

Supplementary Information

Amidoxime Modified UiO-66@PIM-1 Mixed-Matrix Membranes to Enhance CO₂ Separation and Anti-Aging Performance

Jiaming Gao¹, Yongchao Sun¹, Feifei Kang¹, Fei Guo¹, Gaohong He¹, Hanli Wang²,
Zhendong Yang², Canghai Ma¹, Xiaobin Jiang¹ and Wu Xiao^{1,*}

¹ State Key Laboratory of Fine Chemicals, Frontier Science Center for Smart Materials, Dalian University of Technology, Dalian 116024, China; jiaminggao97@outlook.com (J.G.); yongchao_sun@mail.dlut.edu.cn (Y.S.); kangfeifei1998@outlook.com (F.K.); guofei@mail.dlut.edu.cn (F.G.); hgaohong@dlut.edu.cn (G.H.); cma@dlut.edu.cn (C.M.); xbjiang@dlut.edu.cn (X.J.)

² Shandong Huaxia Shenzhou New Material Co., Ltd., Zibo 256401, China; whl89333@huaxiashenzhou.com (H.W.); yangzhendong@huaxiashenzhou.com (Z.Y.)

* Correspondence: wuxiao@dlut.edu.cn

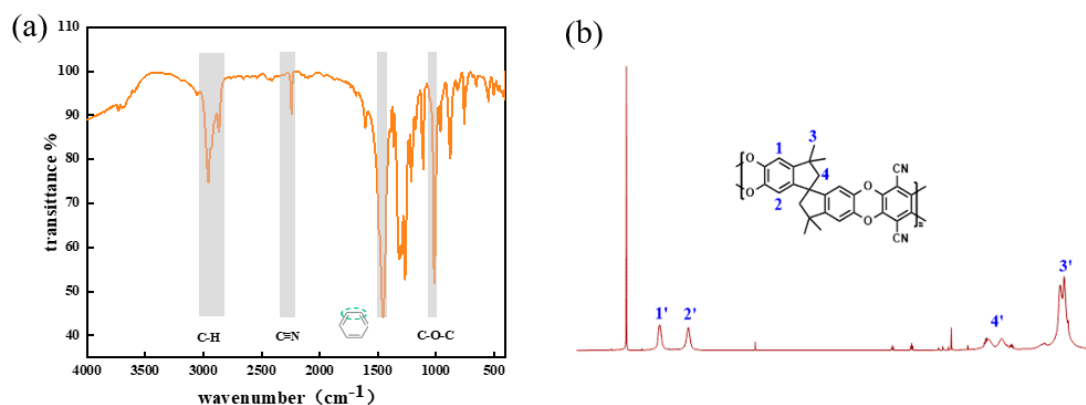


Figure S1. Chemical structure characterization of PIM-1: (a) FT-IR spectra; (b) ¹H NMR spectra.

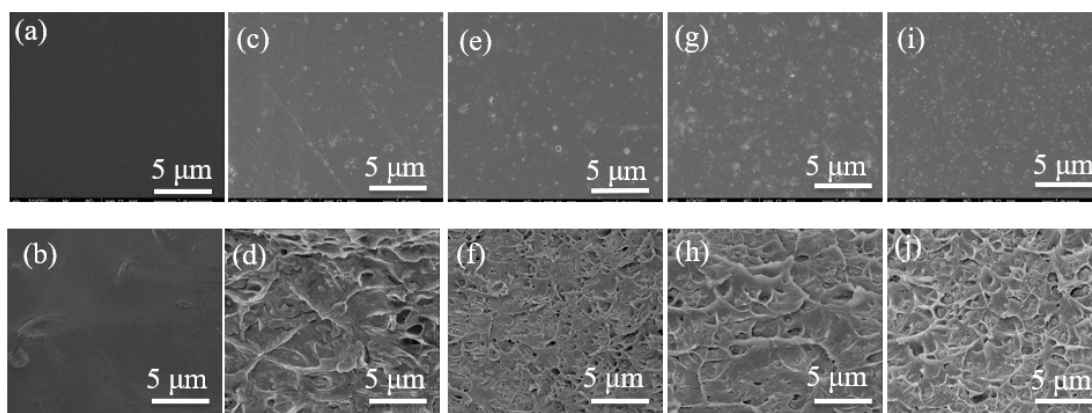


Figure S2. Surface and cross-sectional SEM images of UiO-66-AO@PIM-1 MMMs with different loadings: (a,b) 0 wt%; (c,d) 10 wt%; (e,f) 10 wt%; (g,h) 20 wt%; (i,j) 30 wt%

Table S1. Averaged permeabilities and selectivities at 25 °C and 2 bar, for the pristine PIM-1 and the UiO-66-CN MMMs.

UiO-66-CN	Permeability (P) (Barrer)			Ideal selectivity (α)	
	CO ₂	N ₂	CH ₄	CO ₂ /N ₂	CO ₂ /CH ₄
0	5573.24	300.97	496.18	18.52	11.23
5 wt%	6288.54	312.39	504.69	20.13	12.46
10 wt%	7135.02	318.49	515.50	22.40	13.84
20 wt%	9027.93	468.47	566.72	19.23	15.93
30 wt%	9965.11	549.63	704.23	18.13	14.15

Table S2. Diffusivity (10^{-8} cm² s⁻¹) and solubility (10^{-2} cm³(STP) cm³ atm⁻¹) coefficients, diffusivity selectivity (α_D) and solubility selectivity (α_S) for UiO-66-CN/PIM-1 MMMs.

UiO-66-CN loading	Diffusivity			Solubility			α_D		α_S	
	CO ₂	N ₂	CH ₄	CO ₂	N ₂	CH ₄	CO ₂ /N ₂	CO ₂ /CH ₄	CO ₂ /N ₂	CO ₂ /CH ₄
0%	83.3	49.3	31.3	66.9	6.1	15.9	1.7	2.7	11.0	4.2
5%	89.2	51.1	31.5	70.5	6.1	16.0	1.8	2.8	11.2	4.4
10%	93.1	55.8	32.0	76.7	5.7	16.1	1.9	2.9	11.8	4.8
20%	111.7	72.2	35.6	80.8	6.4	15.9	1.5	3.1	12.6	5.1
30%	119.9	82.0	43.5	83.1	6.7	16.2	1.4	2.8	12.5	5.1

Table S3. Diffusivity (10^{-8} cm² s⁻¹) and solubility (10^{-2} cm³(STP) cm³ atm⁻¹) coefficients, diffusivity selectivity (α_D) and solubility selectivity (α_S) for UiO-66-AO@PIM-1 MMMs.

UiO-66-AO loading	Diffusivity			Solubility			α_D		α_S	
	CO ₂	N ₂	CH ₄	CO ₂	N ₂	CH ₄	CO ₂ /N ₂	CO ₂ /CH ₄	CO ₂ /N ₂	CO ₂ /CH ₄
0%	83.3	49.3	31.3	63.9	6.1	15.9	1.7	2.7	11.0	4.2
5%	88.9	47.8	28.7	71.3	6.2	16.0	1.9	3.1	11.5	4.5
10%	99.3	43.6	30.9	75.9	6.4	16.2	2.3	3.2	11.9	4.7
20%	105.5	52.8	31.5	79.6	6.8	16.1	2.0	3.4	11.7	4.9
30%	108.3	57.4	31.7	81.2	7.1	16.1	1.9	3.3	11.4	5.1