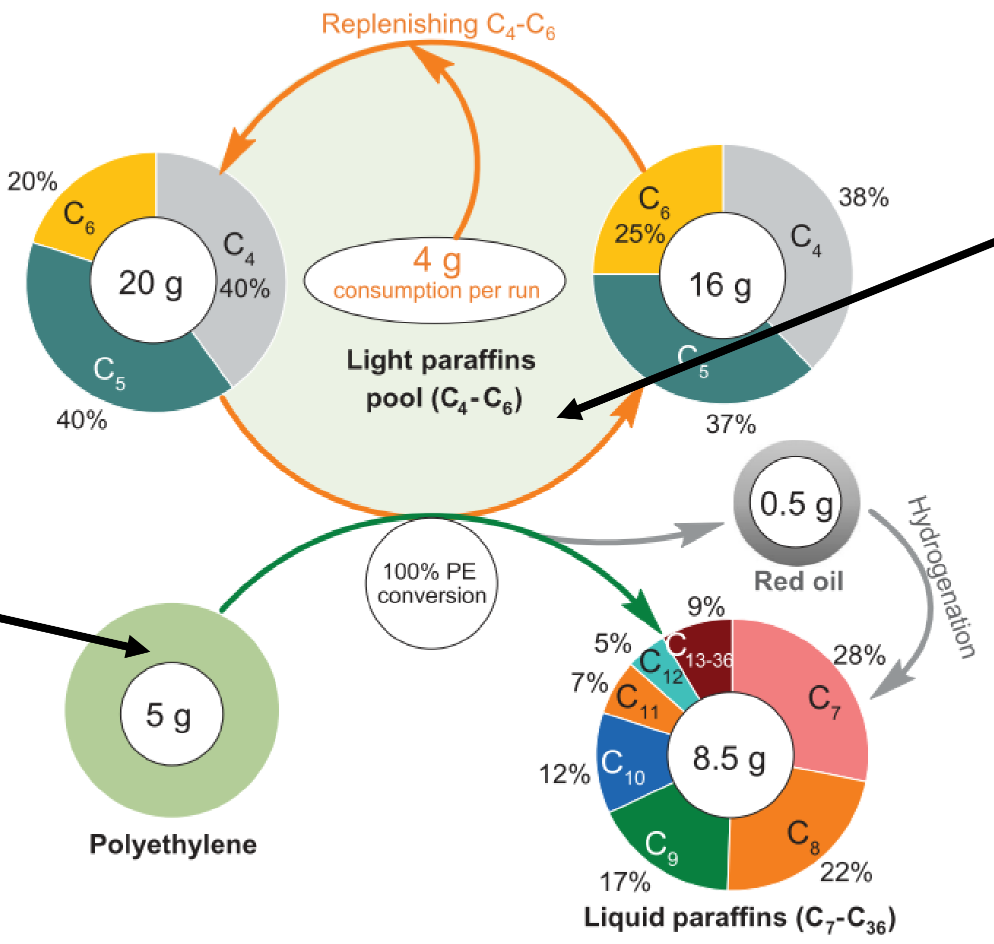

Alkylation with light paraffins

Cleavage of C-C bond

Tanden cracking-alkylation

Polyethylene reaction with light paraffin mixture – 70° C for 2 h

Liquid-liquid separation

Thermally Reversible On-Off Switching of Aggregation-induced Emission via LCST Phase Transition of Ionic Liquids in Water

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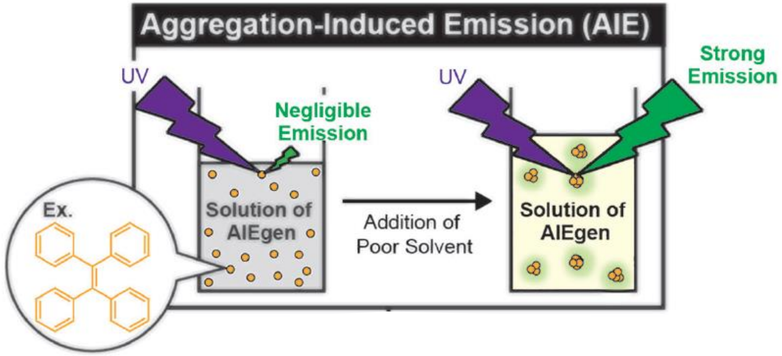
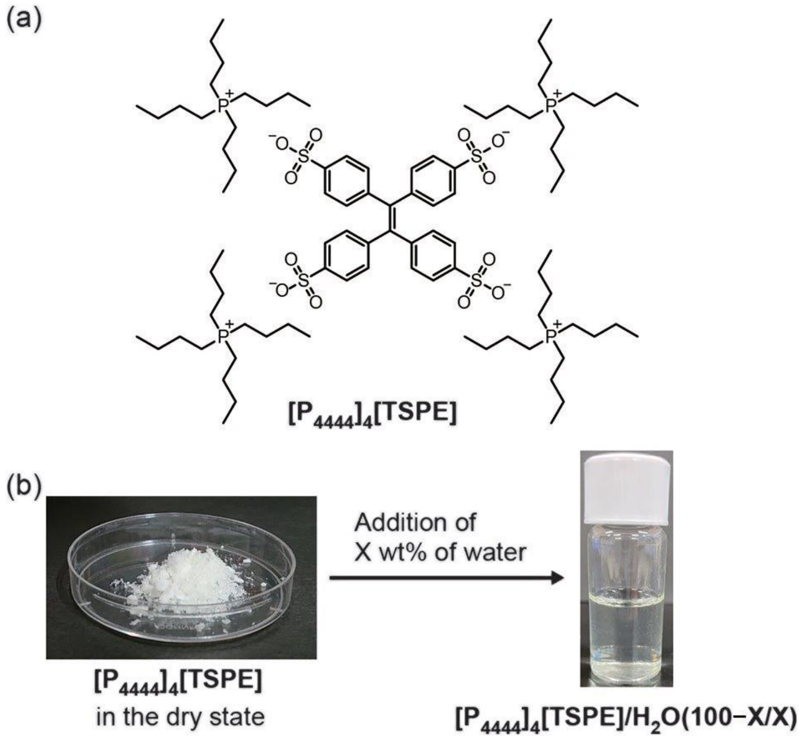
H. Iwasawa, D. Uchida, Y. Hara, M. Tanaka, N. Nakamura, H. Ohno, and T. Ichikawa*, *Adv. Optical Mater*. 2023, **11**, 2301197





AIE : a phenomenon in which a class of π-conjugated molecules show strong photoluminescence in aggregated states and negligible emission in the solution states.

Thermally Reversible On-Off Switching of Aggregation-induced Emission via LCST Phase Transition of Ionic Liquids in Water

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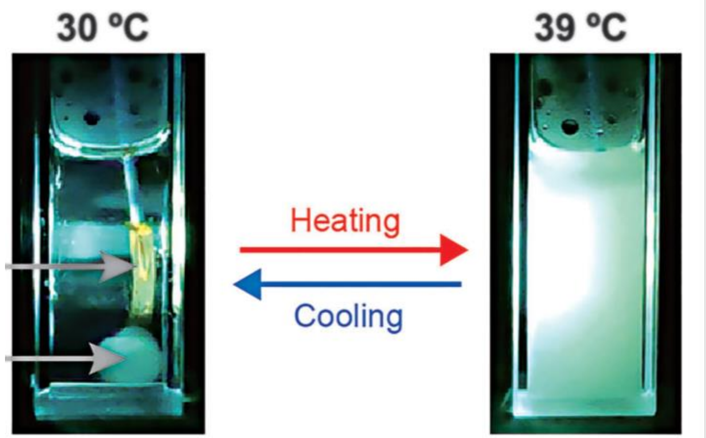

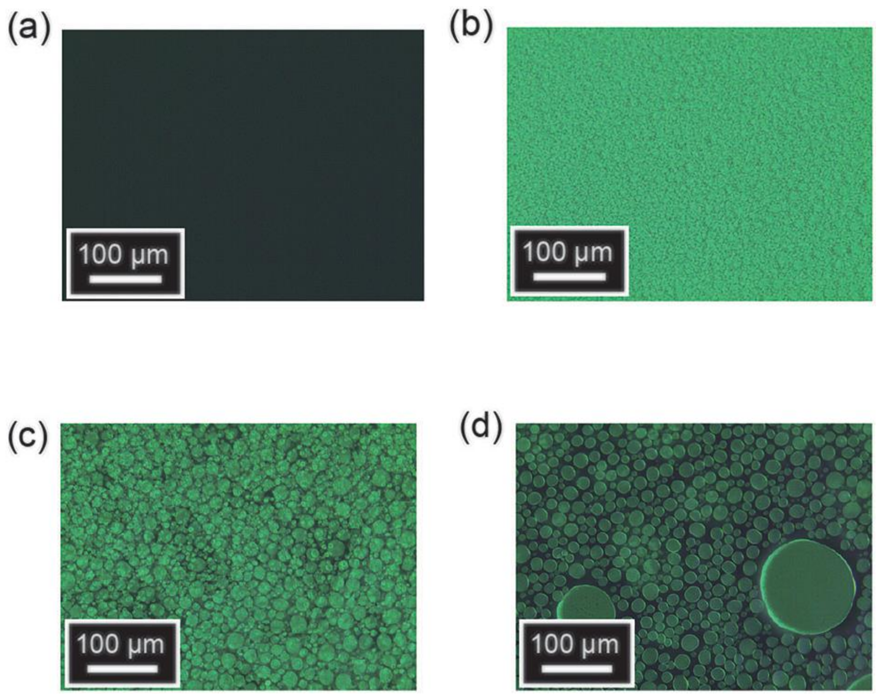

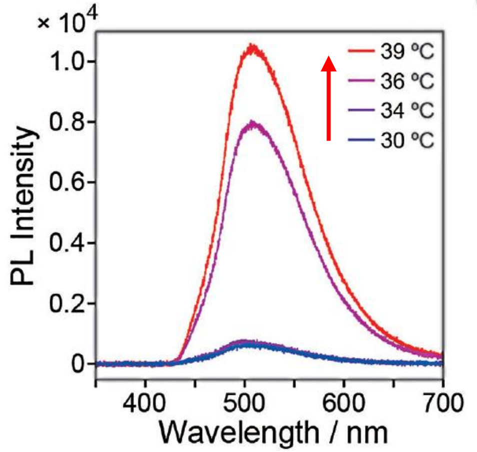

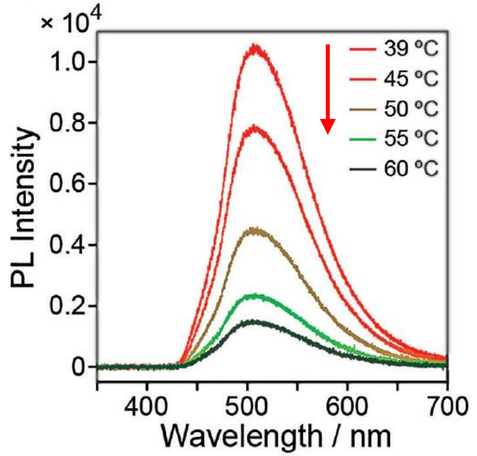

1. The strongest photoluminescence around the LCST phase transition temperature
2. Application: Photoluminescent materials with high sensitivity to temperature

Thermo-switchable hydrophobic solvents formulated with weak acid and base for greener separation processes

J. C. Corzo, K. B. Busserolles, J. Coxam, A. Gautier, J. M. Andanson*, *J. Mol. Liq.* 2023, **377**, 121468

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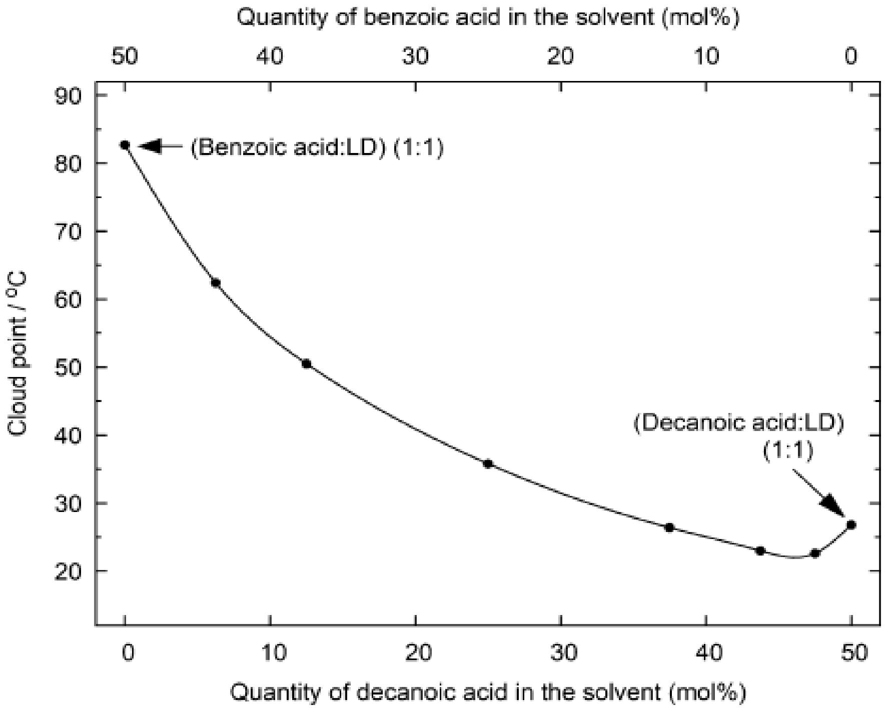
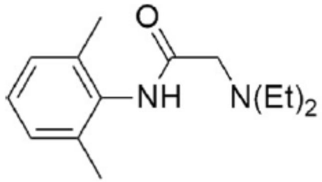
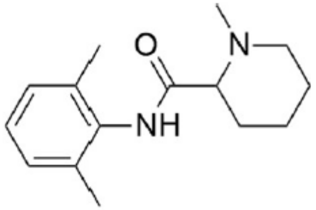
1. Deep Eutectic solvents show LCST phenomena,
2. Cloud point temperature can be adjusted based on acid: base ratio

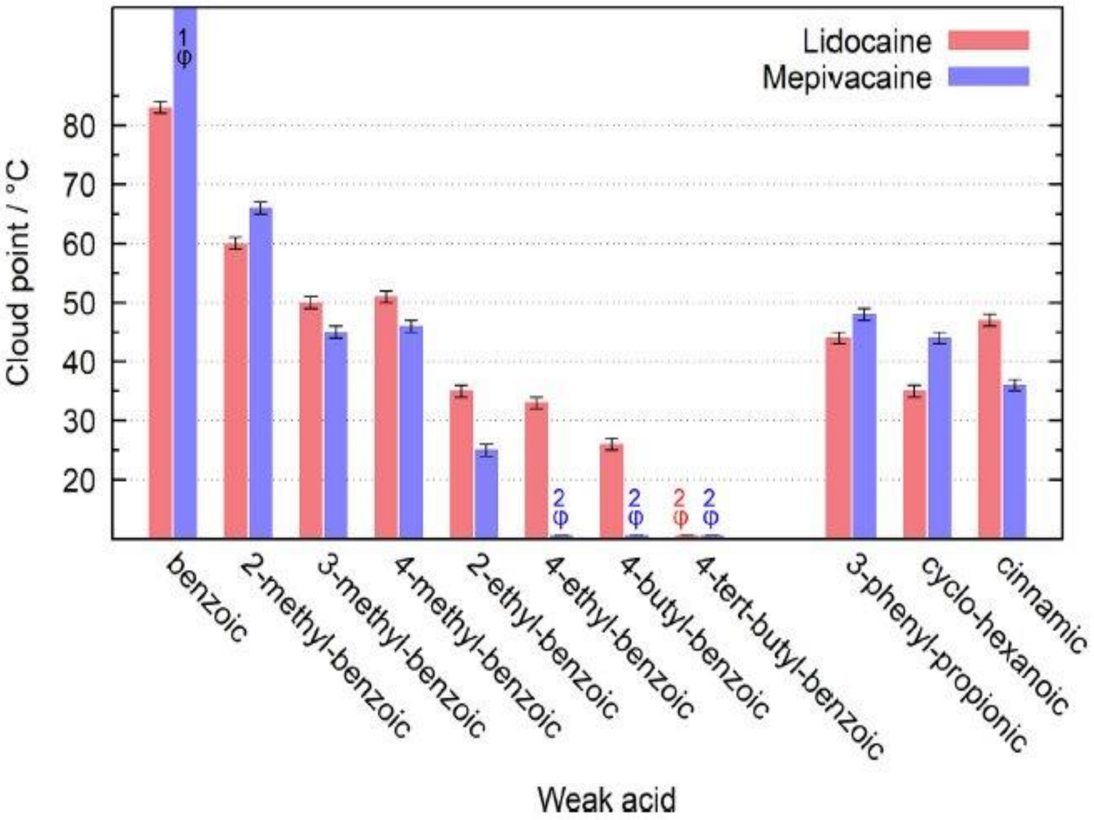




Lidocaine

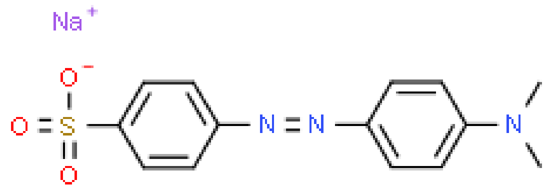


Mepivacaine



Thermo-switchable hydrophobic solvents formulated with weak acid and base for greener separation processes

J. C. Corzo, K. B. Busserolles, J. Coxam, A. Gautier, J. M. Andanson*, *J. Mol. Liq.*, 2023, **377**, 121468



Achieved 99% extraction of anionic dye, methyl orange, with tested solvents.

	Solvent	(Acid:base) (mol%)	Cloud point	EE[5]
1	Decanoic acid:LD	(50:50)	27 °C	99 %
2	Decanoic acid:LD	(50:50)	27 °C	99 %
3	Pentanoic acid:LD	(50:50)	57 °C	89 %
4	Pentanoic acid:LD	(68:32)	33 °C	89 %
5	Pentanoic acid:LD	(68:32)	33 °C	90 %
6	2EB[1] acid:LD	(50:50)	35 °C	96 %
7	2EB[1] acid:LD	(50:50)	35 °C	99 %
8	3PP[2] acid:LD	(50:50)	44 °C	99 %
9	3PP[2] acid:LD	(35:65)	31 °C	97 %
10	3PP[2] acid:LD	(35:65)	31 °C	99 %
11	Decanoic acid[3]	100 %[3]	–	2 %
12	LD in octanol[4]	10 wt%[4]	–	50 %

Thermo-switchable hydrophobic deep eutectic solvent for CuAAC

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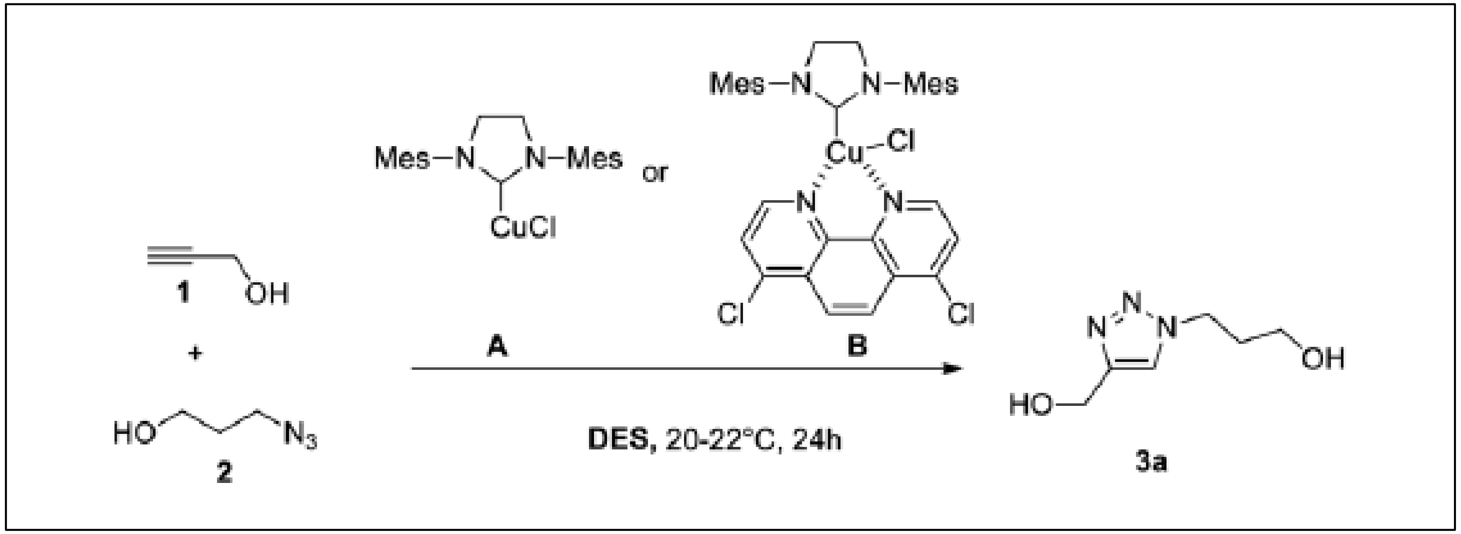
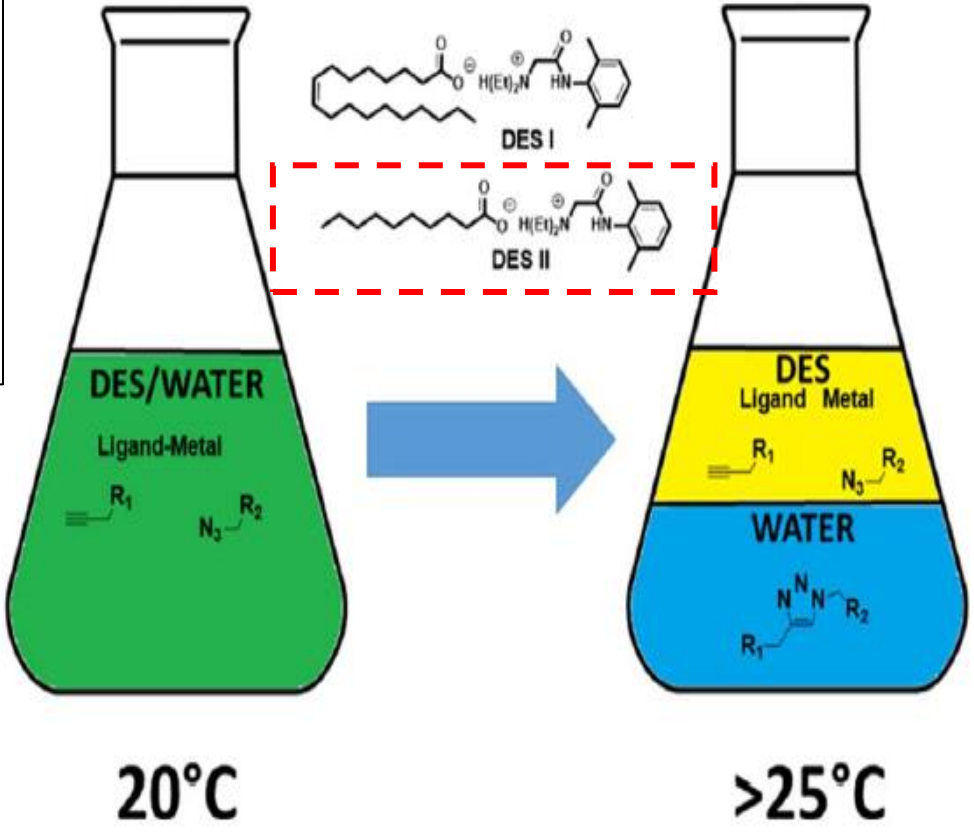
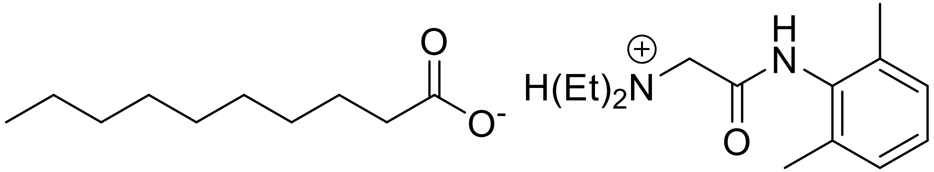
F. C. Pouget, J. M. Andanson* and A. Gautier *, *RSC Sustainability*, **2023**, 1, 1826–1832



1. Solvent separates into aqueous and organic layers upon thermal trigger,

2. DES acts as a metal trap, providing products with low copper contamination





DES II : Lidocaine-decanoic acid

Thermo-switchable hydrophobic deep eutectic solvent for CuAAC

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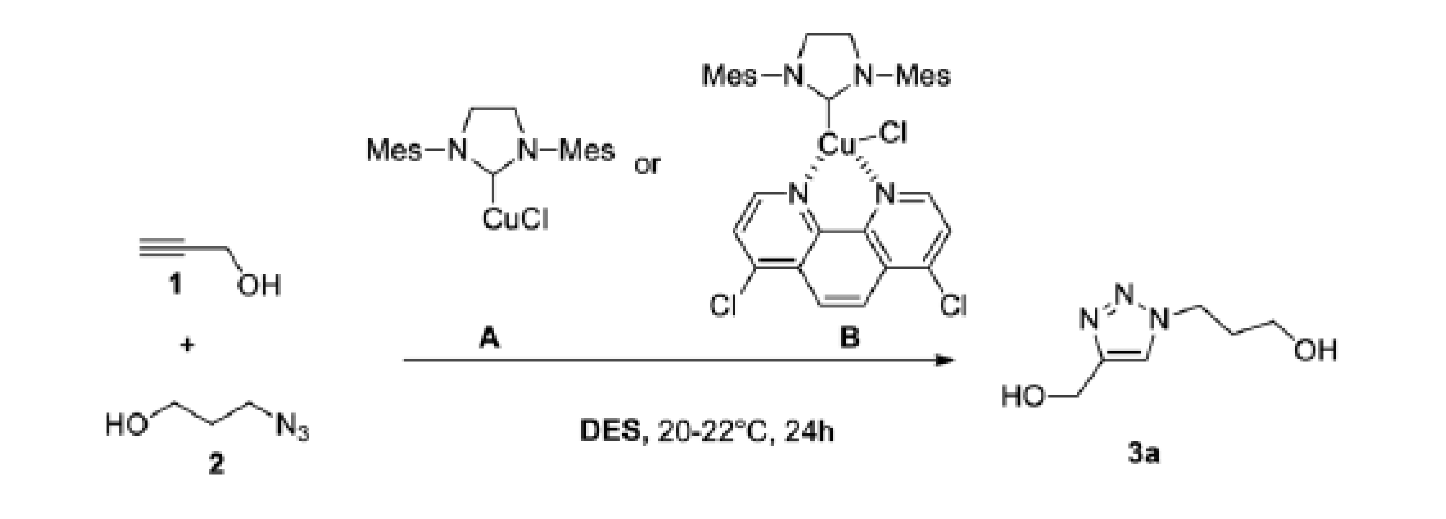
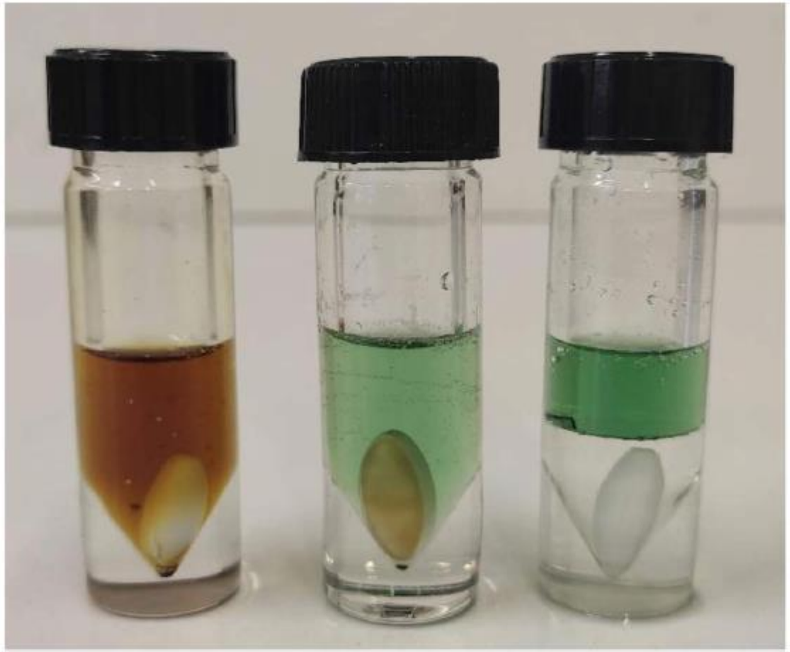
F. C. Pouget, J. M. Andanson* and A. Gautier *, *RSC Sustainability*, **2023**, 1, 1826–1832





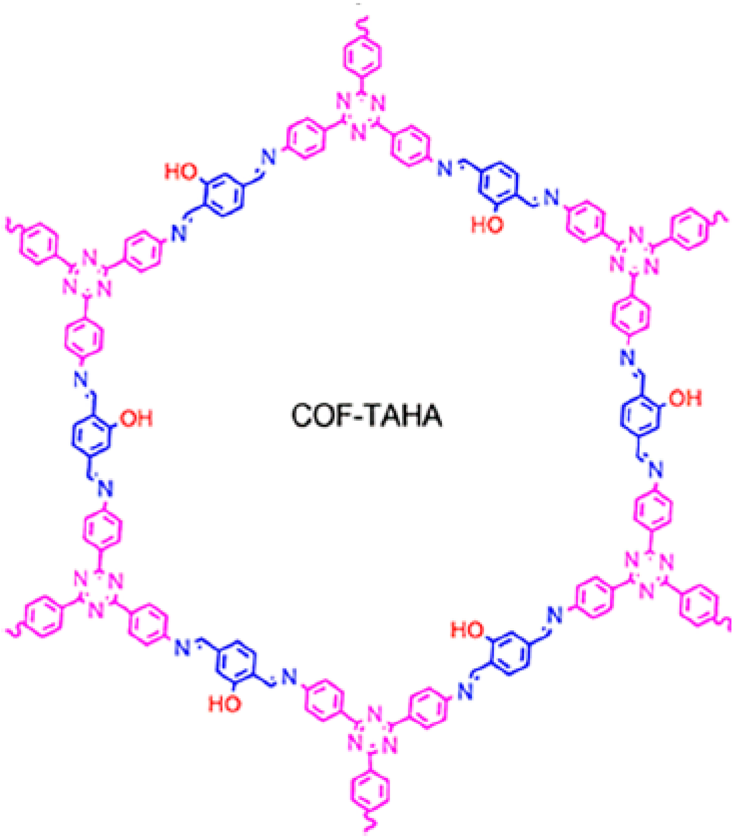
Experiment	1	2	3	4	5
Yield (catalyst)[a]	95% (B)	99% (B)	95% (B)	95% (B)	95% (B)
Copper[b]	0.03%	0.04%	0.02%	0.05%	0.02%
Yield (catalyst)[a]	97% (B)	95% (A)	97% (A)	80% (A)	59% (A)
Copper[b]	0.03%	0.2%	0.07%	0.18%	0.37%

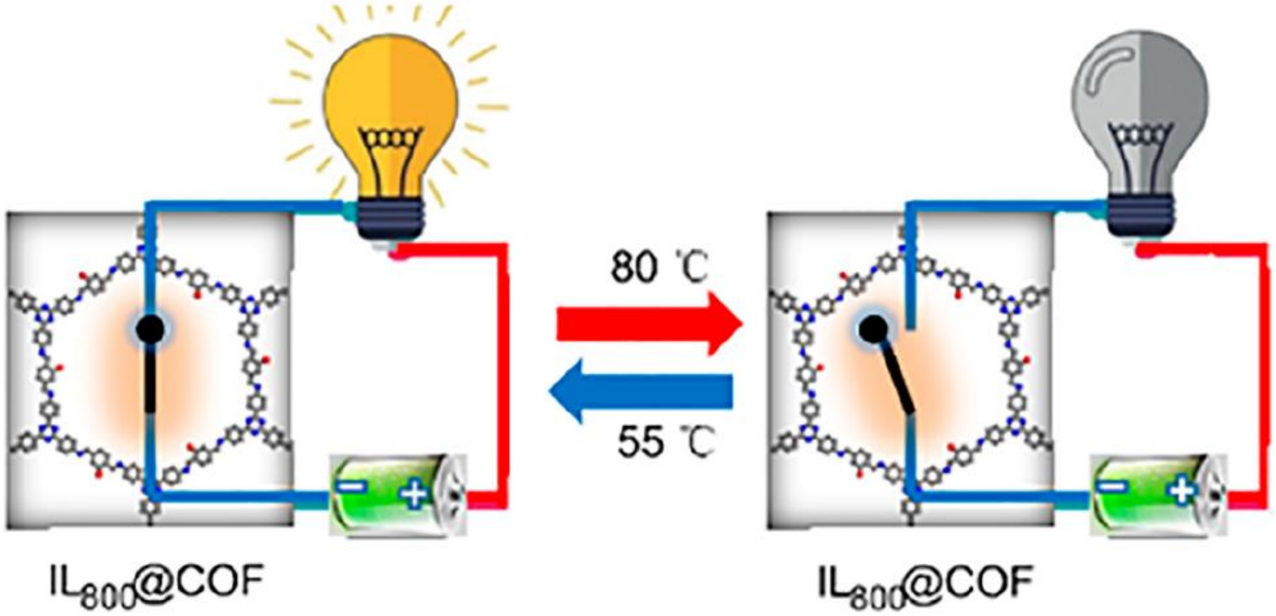
[a] Measured by ^{1}H NMR with 3-trimethylsilyl-1-propanesulfonic acid sodium salt as internal standard. [b] Contamination: mass Cu/total mass.

1. Good yields of alkyne-azide cycloaddition achieved in aqueous layer,
2. Low contamination of products by metals; good reusability of solvents.

Liquid-liquid Phase separation of Aqueous Ionic Liquids in Covalent Organic Frameworks for Thermal Switchable Proton Conductivity

W. Yao, Y. Chen, T. F., X. Liu, X. Zhao, S. Gao, Z. Li, H. Wang,* and J. Wang*, *J. Phys. Chem. Lett*. 2023, **14**, 8165−8174





Concept

TA: 4,4′,4″-(1,3,5-triazine-2,4,6-triyl)trianiline
HA: 2-hydroxyterephthalaldehyde

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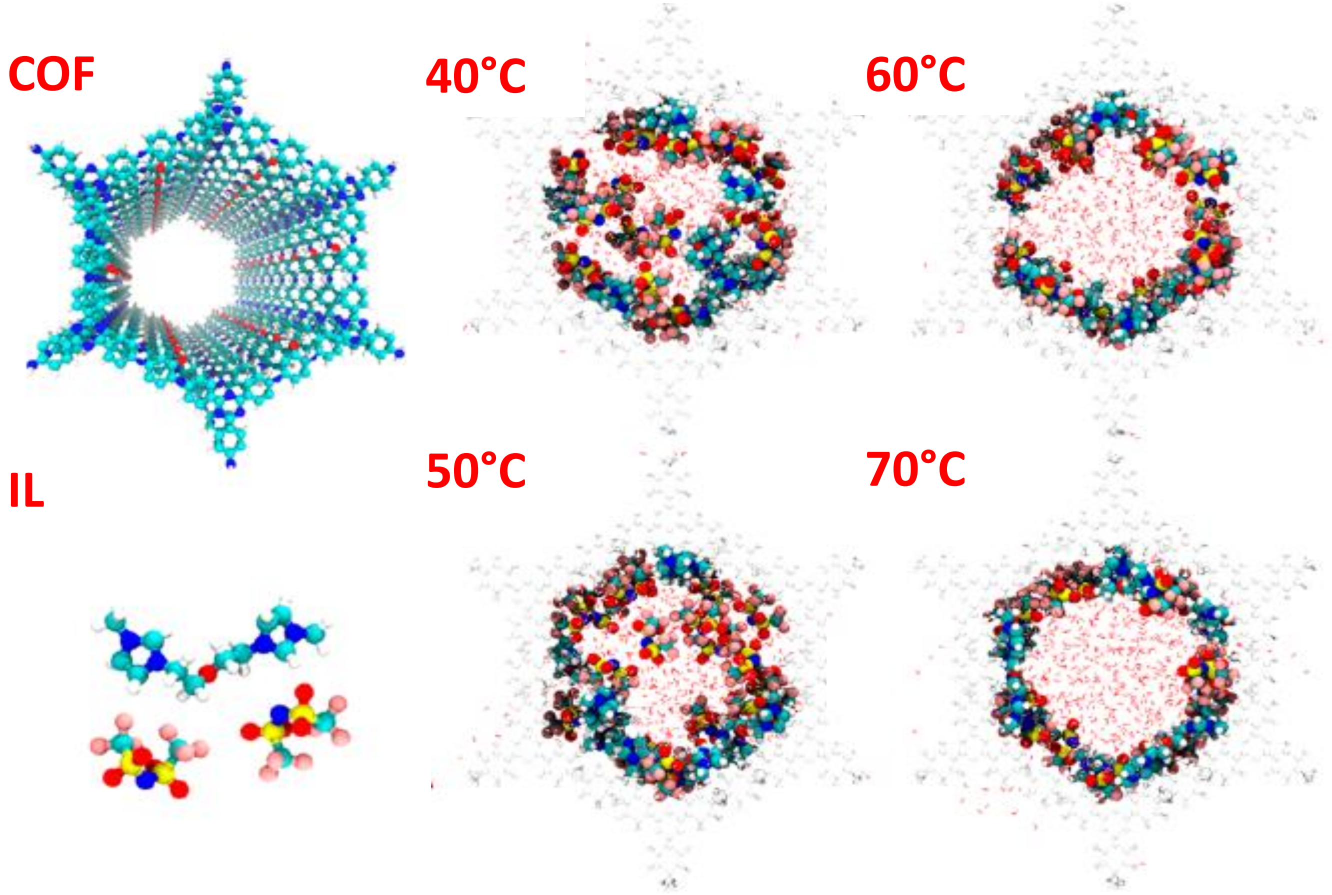

Molecular Dynamics simulations used to study phase separation in IL@COF hybrids

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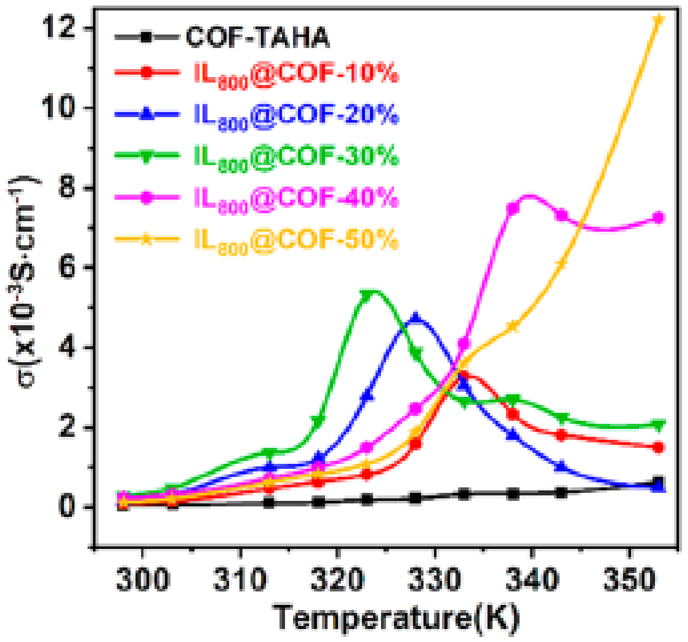
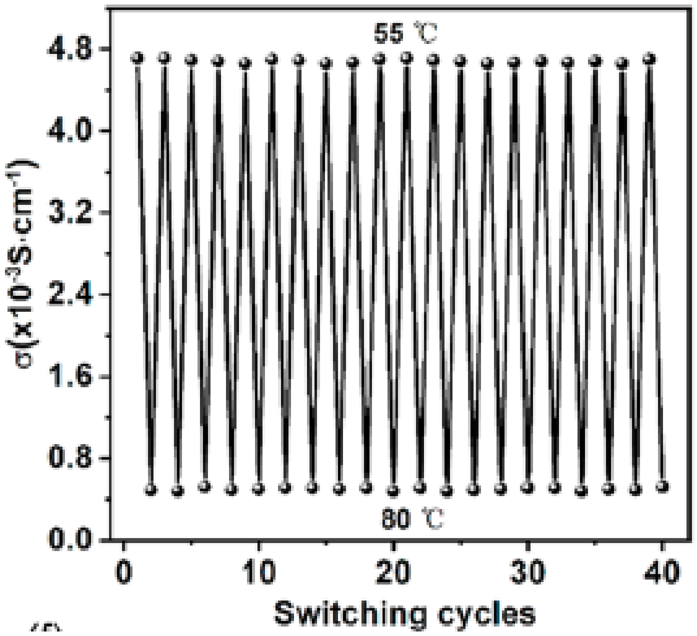
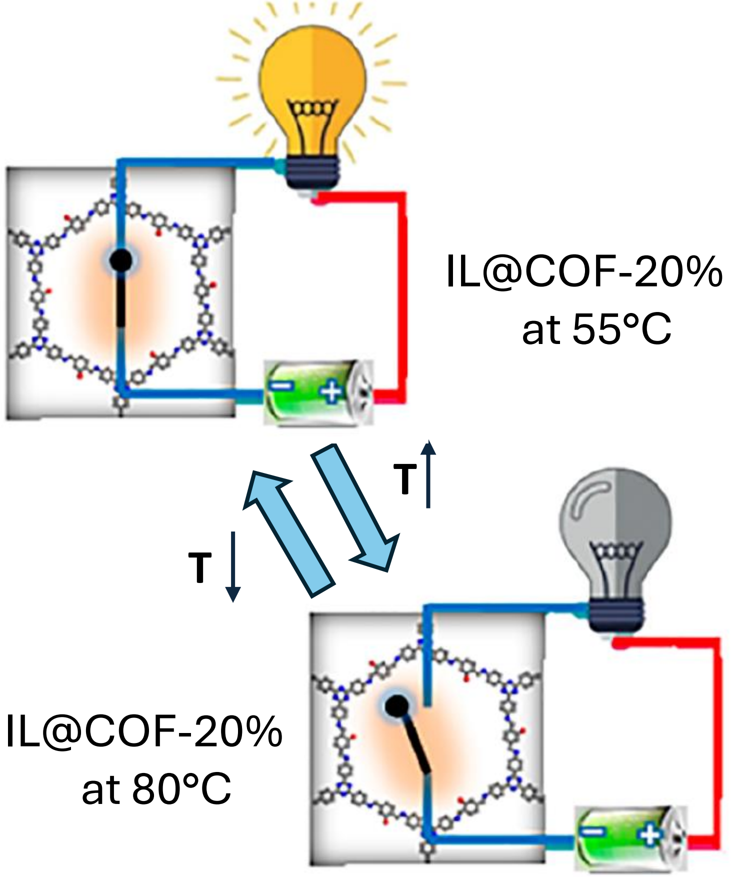


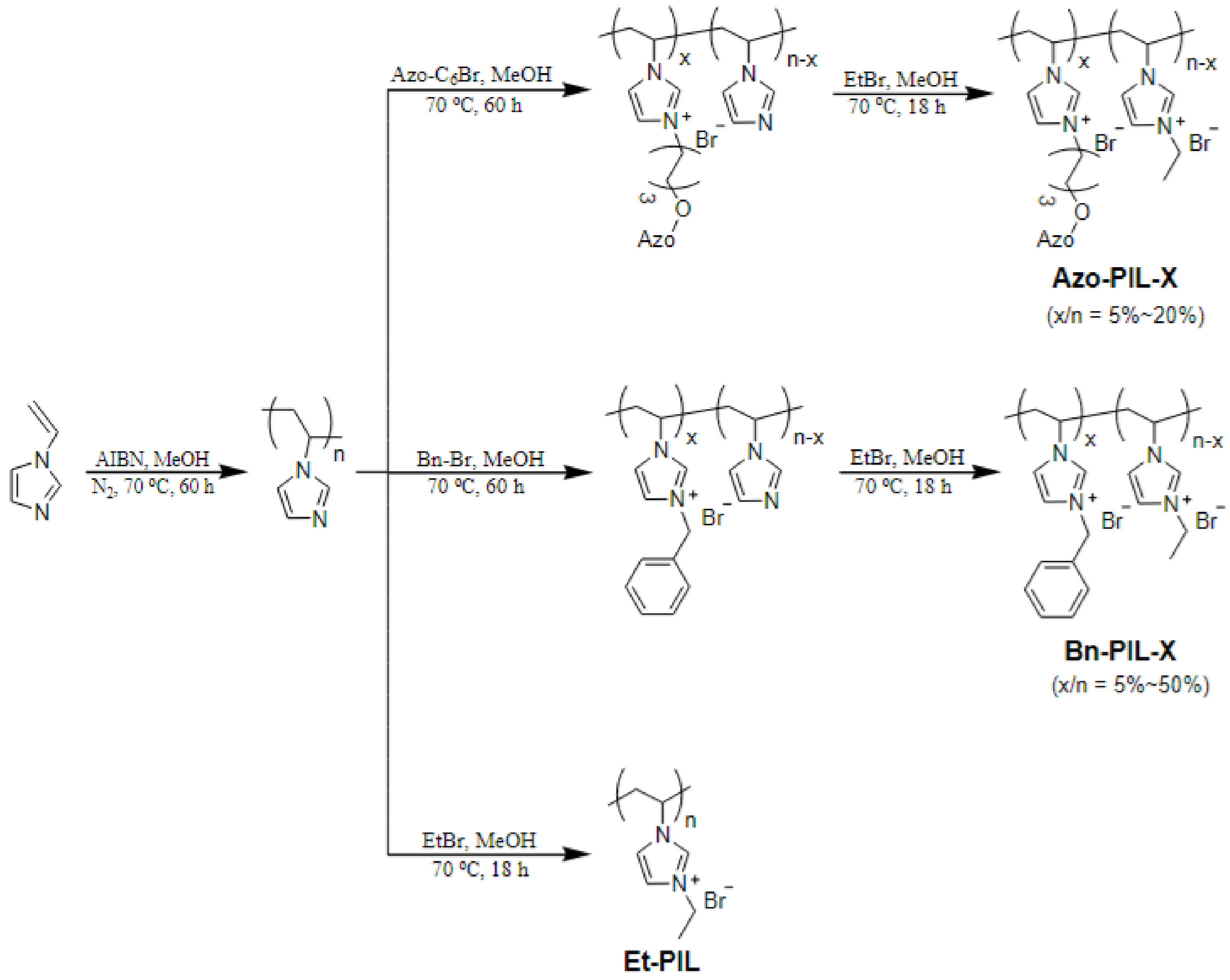


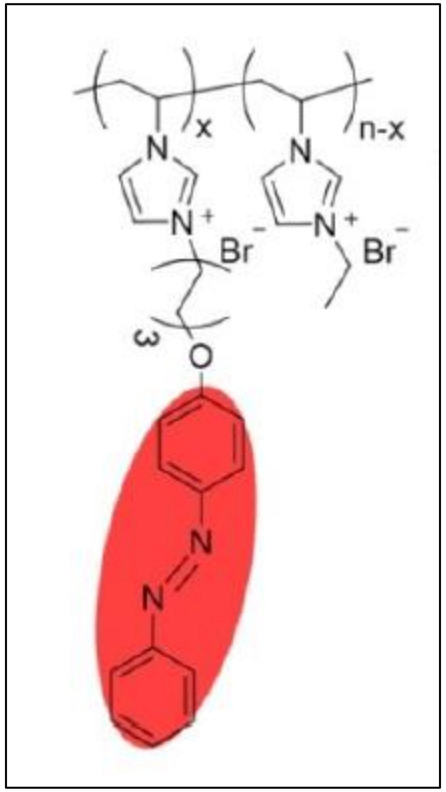


Conductivity performance of the IL@COF hybrids

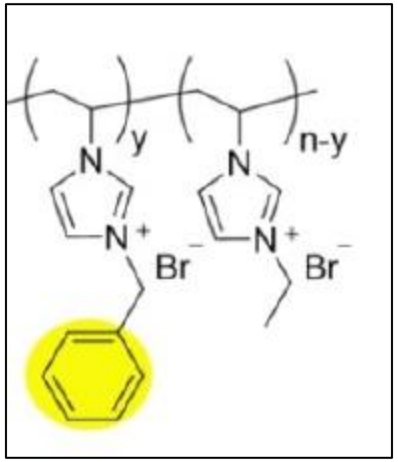
Up/Down Tuning of Poly(Ionic Liquids) in Aqueous Two-phase System

Y. Tang, Y. Zhang, X. Chen, X. Xie, N. Zhou, Z. Dai,* and Y. Xiong*, *Angew. Chem. Int. Ed.* **2023,** *62,* e202215722





Azobenzene modified-Poly(Ionic liquid)-X



Benzyl modified-Poly(Ionic liquid)-X

X: molar percentage of corresponding alkyl bromide w.r.t imidazole repeat units

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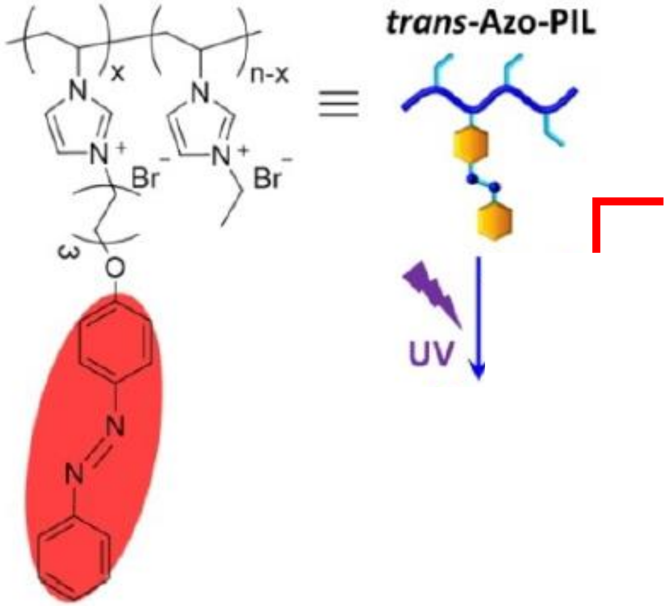

Aqueous Two-phase System:

1. Grafting degree (GD) tuned-
2. Thermo-tuned migration
3. Light irradiation tuned-

Up/Down Tuning of Poly(Ionic Liquids) in Aqueous Two-phase System

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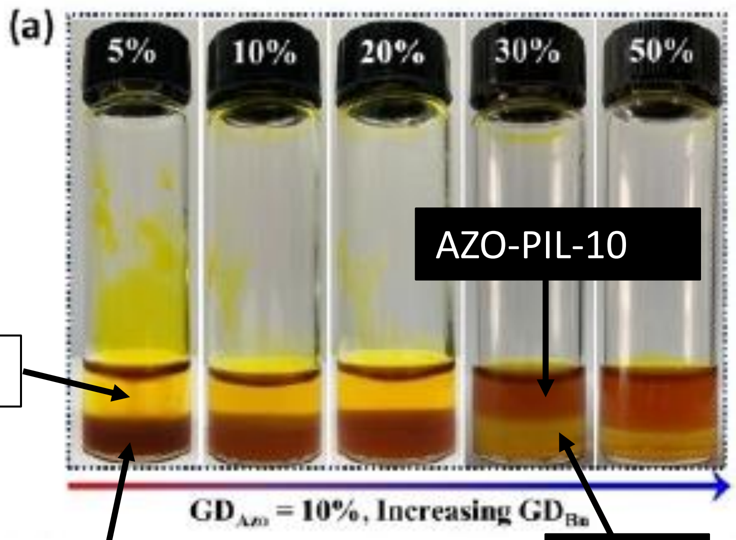
1. Grafting degree (GD) tuned-



AZO-PIL-10

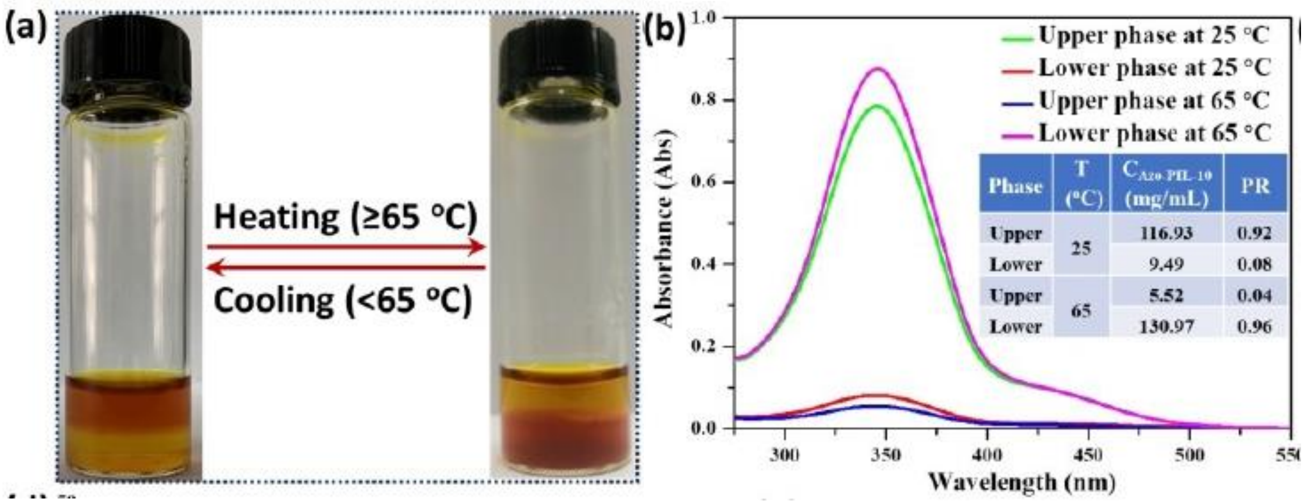
Bn-PIL (yellow)

AZO-PIL-10 (dark yellow)

Bn-PIL

Hydrodynamic Diameter (D_h) of AZO-PIL & Bn-PIL decreased with increasing GD_{azo} & GD_{Bn}

2. Thermo-tuned migration



Hydrodynamic Diameter (D_h) of AZO-PIL-10 & Bn-PIL-30 decreased with increasing temperatures,

Decrease is more for AZO-PIL-10 than for Bn-PIL-30

Up/Down Tuning of Poly(Ionic Liquids) in Aqueous Two-phase System

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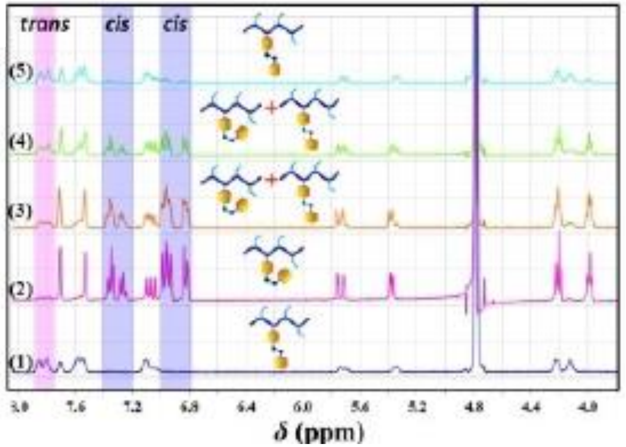
3. Light irradiation tuned-



Cis-Azo-PIL becomes more compatible with Bn-PIL, leading to formation of homogeneous single-phase solution, that can be reversed

Reviews

Ionic liquids and polymers

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Do Ionic Liquids Exhibit the Required Characteristics to Dissolve, Extract, Stabilize, and Purify Proteins? Past-Present-Future Assessment

Published as part of Chemical Reviews virtual special issue "Ionic Liquids for Diverse Applications".

Pankaj Bharmoria,* Alesia A. Tietze, Dibyendu Mondal, Tejwant Singh Kang, Arvind Kumar,* and Mara G Freire*

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David Mecerreyes,* Nerea Casado, Irune Villaluenga, and Maria Forsyth

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Catalytic depolymerization of polyester plastics toward closed-loop recycling and upcycling

Yujing Weng, †[a,b] Cheng-Bin Hong, †[a] Yulong Zhang*[b] and Haichao Liu *[a]

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Viewpoint

Ionic-Liquid-Mediated Deconstruction of Polymers for Advanced Recycling and Upcycling

Ty Christoff-Tempesta and Thomas H. Epps, III*

Cite This: *ACS Macro Lett.* 2023, 12, 1058–1070

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Ionic liquids and electrocatalysis

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Role of Ionic Solvents in the Electrocatalytic CO_2 Conversion and H_2 Evolution Suppression: from Ionic Liquids to Deep Eutectic Solvents

Alejandro Leal-Duaso,[a, b] Yanis Adjez,[a] and Carlos M. Sánchez-Sánchez*[a]

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Green Energy & Environment 9 (2024) 604–622
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Ionic liquid derived electrocatalysts for electrochemical water splitting

Tianhao Li a,b,*, Weihua Hu a,*

molecules
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Ionic Liquids as Promisingly Multi-Functional Participants for Electrocatalyst of Water Splitting: A Review

Chenyun Zhang [1], Puyu Qu [1], Mei Zhou [1], Lidong Qian [1], Te Bai [1], Jianjiao Jin [1] and Bingwei Xin [2,*]

Ionic liquids – general knowledge

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Zhenyu Zhao, Hong Li,* and Xin Gao*

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Protic ionic liquids for sustainable uses

Josh Bailey, Emily L. Byrne, Peter Goodrich, Paul Kavanagh and Małgorzata Swadźba-Kwaśny *

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