Supporting Information

Metal–organic framework membranes: from fabrication to application in gas separation.

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l - Thickness (m)	*T* -Temperature (K)	*P* -Pressure (bar)

Table S1. Comparison of permeation properties of pure MOFs membranes reported in the literature for sorption-driven reverse selective CO_2/H_2 separation. (the data plotted for the reported polymers in Figure 77, b in the article is taken from the https://membrane-australasia.org/polymer-gas-separation-membranes/)

MOF	Support, Method	Permeance (mol/(m^2*s*Pa))		Permeation (Barrer)		H_2/CO_2	l (m)	T (K)	P (bar)	Reference (DOI)
		H_2	CO_2	H_2	CO_2					
[Ni_2(L-aspartic acid)$_2$(1,2-bis(4-pyridyl)ethylene))]·(Guest)	Nickel meshes	1.02E-06	4.52E-08	6.09E+04	2.70E+03	22.6	2.0E-05	298	1	10.1039/c7ce00102a
ZIF-22	APTES-functionalized Ti_2O	1.70E-07	2.00E-08	2.03E+04	2.39E+03	8.5	4.0E-05	323	1	10.1002/anie.201001919
ZIF-90	APTES-functionalized Al_2O_3	2.50E-07	3.48E-08	1.49E+04	2.08E+03	7.2	2.0E-05	473	1	10.1021/ja108774v
ZIF-7	Al_2O_3, seeding	4.55E-08	3.50E-09	2.72E+02	2.09E+01	13.0	2.0E-06	493	1	10.1016/j.memsci.2010.02.074
ZIF-69	Al_2O_3	6.70E-08	2.55E-08	1.00E+04	3.81E+03	2.6	5.0E-05	298	1	10.1016/j.memsci.2010.02.023
HKUST-1	Al_2O_3, seeding	7.48E-07	1.48E-07	5.59E+04	1.11E+04	5.1	2.5E-05	298	1	10.1021/la200103w
NH_2 -MIL-53(Al)	glass frit, seeding	2.67E-06	9.80E-08	1.20E+05	4.39E+03	27.3	1.5E-05	288	1	10.1002/adfm.201200084
ZIF-8	Al_2O_3 hollow fiber, seeding	4.32E-07	1.22E-07	2.58E+03	7.29E+02	3.5	2.0E-06	298	1	10.1039/c3cc46244g
JUC-150 [Ni_2(L-aspartic acid)$_2$(pyrazine)]	Nickel meshes	1.83E-07	4.60E-09	1.91E+04	4.81E+02	39.8	3.5E-05	298	1	10.1039/c4ee02275k
JUC-150 [Ni_2(L-aspartic acid)$_2$(bipy)]	Nickel meshes	1.82E-06	1.65E-07	2.45E+05	2.22E+04	11.0	4.5E-05	298	1	10.1039/c4ee02275k
ZIF-100	polydopamine modified Al_2O_3	6.30E-08	8.10E-10	1.88E+03	2.42E+01	77.8	1.0E-05	298	1	10.1039/c4ta06763k
Amine-modified Mg-MOF-74/CPO-27-Mg	MgO seeds, Al_2O_3	8.20E-08	2.90E-09	2.45E+03	8.66E+01	28.3	1.0E-05	298	1	10.1016/j.ces.2014.10.037
Mg-MOF-74/CPO-27-Mg	MgO seeds, Al_2O_3	1.24E-07	1.10E-08	3.70E+03	3.29E+02	11.3	1.0E-05	298	1	10.1016/j.ces.2014.10.037

ZIF-8	1H,1H,2H,2H-perfluoroalkyltriethoxysilanes modified Al_2O_3	2.66E-07	1.55E-08	1.59E+04	9.26E+02	17.2	2.0E-05	473	1	10.1016/j.memsci.2018.04.053
ZIF-67	porous Al_2O_3 tube, from Cobalt carbonate	5.70E-07	1.30E-07	2.89E+03	6.60E+02	4.4	1.7E-06	323	1	10.1039/c8ce00238j
2D sheet Zn2(benzimidazole)4	porous Al_2O_3 tube, from GO coated ZnO	1.50E-07	1.42E-09	8.96E+01	8.45E-01	106.0	2.0E-07	423	1	10.1039/c7sc04815g
2D sheet Zn_2(benzimidazole)$_4$	porous Al_2O_3 tube, from ZnO	2.10E-07	3.94E-09	3.14E+01	5.88E-01	53.3	5.0E-08	323,473	1	10.1007/s12274-017-1803-0
ZIF-8	reduced GO-modified PVDF hollow fibe. con-diffusion	6.79E-07	2.72E-08	3.04E+02	1.22E+01	25.0	1.5E-07	298	1	10.1002/admi.201800032
ZIF-8-on-ZIF-67	Al_2O_3, LbL	1.20E-08	9.00E-10	1.29E+01	9.68E-01	13.3	3.6E-07	298	1	10.1002/chem.201705562
ZIF-8/2D g-C3N4	Al_2O_3, spin LbL	6.70E-08	1.60E-09	4.80E+01	1.15E+00	41.9	2.4E-07	298	1	10.1016/j.ces.2018.02.046
ZIF-8	polyacrylonitrile, PAN, electrophoretic nuclei assembly	9.90E-08	1.36E-08	1.48E+02	2.03E+01	7.3	5.0E-07	298	1	10.1002/adfm.201707427
2D sheet Zn_2(benzimidazole)4	Al_2O_3	6.51E-07	5.20E-09	1.94E+01	1.55E-01	125.2	1.0E-08	293	1	10.1002/anie.201703959
2D sheet Zn_2(benzimidazole)$_4$	Al_2O_3	9.00E-07	5.42E-09	2.69E+01	1.62E-01	166.0	1.0E-08	393	1	10.1002/anie.201703959
CAU-10-H (Al, 1,3-benzene dicarboxylic acid)	Al_2O_3	3.80E-09	3.62E-10	6.81E+01	6.49E+00	10.5	6.0E-06	473	2	10.1016/j.memsci.2016.04.017
ZIF-9	APTES-functionalized Al_2O_3	7.43E-06	5.00E-07	1.11E+06	7.47E+04	14.9	5.0E-05	298	1	10.1021/acs.iecr.6b01290
COF-300	SiO_2 disk			1.10E+05	1.83E+04	6.0	4.5E-05	298	1	10.1021/jacs.6b03348
Zn2(bdc)2(dabco)	SiO_2 disk			2.80E+05	4.00E+04	7.0	1.2E-04	298	1	10.1021/jacs.6b03348
ZIF-8	SiO_2 disk			1.20E+05	1.32E+04	9.1	6.0E-05	298	1	10.1021/jacs.6b03348
(COF-300)-(Zn_2(bdc)$_2$(dabco))	SiO_2 disk			1.30E+05	1.03E+04	12.6	9.7E-05	298	1	10.1021/jacs.6b03348
(COF-300)-(ZIF-8)	SiO_2 disk			1.10E+05	8.15E+03	13.5	1.0E-04	298	1	10.1021/jacs.6b03348

NH_2-MIL-125	Al_2O_3			4.25E+03	5.20E+02	8.2	2.0E-06	298	1	10.1016/j.memsci.2016.06.015
CuBTC/MIL-100	polydopamine modified PVDF hollow fiber, converted CuBTC	8.80E-08	1.13E-09	5.26E+03	6.77E+01	77.6	2.0E-05	298	2	10.1038/ncomms11315
CuBTC/MIL-100	polydopamine modified PVDF hollow fiber, converted CuBTC	1.05E-07	1.18E-09	6.27E+03	7.05E+01	89.0	2.0E-05	358	2	10.1038/ncomms11315
MIL-96(Al)	Al_2O_3, toluene seeding	5.30E-07	6.09E-08	1.11E+04	1.27E+03	8.7	7.0E-06	298	1	10.1021/acsami.5b12541
MIL-96(Al)	Al_2O_3, DMF seeding	3.80E-07	5.76E-08	2.27E+03	3.44E+02	6.6	2.0E-06	298	1	10.1021/acsami.5b12541
ZIF-8	APTES, Titania-functionalized PVDF hollow fiber	2.01E-05	2.86E-06	6.00E+04	8.53E+03	7.0	1.0E-06	293	1	10.1002/anie.201511340
ZIF-8	Al_2O_3	1.40E-08	1.87E-09	9.20E+00	1.23E+00	7.5	2.2E-07	298	1	10.1002/cssc.201500977
NH2-MIL-53	ammoniated PVDF hollow fibe	5.42E-06	1.78E-07	1.30E+05	4.26E+03	30.4	8.0E-06	298	1	10.1016/j.memsci.2015.08.049
ZIF-7-NH_2 coated PEBAX 1657	Al_2O_3	1.00E-07	5.26E-09	5.97E+03	3.14E+02	19.0	2.0E-05	298	1	10.1016/j.ces.2018.07.027
$Zn_2(bim)_4$ nanosheets	Al_2O_3	1.20E-06	1.35E-08	3.58E+00	4.03E-02	89.0	1.0E-09	298	1	10.1126/science.1254227
MOF-5	Al_2O_3	4.70E-06	1.05E-06	3.51E+05	7.84E+04	4.5	2.5E-05	298	1	10.1016/j.micromeso.2008.08.054
MOF-5 oriented	graphite-coated Al_2O_3	8.30E-07	2.10E-07	9.92E+04	2.51E+04	4.0	4.0E-05	298	1	10.1016/j.micromeso.2009.03.036
HKUST-1	Al_2O_3 hollow fiber, seeding	7.25E-08	5.50E-09	2.82E+03	2.14E+02	13.2	1.3E-05	313	1	10.1039/c2jm16371c
ZIF-8	Al_2O_3	6.04E-08	1.33E-08	7.22E+03	1.59E+03	4.5	4.0E-05	298	1	10.1021/ja907359t
ZIF-8	Al_2O_3, seeding	1.87E-06	5.00E-07	1.40E+05	3.73E+04	3.7	2.5E-05	298	1	10.1039/b924536g
ZIF-8/GO	Al_2O_3	1.45E-07	6.46E-09	1.52E+04	6.75E+02	22.4	3.5E-05	523	1	10.1021/ja5083602
ZIF-7	Al_2O_3, polyethyleneimine assisted seeding	7.40E-08	1.10E-08	3.32E+02	4.93E+01	6.7	1.5E-06	473	1	10.1002/ange.200905645
ZIF-95	APTES-functionalized Al_2O_3	2.46E-06	7.04E-08	2.20E+05	6.31E+03	34.9	3.0E-05	298	1	10.1039/c2cc35691k
MIL-53	Al_2O_3, seeding	4.90E-07	1.10E-07	1.17E+04	2.63E+03	4.5	8.0E-06	298	1	10.1039/c0cc03927f

Ni-MOF-74	Al_2O_3, seeding	0.0000127	0.0000014	9.48E+05	1.05E+05	9.1	0.000025	298	1	10.1016/j.micromeso.2012.07.008
ZIF-7-8	Al_2O_3, microwave	0.0000003	0.00000006	1.79E+03	3.58E+02	5.0	0.000002	298	1	10.1021/acsami.7b18506

Table S2. Comparison of permeation properties of pure MOFs membranes reported in the literature for diffusion-driven H_2/CO_2 separation. (the data plotted for the reported polymers in Figure 77, a in the article is taken from the https://membrane-australasia.org/polymer-gas-separation-membranes/)

MOF	Support	Permeation (Barrer)		CO_2/H_2	Mix gas		*l* (m)	*T* (K)	*P* (bar)	Reference (DOI)
		H_2	CO_2		%/%	CO_2/H_2				
CAU-1	Al_2O_3 hollow fiber, seeding	3.79E+03	9.86E+03	2.6			2.5E-06	298	1	10.1039/c4cc00068d
$[Cu_2(benzoate)_4(pyrazine)]_n$ [100] direction	single crystal	5.26E-01	7.17E-01	1.4	10/90	0.36	0.00016	298	1	10.1021/ja910492d
		5.26E-01	7.17E-01		20/80	1.29	0.00016	298	1	10.1021/ja910492d
		5.26E-01	7.17E-01		70/30	2.19	0.00016	298	1	10.1021/ja910492d
		5.26E-01	7.17E-01		60/40	3.85	0.00016	298	1	10.1021/ja910492d
		5.26E-01	7.17E-01		50/50	4.08	0.00016	298	1	10.1021/ja910492d
		5.26E-01	7.17E-01		40/60	6.49	0.00016	298	1	10.1021/ja910492d
		5.26E-01	7.17E-01		30/70	14.17	0.00016	298	1	10.1021/ja910492d
		5.26E-01	7.17E-01		20/80	18.20	0.00016	298	1	10.1021/ja910492d
		5.26E-01	7.17E-01		10/90	32.65	0.00016	298	1	10.1021/ja910492d
sod-ZMOF	Al_2O_3	35.8	94.1	2.6	70/30	5.20	0.00005	298	2	10.1021/ja511495j
MOF-5	Al_2O_3, seeding	710.9	8154.1	4.5	20/80	1.25	0.000014	298	2.7	10.1021/ie202777q
		710.9	8154.1		60/40	1.75	0.000014	298	2.7	10.1021/ie202777q
		710.9	8154.1		40/60	2.60	0.000014	298	2.7	10.1021/ie202777q
		710.9	8154.1		82/18	4.50	0.000014	298	2.7	10.1021/ie202777q
MOF-5, CO_2 treated		5266.7	23709.7	4.5	98/2	5781.00	0.000014	298	5	10.1016/j.memsci.2018.03.036

Table S3. Comparison of permeation properties of pure MOFs membranes reported in the literature for CO_2/CH_4 separation. (the data plotted for the reported polymers in Figure 78, a in the article is taken from the https://membrane-australasia.org/polymer-gas-separation-membranes/)

MOF	Support, Method	Permeance (mol/(m^2*s*Pa))		Permeation (Barrer)		CO_2/CH_4	l (m)	T (K)	P (bar)	Reference (DOI)
		CH_4	CO_2	CH_4	CO_2					
MOF-5	Al_2O_3	1.38E-07	0.00000015	5.75E+03	6.27E+03	1.1	0.000014	298	3	10.1002/aic.15367
ZIF-8	Al_2O_3	2.41E-06	0.0000169	6.49E+04	4.54E+05	7.0	0.000009	295	1	10.1021/ja909263x
$Co_3(HCOO)_6$	silicon wafer, seeding	4.1513E-07	0.00000225	1.49E+04	8.06E+04	5.4	0.000012	298	1	10.1002/chem.201101733
ZIF-69	Al_2O_3, seeding	8.6E-09	2.36E-08	1.03E+03	2.82E+03	2.7	0.00004	298	1	10.1016/j.memsci.2011.05.041
$[Cu_2(ndc)_2(dabco)]$	Al_2O_3	4E-09	1.4E-08	2.39E+02	8.36E+02	3.5	0.00002	298	1	10.1016/j.micromeso.2011.09.006
Bio-MOF-1	stainless steel tube, seeding	0.00000046	0.00000119	2.06E+04	5.33E+04	2.6	0.000015	298	1.4	10.1039/c2cc31821k
Bio-MOF-13	stainless steel tube, seeding	0.00000082	0.0000031	1.71E+04	6.48E+04	3.8	0.000007	298	1	10.1039/c3ta14058j
Bio-MOF-14	stainless steel tube, seeding	0.00000118	0.00000416	4.58E+04	1.62E+05	3.5	0.000013	298	1	10.1039/c3ta14058j
ZIF-7-8	Al_2O_3, microwave	1.4E-08	0.00000006	8.36E+01	3.58E+02	4.3	0.000002	298	1	10.1021/acsami.7b18506
sod-ZMOF	Al_2O_3	1.8E-10	6.3E-10	2.69E+01	9.41E+01	3.5	0.00005	298	2	10.1021/ja511495j
MIL-100(In)	Al_2O_3	2.4658E-07	0.0000009	3.68E+03	1.34E+04	3.7	0.000005	298	2	10.1002/zaac.201400574
ZIF-8-ZnAl-NO_3 LDH composite membrane	Al_2O_3	7.5786E-10	9.7763E-09	4.53E+01	5.84E+02	12.9	0.00002	363	1	10.1002/anie.201411550
CAU-1	Al_2O_3 hollow fiber, seeding	8.9189E-08	0.00000132	6.66E+02	9.86E+03	14.8	0.0000025	298	1	10.1039/c4cc00068d

Table S4. Comparison of permeation properties of pure MOFs membranes reported in the literature for CO_2/N_2 separation. (the data plotted for the reported polymers in Figure 78, b in the article is taken from the https://membrane-australasia.org/polymer-gas-separation-membranes/)

MOF	Support, Method	Permeance (mol/(m^2*s*Pa))		Permeation (Barrer)		CO_2/N_2	*l* (m)	*T* (K)	*P* (bar)	Reference (DOI)
		N_2	CO_2	N_2	CO_2					
MOF-5	Al_2O_3	1.82927E-07	0.00000015	5.75E+03	6.27E+03	0.8	0.000014	298	3	10.1002/aic.15367
ZIF-69	Al_2O_3, seeding	1.06E-08	2.36E-08	1.03E+03	2.82E+03	2.2	0.00004	298	1	10.1016/j.memsci.2011.05.041
ZIF-7-8	Al_2O_3, microwave	0.000000024	0.00000006	8.36E+01	3.58E+02	2.5	0.000002	298	1	10.1021/acsami.7b18506
sod-ZMOF	Al_2O_3	7.3E-11	6.3E-10	2.69E+01	9.41E+01	8.6	0.00005	298	2	10.1021/ja511495j
MIL-100(In)	Al_2O_3	2.85714E-07	0.0000009	3.68E+03	1.34E+04	3.2	0.000005	298	2	10.1002/zaac.201400574
ZIF-8-ZnAl-NO_3 LDH composite membrane	Al_2O_3	2.44048E-09	9.7763E-09	4.53E+01	5.84E+02	4.0	0.00002	363	1	10.1002/anie.201411550
CAU-1	Al_2O_3 hollow fiber, seeding	5.04E-08	0.00000132	6.66E+02	9.86E+03	26.2	0.0000025	298	1	10.1039/c4cc00068d

Table S5. Comparison of permeation properties of pure MOFs membranes reported in the literature for C_2H_4/C_2H_6 separation. (the data plotted for the reported polymers in Figure 79, a in the article is taken from the 10.1002/aic.14105)

MOF	Support, Method	Permeance (mol/(m^2*s*Pa))		Permeation (Barrer)		C_2H_4/C_2H_6	*l* (m)	*T* (K)	*P* (bar)	Reference (DOI)
		C_2H_4	C_2H_6	C_2H_4	C_2H_6					
MOF-5	Al_2O_3	0.000000018	6.66667E-09	1.34E+03	4.98E+02	2.7	0.000025	298	1	10.1016/j.memsci.2010.12.001

Table S6. Comparison of permeation properties of pure MOFs membranes reported in the literature for C_3H_6/C_3H_8 separation. (the data plotted for the reported polymers in Figure 79, b in the article is taken from the 10.1016/s0376-7388(02)00430-1)

MOF	Support, Method	Permeance (mol/(m^2*s*Pa))		Permeation (Barrer)		mix C_3H_6/C_3H_8	*l* (m)	*T* (K)	*P* (bar)	Reference (DOI)
		C_3H_6	C_3H_8	C_3H_6	C_3H_8					
ZIF-8	Al2O3 , counter-diffusion	2.7799E-08	6.46488E-10	1.25E+02	2.90E+00	43.0	0.0000015	298	1	10.1021/ja403849c
ZIF-8	Al2O3	8.09E-09	1.97317E-10	2.42E+02	5.89E+00	41.0	0.00001	298	1	10.1021/la4014637
ZIF-8	Al2O3 , counter-diffusion	2.5E-09	4.23729E-11	5.97E+02	1.01E+01	59.0	0.00008	298	1	10.1016/j.memsci.2013.09.012
ZIF-8	Al2O3, secondary growth	0.000000011	3.66667E-10	8.21E+01	2.74E+00	30.0	0.0000025	298	1	10.1016/j.memsci.2013.09.029
ZIF-8	PAI hollow fiber, IMMP	1.4405E-08	9.47697E-11	3.49E+02	2.29E+00	152.0	0.0000081	298	1	10.1021/acsami.6b08801

Table S7. Comparison of permeation properties of pure MOFs membranes reported in the literature for C_4H_{10}/i-C_4H_{10} separation. (the data plotted for the reported polymers in Figure 79, c in the article is taken from the 10.1038/s41563-017-0013-1)

MOF	Support, Method	Permeation (Barrer)		C_4H_{10}/i-C_4H_{10}	*l* (m)	*T* (K)	*P* (bar)	Reference (DOI)
		C_4H_{10}	i-C_4H_{10}					
ZIF-90	carbon hollow fibers, fluidic processing technique	192	16	12	0.0000031	298	1	10.1002/admi.201700080