Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Highly permeable thermally rearranged polymer composite membranes with a graphene oxide scaffold for gas separation

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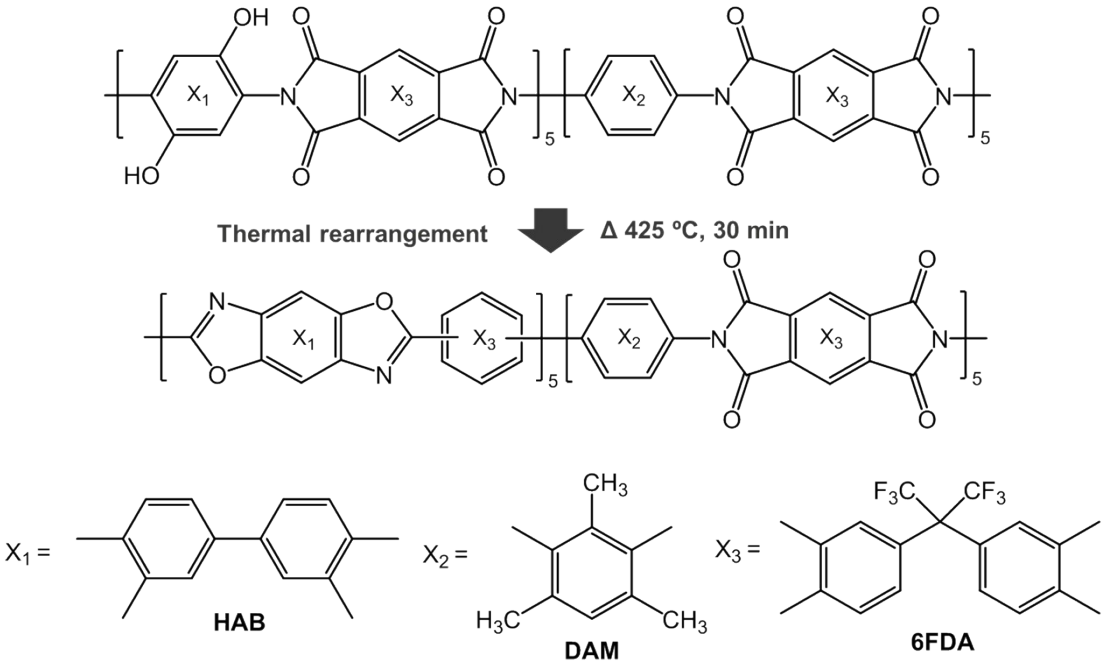

Fig. S1 Chemical structures of the monomers, PI and TR-PBOI membranes.

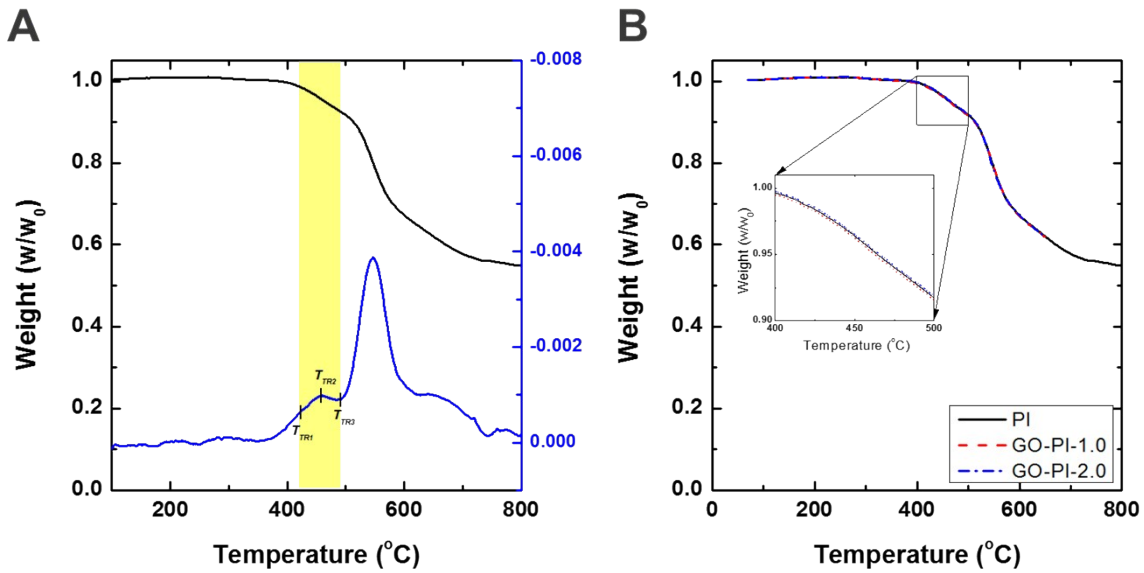

Fig. S2 Thermogravimetric analysis (TGA) curves of PI and GO-PI freestanding membranes.

The first weight loss between 420 ºC to 490 ºC represents thermal conversion from PI to PBOI. Thermal rearrangement temperatures (T_{TR1}, T_{TR1}, and T_{TR1}) were determined from its derivation curve and a duration time at 425 ºC was determined from its isotherm curve at 425 ºC by comparing to theoretical and experimental weight loss of thermal conversion.

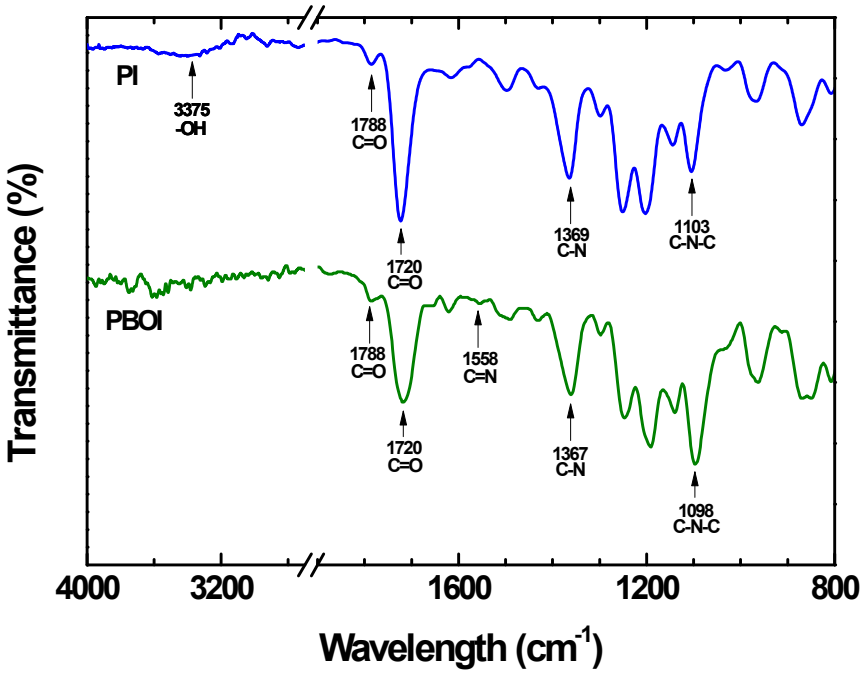

Fig. S3 Fourier transform infrared spectroscopy (ATR-FTIR) spectra of PIs and TR-PBOIs.

Typical bands of imide at 1788 cm^{-1}, 1720 cm^{-1}, 1369 cm^{-1}, and 1103 cm^{-1} were found in both PIs and PBOIs and a broad band of hydroxyl groups (3375 cm^{-1}) was only observed in PIs. Hydroxyl groups in PI and GO were disappeared during thermal rearrangement and a typical band of benzoxazoles (1558 cm^{-1}) was appeared.

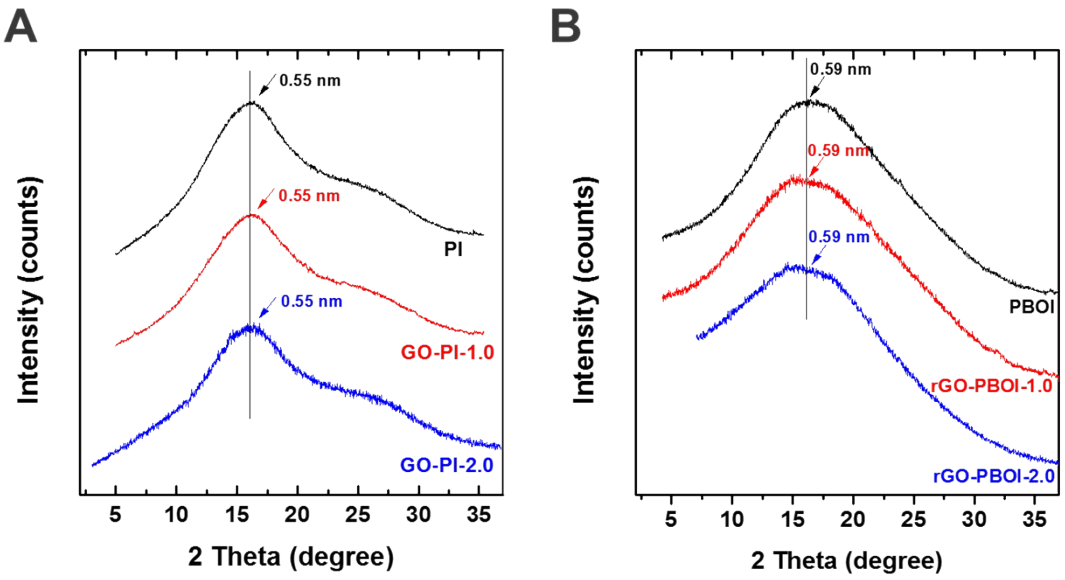

Fig. S4 X-ray diffraction (XRD) curves of PIs and TR-PBOIs.

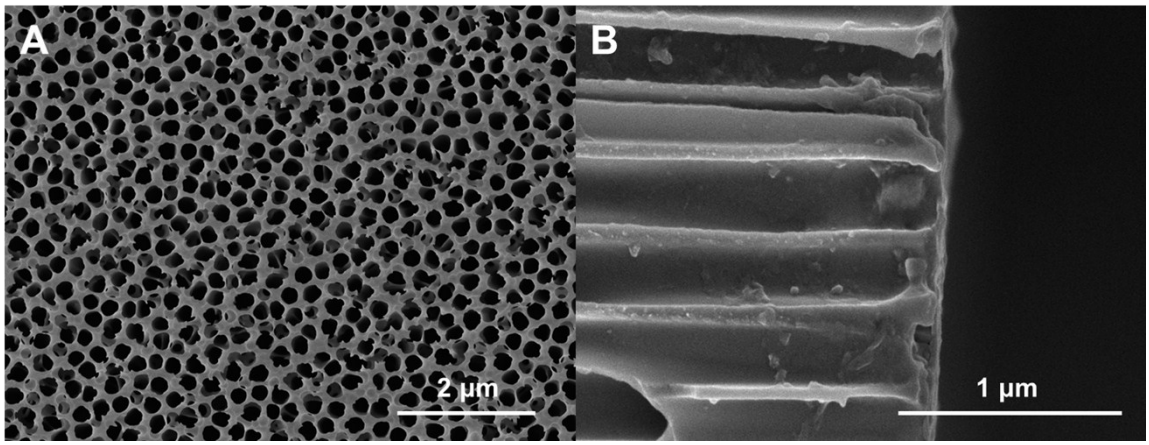

Fig. S5 Scanning electron microscope (SEM) images of AAO substrate (a) surface and (b) cross-section.

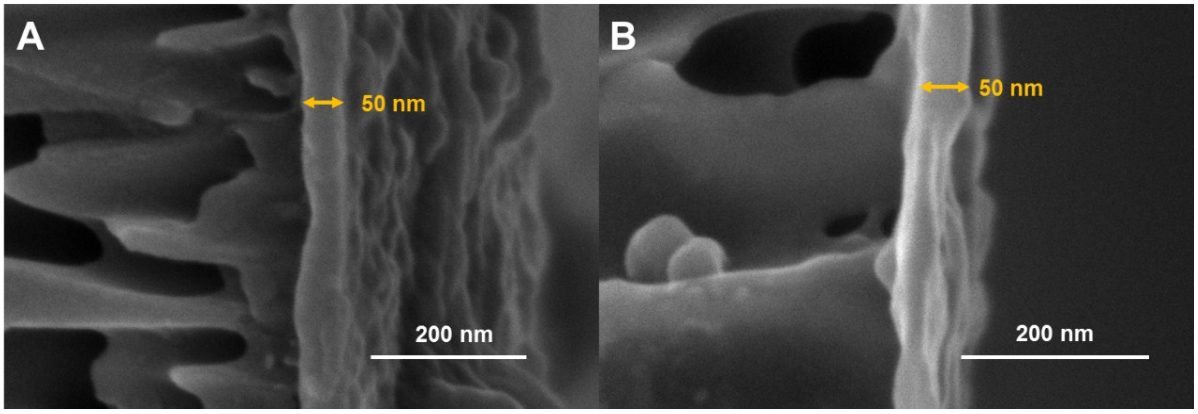

Fig. S6 Scanning electron microscope (SEM) images of (a) GO-PI-2.0 and (b) rGO-PBOI-2.0 prepared from 2.0 wt% solution in THF.

Table S1. Single gas permeability and permeance of TR-PBOI freestanding membranes.

	H_2	CO_2	O_2	N_2	CH_4	H_2/N_2	CO_2/N_2	O_2/N_2	CO_2/CH_4
Permeability (Barrer*)	203	185	32	7.5	5.3				
Permeance (GPU*)	4.1	3.7	0.64	0.15	0.11				
Ideal selectivity						27	26	4.2	35

*1 Barrer = 10^{-10} cm^3(STP) cm/cm^2 s cmHg = 3.35×10^{-16} mol m/m^2 s Pa
*1 GPU = 10^{-6} cm^3(STP)/cm^2 s cmHg = 3.35×10^{-10} mol/m^2 s Pa

Table S2. Single gas permeance of rGO-PBOI membranes.

	Gas permeance (GPU)					Ideal selectivity			
	H_2	CO_2	O_2	N_2	CH_4	H_2/N_2	CO_2/N_2	O_2/N_2	CO_2/CH_4
rGO-PBOI-1.0	1847	1784	363	101	55.1	18.3	17.7	3.6	32.4
rGO-PBOI-1.5	1505	1450	280	76	41.7	19.8	19.1	3.7	34.8
rGO-PBOI-2.0	1233	1149	201	56.4	29.4	21.3	20.4	3.6	39.1
rGO-PBOI-2.2	986	872	150	41.7	20.3	23.7	20.9	3.6	43.0
rGO-PBOI-2.4	761	673	125	30.7	15.1	24.8	21.9	4.1	44.6

Table S3. Mixed gas permeance of rGO-PBOI-1.0 membranes.

Gas permeance (GPU)				Separation factor	
CO_2 - CH_4 pair		CO_2 - N_2 pair			
CO_2	CH_4	CO_2	N_2	CO_2/CH_4	CO_2/N_2
1780	50.7	1785	98.1	35.1	18.2