Amino-ionic liquids assisted highly compatible mixed matrix membrane of ZIF-8 and PIM-1 for efficient CO_2/N_2 seperation

Zhaojie Wang,[a] Xinle Sun,[a] Qinglong Liu,[a] Caifeng Xia,[a] Qikang Yin,[b] Siyuan Liu,[a] Xiaoqing Lu,[a] Hongyu Chen,*[b]

[a]Shandong Key Laboratory of Intelligent Energy Materials, School of Materials Science and Engineering, China University of Petroleum (East China), Qingdao 266580, P. R. China

[b]College of Science, China University of Petroleum (East China), Qingdao 266580, P. R. China

Corresponding Authors:

*E-mail: hychen1226@163.com

Keywords: PIM-1, AFIL, ZIF-8, Mixed matrix membrane, CO_2/N_2 separation

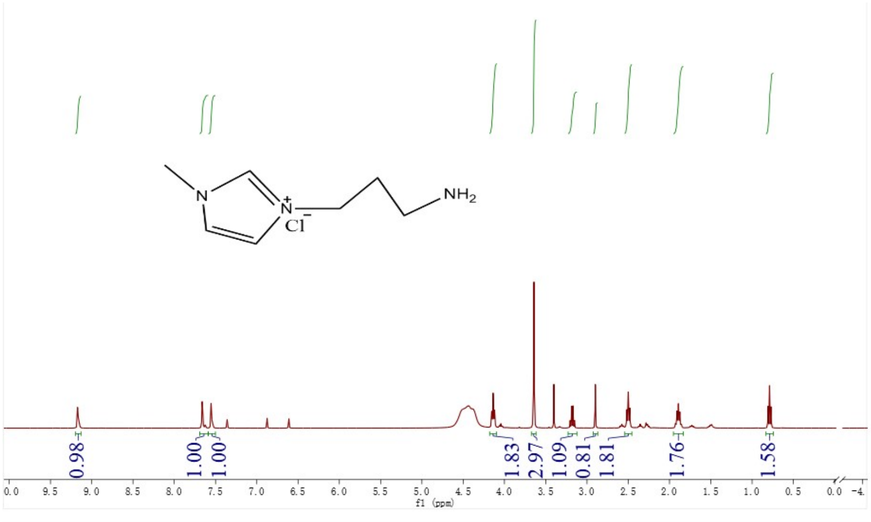

Figure S1. ^{1}H NMR spectrum of AFIL.

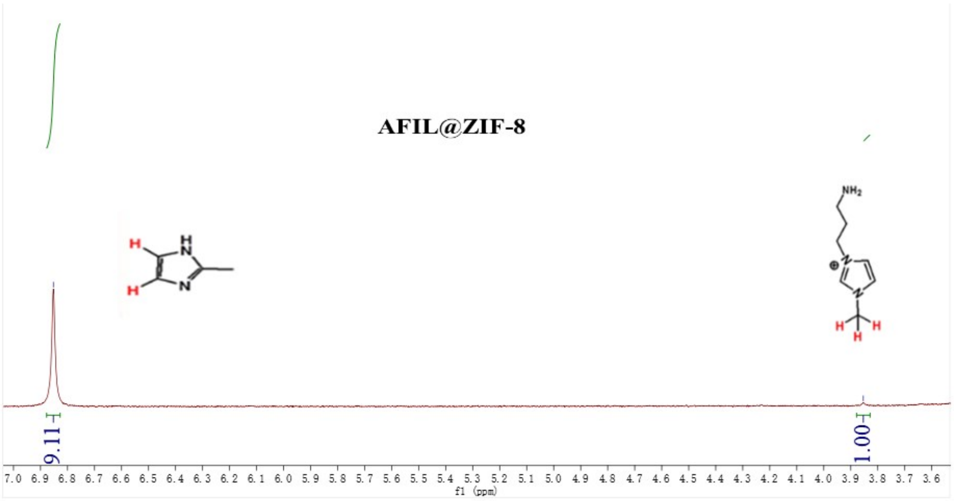

Figure S2. ^{1}H NMR spectrum of AFIL@ZIF-8.

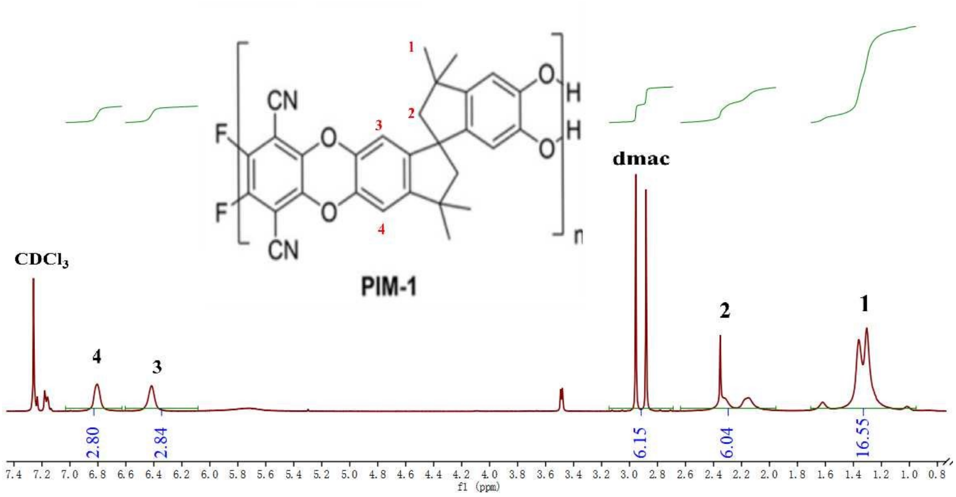

Figure S3. ^{1}H NMR spectrum of PIM-1.

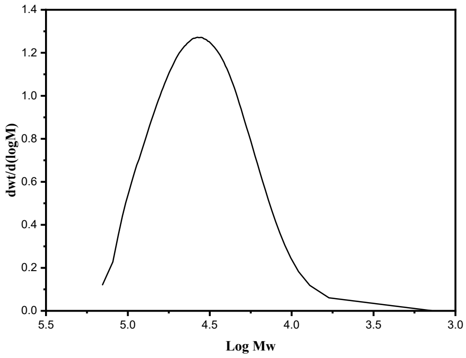

Figure S4. The molecular weight distribution curve of PIM-1 measured by GPC system.

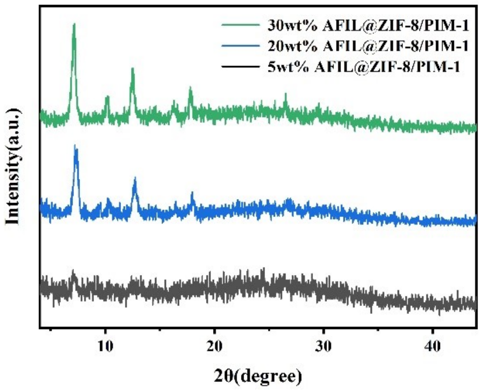

Figure S5. XRD patterns of 5 wt.% AFIL@ZIF-8/PIM-1, 20 wt.% AFIL@ZIF-8/PIM-1, and 30 wt.% AFIL@ZIF-8/PIM-1.

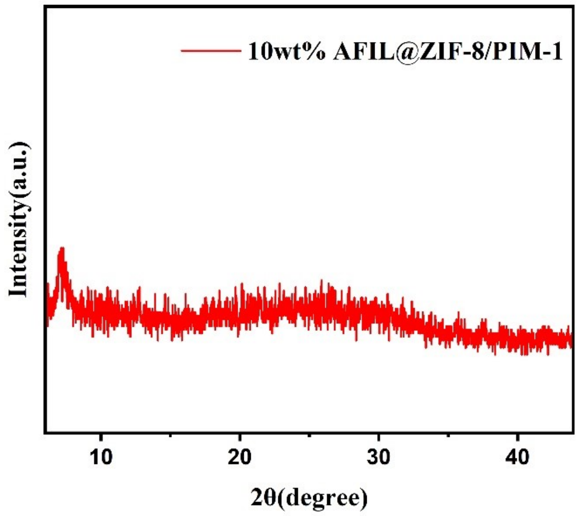

Figure S6. XRD pattern of 10 wt.% AFIL@ZIF-8/PIM-1 after the gas separation experiments.

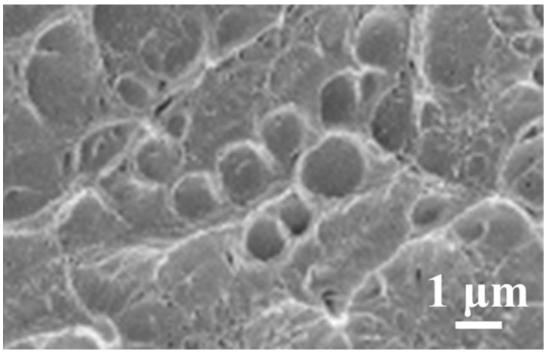

Figure S7. SEM image of 10 wt.% AFIL@ZIF-8/PIM-1 after the gas separation experiments.

Table S1. The mechanical properties of PIM-1, 10 wt.% ZIF-8/PIM-1, and 10 wt.% AFIL@ZIF-8/PIM-1.

Membranes	Tensile strength/MPa	Elongation at break/%
PIM-1	33.43	15.66
10 wt.% ZIF-8/PIM-1	44.49	6.93
10 wt.% AFIL@ZIF-8/PIM-1	47.52	6.86

Table S2. The gas separation performance of MMMs with different packing loadings.

Membranes	CO_2 Permeability (Barrer)	N_2 Permeability (Barrer)	CO_2/N_2 selectivity
PIM-1	3988	218	18.22
10 wt.% ZIF-8/PIM-1 MMM	4597	220	20.82
5 wt.% AFIL@ZIF-8/PIM-1 MMM	5004	172	29.42
10 wt.% AFIL@ZIF-8/PIM-1 MMM	7864	264	29.66
20 wt.% AFIL@ZIF-8/PIM-1 MMM	4416	168	26.17
30 wt.% AFIL@ZIF-8/PIM-1 MMM	4696	196	24.18

Table S3. Comparison of gas separation performance with the previously reported membranes.

Membrane	Loading (wt.%)	Operation conditions T (°C)	Operation conditions P (bar)	P (CO_2) [Barrer]	α (CO_2/N_2)	Ref.
ZIF-8/PPEES	30	30	1	50	24.5	S1
ZIF-8/P[vbim][Tf_2N]	18.9	35	3.5	198.8	19.5	S2
[emim][Tf_2N]/ZIF-8/P[vbim][Tf_2N]	23.7			693.6	19.6	
[Emim][Ac]/ZIF-8/CS	10	50	2	5413	11.5	S3
[Bmim][NTf_2]ZIF-8/Pebax1657	15	23	1	231.4	27.06	S4
[Bmim][NTf_2]@ZIF-8/Pebax1657	15	25	1	104.9	83.9	S5
[C_3NH_2bim][NTf_2]@MIL-101(Cr)-NH_2/PIM-1	5	25	3	2979	37	S6
[Bmim]NTf_2]@MOF-801/PIM	5	34	4	9420	29	S7
[Bmim]NTf_2]@UiO-66-NH_2/PIM-1	10	20	1	8283.4	22.5	S8
DnBMCl/ZIF-8/Pebax1657	8	30	2	261	71	S9
IL-NH_2@GO/Pebax1657	0.2	254	4	11836	71	S10
ZIF-8/Matrimd	50	25	2.7	4.7	26.2	S11
ZIF-8/6FDA-durene	30	25	6	2185	17	S12
ZIF-8/ Pebax	35	25	6	1287	32.3	S13
[C_6mim] [Tf_2N]/PIM-1	10	30	0.5	800	30	S14
PIM-1	~	30	0.5	7440	19	
PIM-1	~	25	1	4770	21.8	S15

UiO-66/PIM-1	9.1	25	1	5940	13.2	
UiO-66-NH_2/PIM-1	9.1	25	1	4810	22.3	
UiO-66-$(COOH)_2$/PIM-1	9.1	25	1	4600	21	
ZIF-67/PIM-1	20	30	2	5206	23.7	S16
Mg-MOF-74/PIM-1	10	30	~	1935	16.4	S17
MIL-53/PIM-1	4	31	~	953	17	
TIFSIX-3/PIM-1	4	32	~	1000	19.2	
Zn_2 $(bim)_4$/PIM-1	10	33	~	1900	19	
AFIL@ZIF-8/PIM-1	10	25	1	7864	29.66	This work
AFIL@ZIF-8/PIM-1	10	25	2	6108	34.79	

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