

**Highly stable Pebax® Renew® thin-film nanocomposite membranes with metal organic
framework ZIF-94 and ionic liquid [Bmim][BF₄] for CO₂ capture**

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Membrane characterization

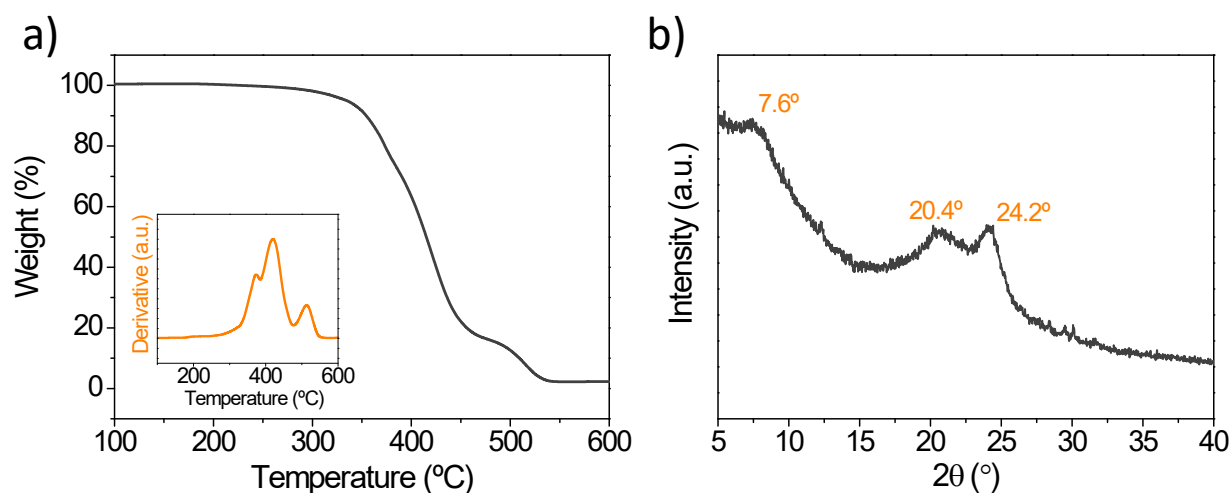


Figure S1. Pebax® Renew® dense membrane: thermal stability in terms of TGA and DTG (a), and XRD pattern (b)..

Gas separation results

CO₂/N₂ separation

Table S1. CO₂/N₂ separation performance of the TFC membranes prepared with different ionic liquid [Bmim][BF₄] content dispersed in Pebax® Renew®. Measures at 35 °C and 3 bar.

Membrane	wt% IL	CO ₂ permeance	N ₂ permeance	CO ₂ /N ₂ selectivity
		(GPU)		
TFC_PEBA	0	497 ± 71	21 ± 4	27 ± 3
TFC_PEBA(5IL)	5	517 ± 62	18 ± 5	30 ± 4
TFC_PEBA(10IL)	10	629 ± 74	22 ± 4	29 ± 1
TFC_PEBA(15IL)	15	585 ± 69	18 ± 3	32 ± 1
TFC_PEBA(20IL)	20	438 ± 66	18 ± 3	25 ± 1

Table S2. CO₂/N₂ separation performance of the TFN membranes prepared with 10 wt% of ionic liquid [Bmim][BF₄] and different ZIF-8 content. Measured at 35 °C and 3 bar.

Membrane	wt% ZIF-8	CO ₂ permeance	N ₂ permeance	CO ₂ /N ₂ selectivity
		(GPU)		
TFC_PEBA	0	497 ± 71	21 ± 4	27 ± 3
TFC_PEBA(10IL)	0	629 ± 74	22 ± 4	29 ± 1
TFN_PEBA(10IL)_ZIF8(10)	10	665 ± 35	27 ± 2	25 ± 0
TFN_PEBA(10IL)_ZIF8(15)	15	751 ± 81	33 ± 8	25 ± 2
TFN_PEBA(10IL)_ZIF8(20)	20	770 ± 20	39 ± 2	20 ± 2

Table S 3. CO₂/N₂ separation performance of the TFN membranes prepared with 10 wt% of ionic liquid [Bmim][BF₄] and different ZIF-94 (SALE) content. Measured at 35 °C and 3 bar.

Membrane	wt% ZIF-94	CO ₂ permeance	N ₂ permeance	CO ₂ /N ₂ selectivity
		(GPU)		
TFC_PEBA	0	497 ± 71	21 ± 4	27 ± 3
TFC_PEBA(10IL)	0	629 ± 74	22 ± 4	29 ± 1
TFC_PEBA(10IL)_ZIF94(10)	10	789 ± 2	32 ± 2	25 ± 2
TFC_PEBA(10IL)_ZIF94(15)	15	819 ± 79	34 ± 4	25 ± 1
TFC_PEBA(10IL)_ZIF94(20)	20	716 ± 26	37 ± 13	26 ± 1

Long-term stability

Figure S2 illustrates the fitting to a linear regression of the long-term stability data. The intercept for each regression corresponds to the fresh membrane's CO₂ permeance. The figure shows R² regression values and the corresponding line equations. The time at which the CO₂ permeance was lowered by two was determined as the half-life of each configuration and values are presented in Table S4.

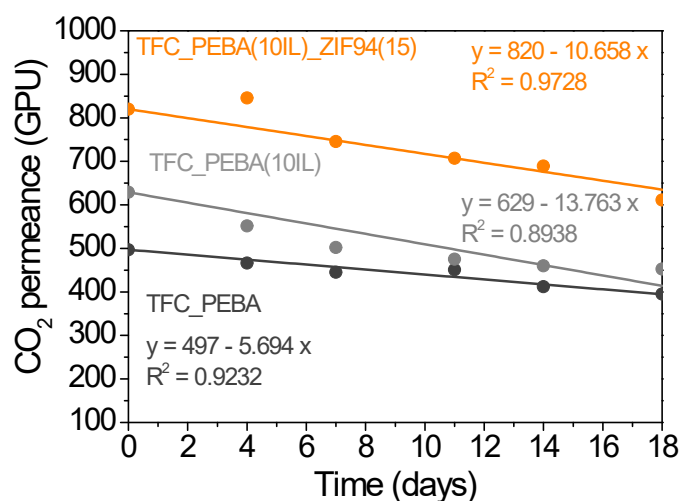


Figure S2. Linear fitting of the long-term stability studies of the TFC_PEBA, TFN_PEBA(10IL) and TFN_PEBA(10IL)_ZIF94(15) membranes with equations and R² regression.

Table S4. Half-time in days calculated with the linear equations depicted in Figure S2.

Membrane	$PCO_{2,1/2}$ (GPU)	$t_{1/2}$ (days)
TFC_PEBA	249	44
TFC_PEBA(10IL)	315	23
TFC_PEBA(10IL)_ZIF94(15)	410	39

CO₂/CH₄ separation

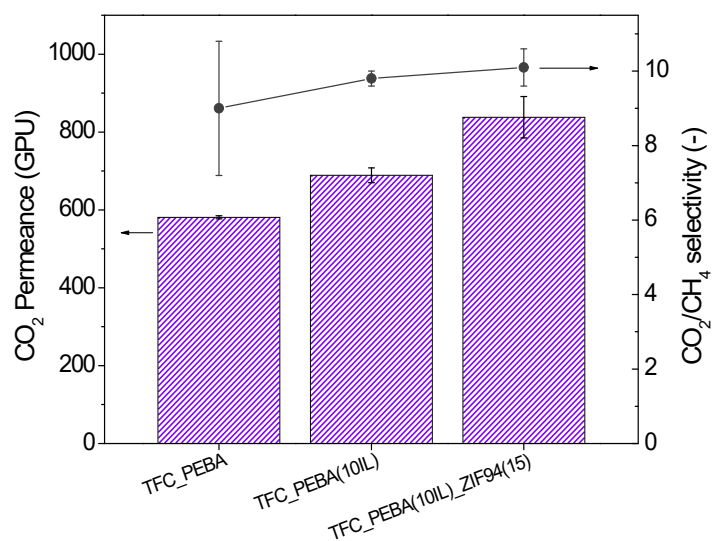


Figure S3. CO₂/CH₄ separation performance of the TFC and TFN membranes prepared with the optimal conditions. Measured at 3 bar and 35 °C.