

Mitigating the Agglomeration of Nanofiller in a Mixed Matrix Membrane by Incorporating an Interface Agent

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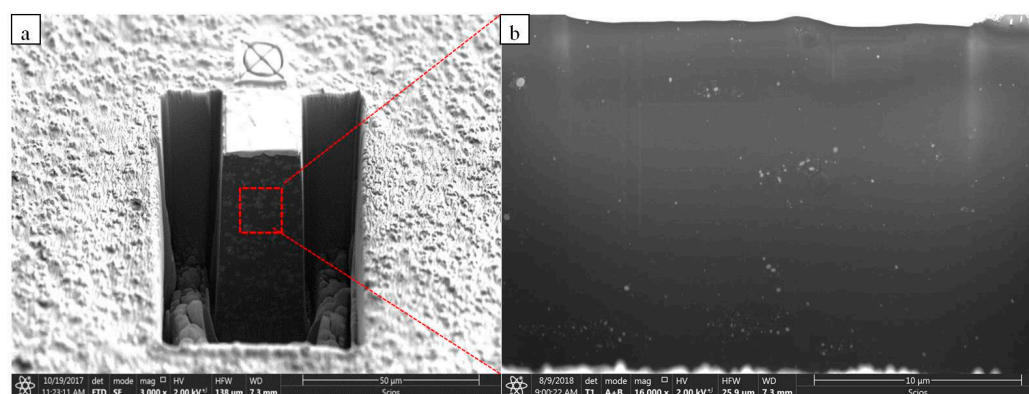


Figure S1. Typical FIB-SEM images of Pebax/ND 1.5 wt.% MMM: (a) FIB milling trend and (b) cross-sectional image in BSE mode.

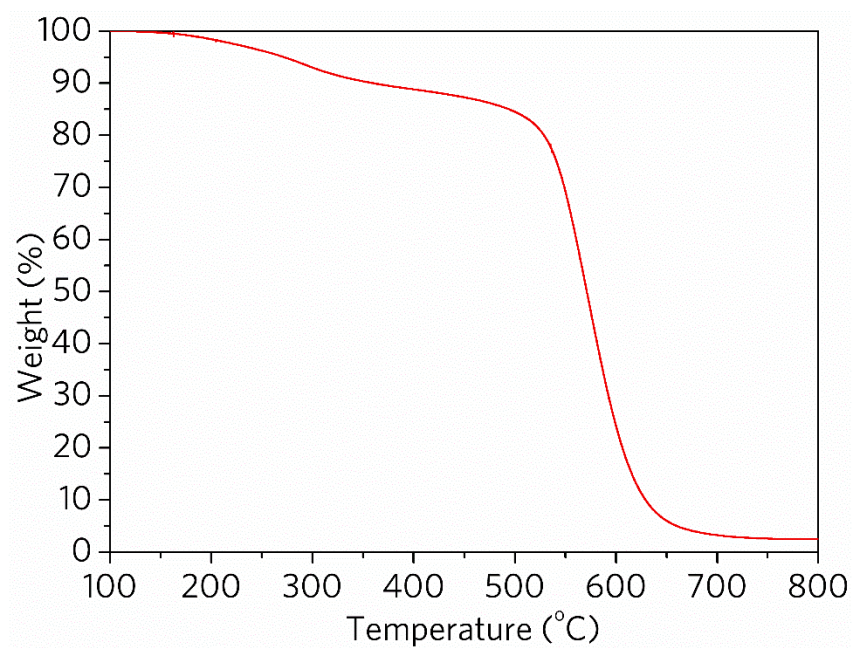


Figure S2. Thermogravimetric analysis of ND-PEI at a ramp rate of $20^{\circ}\text{C min}^{-1}$.

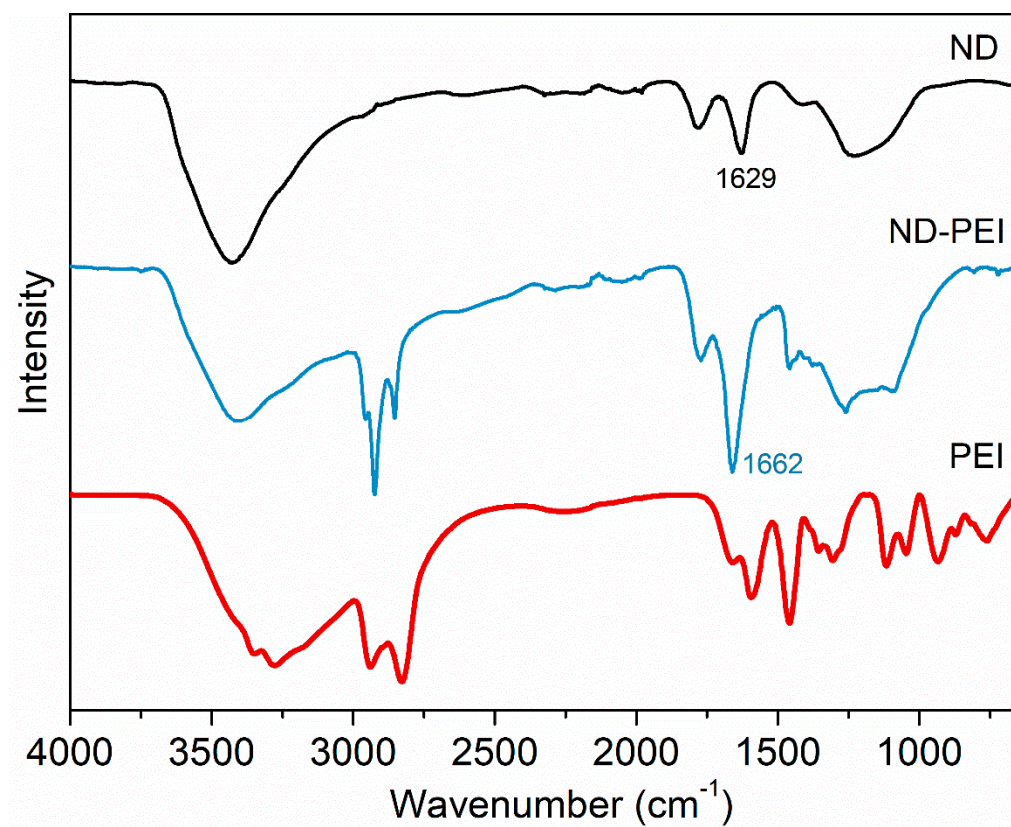


Figure S3. Fourier-transform infrared spectra of ND, ND-PEI and PEI.

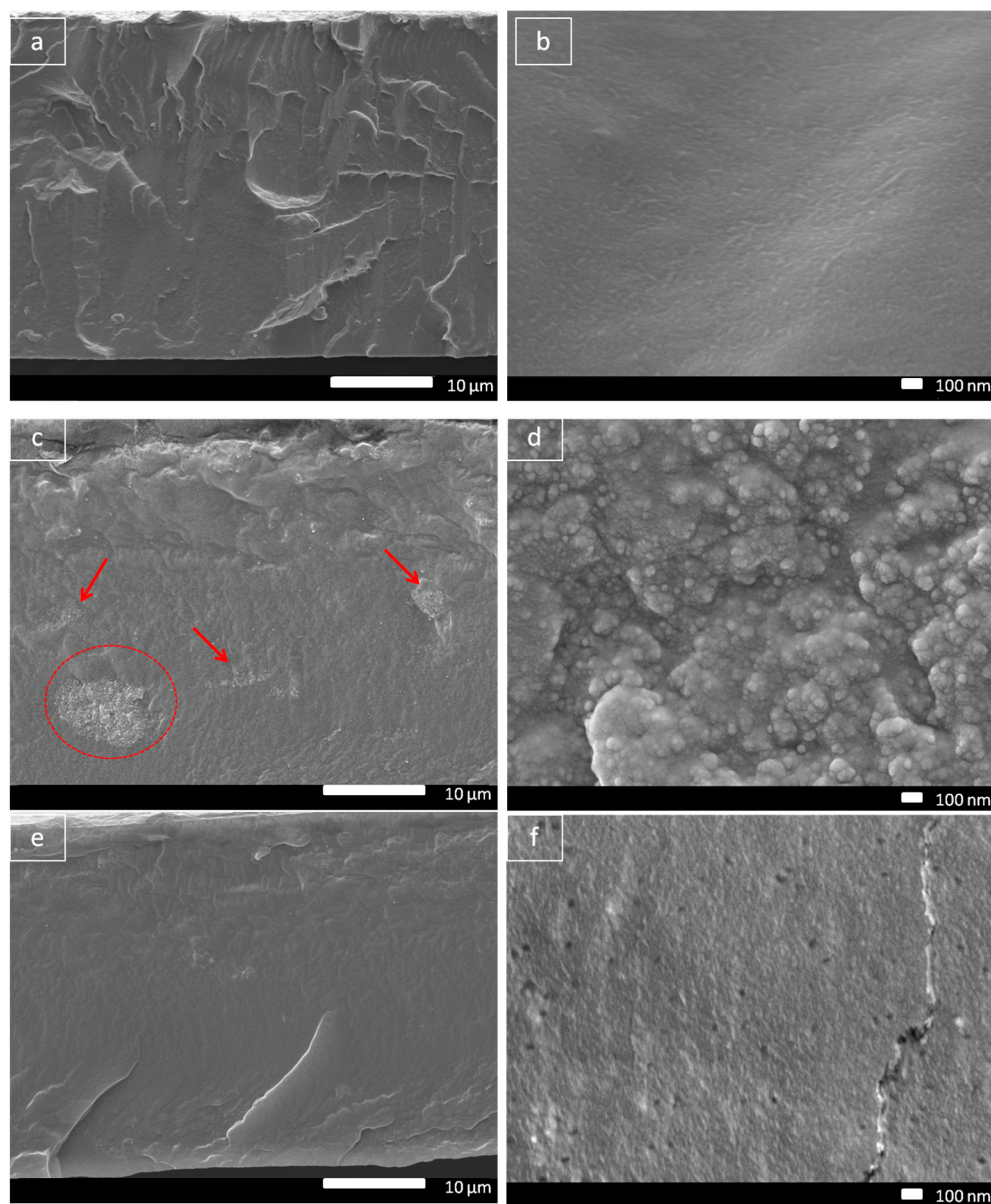


Figure S4. Membrane cross-section SEM images of pristine Pebax (a, b), Pebax/ND 1.5 wt.% (c, d) and Pebax/ND-PEI 1.5 wt.% (e, f) MMMs.

Predicted CO₂ and N₂ interfacial permeabilities with increase of the ratio of the interface thickness to particle size

Figure S5 depicts predicted CO₂ and N₂ interfacial and MMM permeabilities with increase in the ratio of the interface thickness to particle size (ℓ_i/r_o) for a Pebax/ND-PEI MMM with a nominal ND loading of 1.0 wt.%. In Figure S5a, c the mean CO₂ and N₂ interfacial permeabilities are shown in the right corner. In Figure S5b, d the continuous line correspond to the CO₂ and N₂ experimental permeabilities while the dotted lines correspond to one standard deviation of the experimental data point. In both cases, the closed circle symbol corresponds to ℓ_i/r_o in which the Felske model prediction deviates beyond the experimental error.

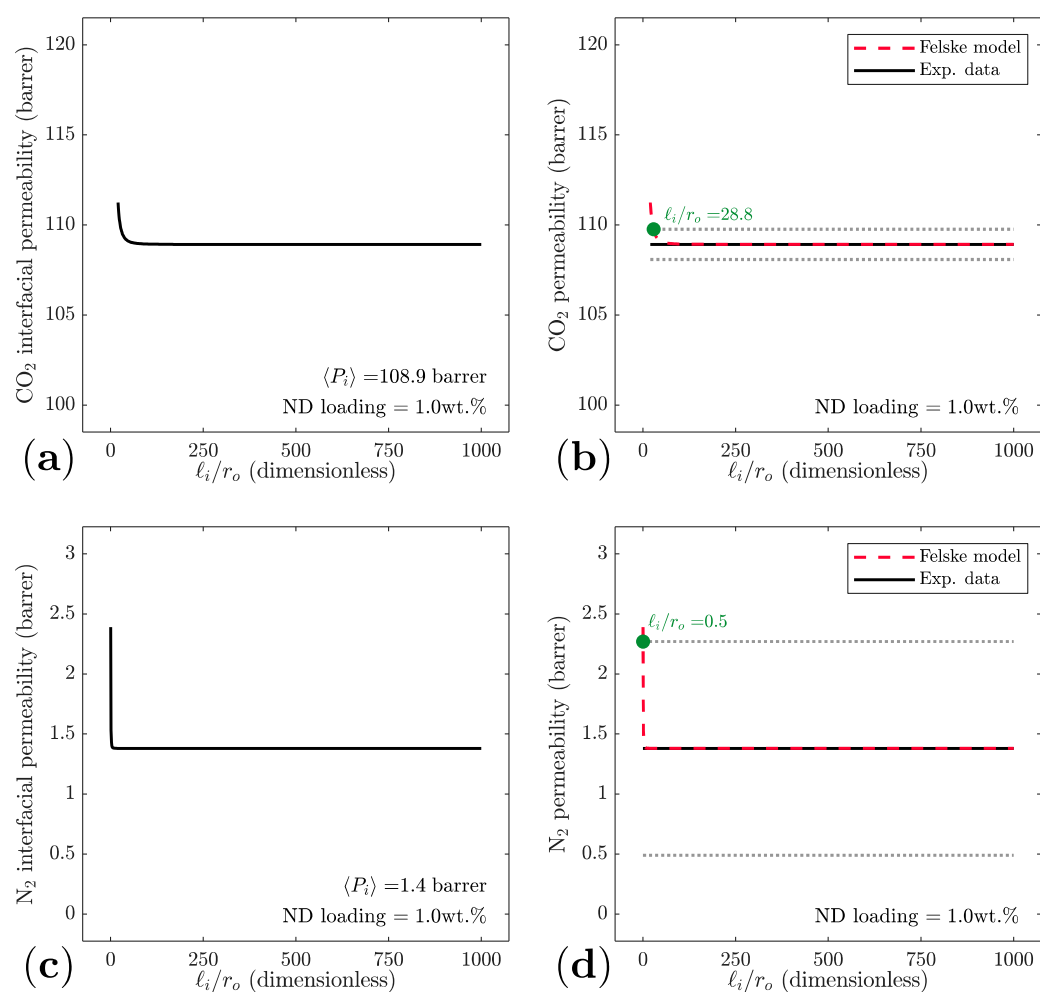


Figure S5. Predicted CO₂ and N₂ interfacial and MMM permeabilities with increase the ratio of the interface thickness to particle size. (a) CO₂ interfacial permeability (b) CO₂ permeability in Pebax/ND-PEI and, (c) N₂ interfacial permeability (d) N₂ permeability in Pebax/ND-PEI.

Table S1. Gas permeability and selectivity of pure Pebax membrane, Pebax/ND MMMs and Pebax/ND-PEI MMMs.

Sample	Permeability (barrer)		Selectivity
	CO ₂	N ₂	
Pebax	56.03±1.96	1.38±0.50	40.60
Pebax/ND 0.1 wt.%	43.12±2.29	1.09±0.14	39.57
Pebax/ND 0.5 wt.%	46.08±0.53	1.30±0.19	35.41
Pebax/ND 1.0 wt.%	46.12±0.84	1.43±0.29	32.25

Pebax/ND 1.5 wt.%	91.06±1.23	2.53±0.21	36.04
Pebax/ND-PEI 0.1 wt.%	33.92±1.11	0.89±0.21	38.11
Pebax/ND-PEI 0.5 wt.%	49.31±6.63	0.97±0.24	50.84
Pebax/ND-PEI 1.0 wt.%	108.92±0.84	2.27±0.89	47.98
Pebax/ND-PEI 1.5 wt.%	147.23±2.21	3.97±0.31	37.09
