

**Supporting Information**

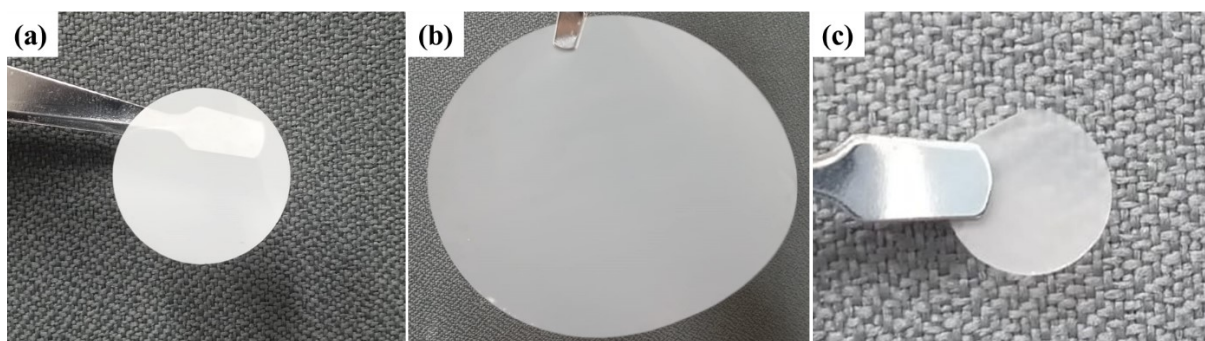
**Aqueous Amination of Track-Etched Polycarbonate Membranes for  
Tuneable Nanochannel Surface Charge Density**

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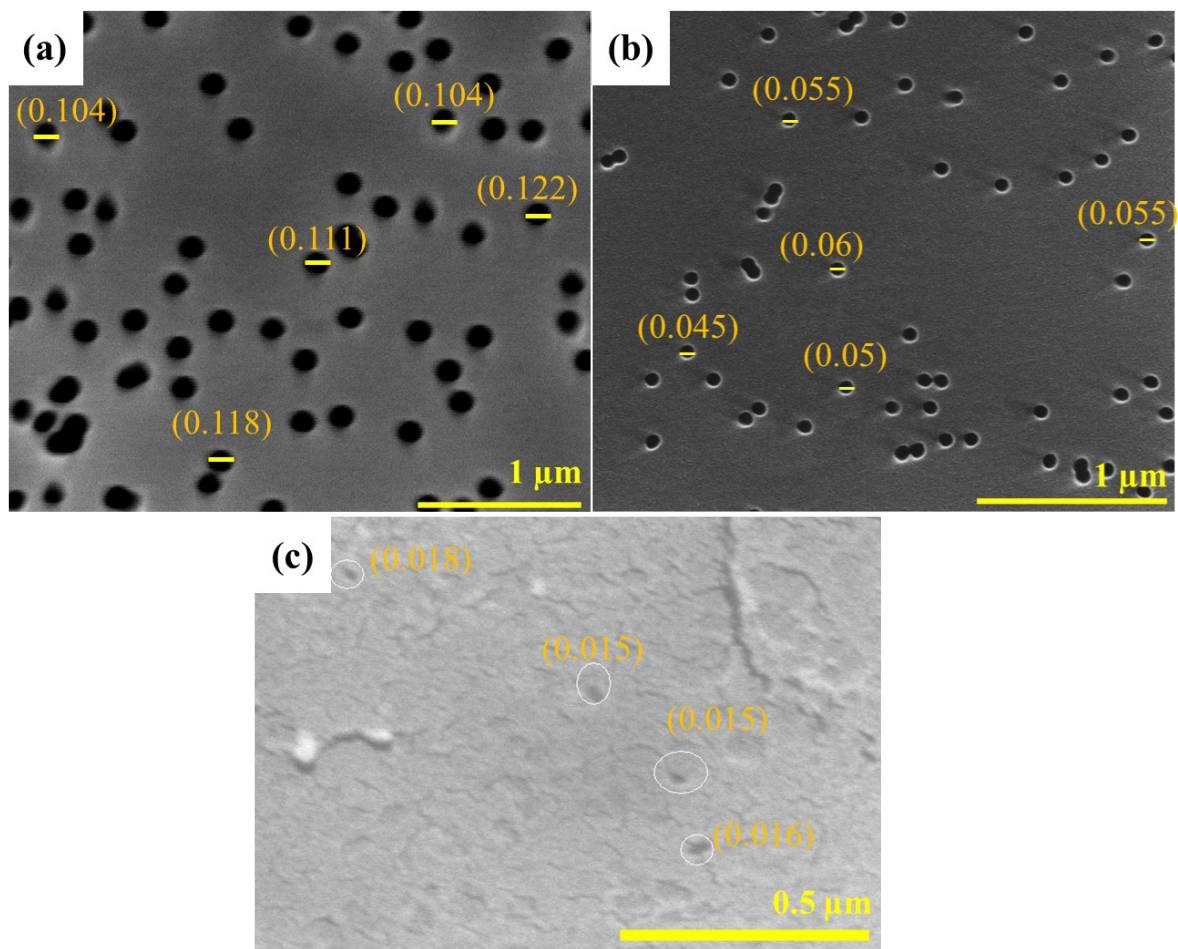
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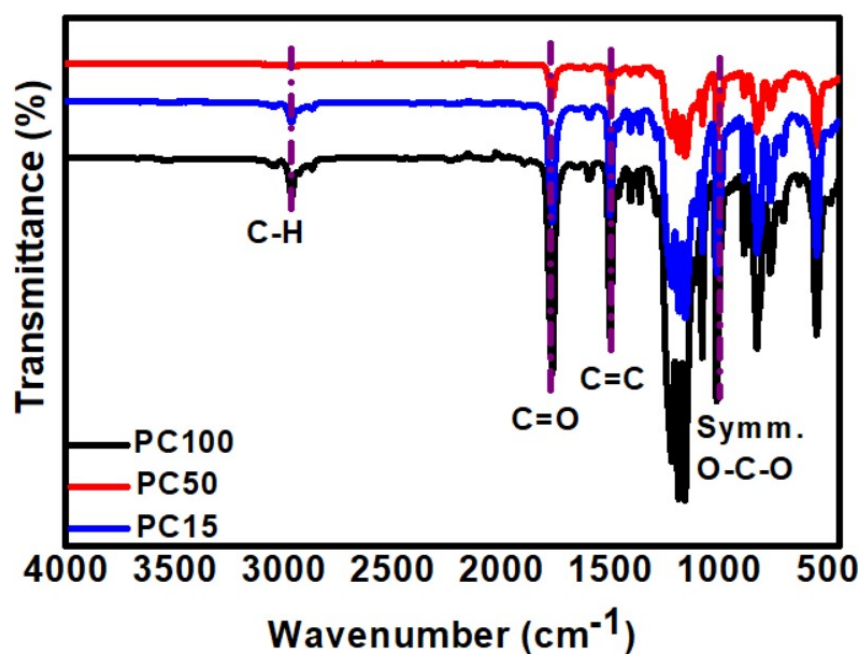
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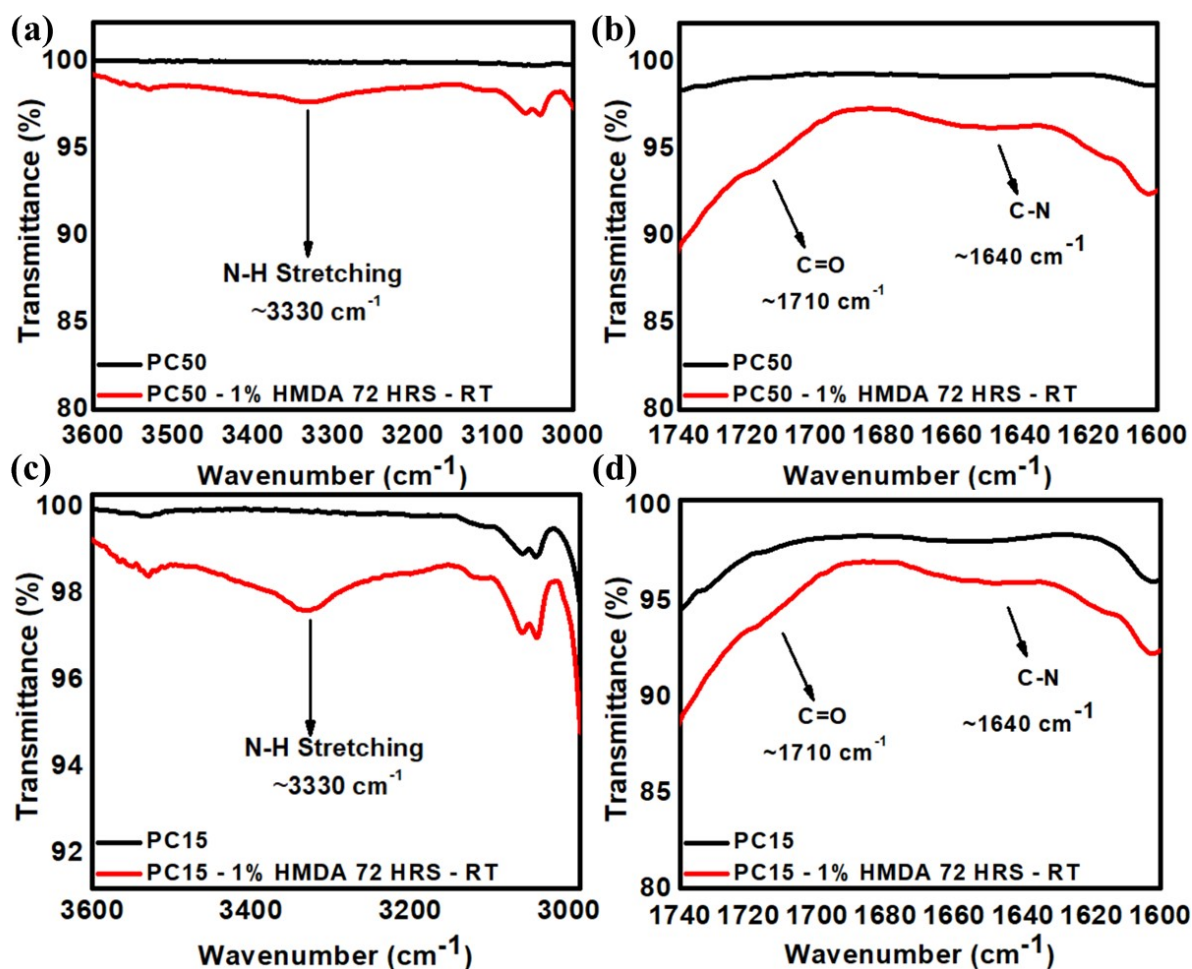
**Figure S1.** Photographic images of Isopore™ Merck Millipore membranes with nominal pore sizes of (a) 0.1  $\mu\text{m}$ , (b) 0.05  $\mu\text{m}$ , and (c) 0.015  $\mu\text{m}$ .



**Figure S2.** SEM images of Isopore™ Merck Millipore membranes with pore sizes of (a) 0.1 μm, (b) 0.05 μm, and (c) 0.015 μm, analysed using ImageJ software.



**Figure S3.** FTIR spectra of pristine PC100, PC50, and PC15 membranes.



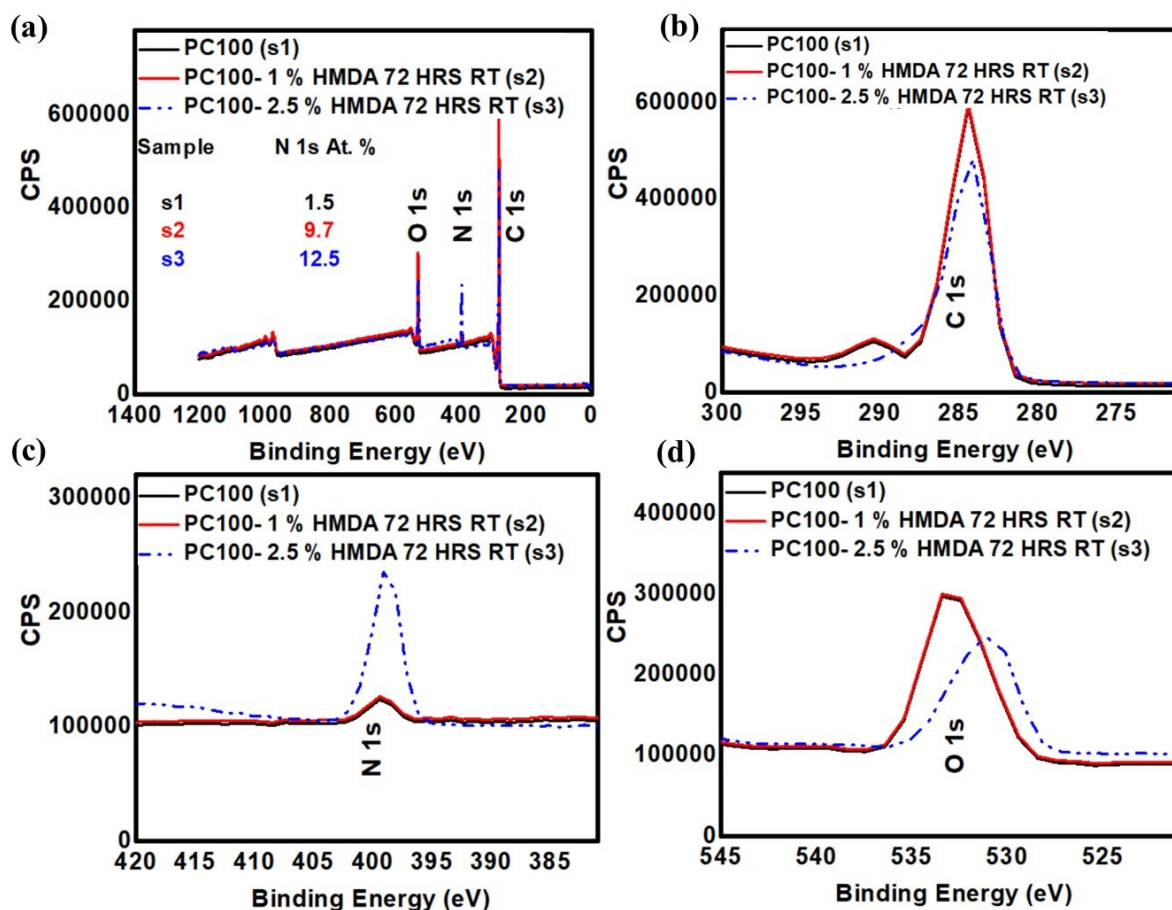
**Figure S4.** FTIR spectra of (a), (b) PC50 and (c), (d) PC15 membranes before and after functionalisation with 1 % w/v HMDA, highlighting (i) the 3000-3600  $\text{cm}^{-1}$  region, where N-H stretching bands from HMDA appear, and (ii) the 1600-1740  $\text{cm}^{-1}$  carbonyl (C=O) region, where slight shifts indicate urethane bond formation between HMDA and PC.

**Table S1.** Contact angles of PC membranes (0.1, 0.05, and 0.015  $\mu\text{m}$ ) were measured for untreated (blank) samples and for those treated with 1 % w/v HMDA for 72 h at room temperature.

<b>Membrane</b>	<b>Mean Contact Angle (°)</b>
100 nm pore size:	
- PC100-BLANK	71.7
- PC-100-HMDA, 1 % w/v, 72 h at RT	91.7
50 nm pore size:	
- PC50-BLANK	67.8
- PC-50-HMDA, 1 % w/v, 72 h at RT	95.3
15 nm pore size:	
- PC15-BLANK	64.5
- PC-15-HMDA, 1 % w/v, 72 h at RT	81.2

**Table S2.** Contact angles of PC membranes (0.1, 0.05, and 0.015  $\mu\text{m}$ ) for untreated (blank) samples and for those treated with 1 % w/v TETA for 74 h at room temperature, followed by heating at 70 °C for 2 h.

Membrane	Mean Contact Angle (°)
100 nm pore size: - PC100-BLANK	64.6
- PC-100-TETA, 1 % w/v, 74 h at RT	66.11
- PC-100-TETA, 1 % w/v, 74 h at RT, then 2 h at 70 °C	56.4
50 nm pore size: - PC50-BLANK	67.8
- PC-50-TETA, 1 % w/v, 74 h at RT	67.8
- PC-50-TETA, 1% w/v, 74 h at RT, then 2 h at 70 °C	55.9
15 nm pore size: - PC15-BLANK	64.5
- PC-15-TETA, 1 % w/v, 74 h at RT	63.5
- PC-15-TETA, 1 % w/v, at 74 h at RT, then 2 h at 70 °C	51.4



**Figure S5.** (a) XPS survey spectra of PC100 membranes before and after functionalisation with 1 % w/v HMDA (72 h at RT) and 2.5 % w/v HMDA (72 h at RT), with N 1s atomic % indicated. High-resolution spectra of (b) C 1s (270-300 eV), (c) N 1s (380-420 eV), and (d) O 1s (520-545 eV) regions show increased N 1s signal and shifts in C 1s and O 1s peaks, confirming successful HMDA grafting onto PC membranes.



**Table S3.** Summary of elemental quantification obtained from XPS survey spectra, for HMDA functionalised PCs.

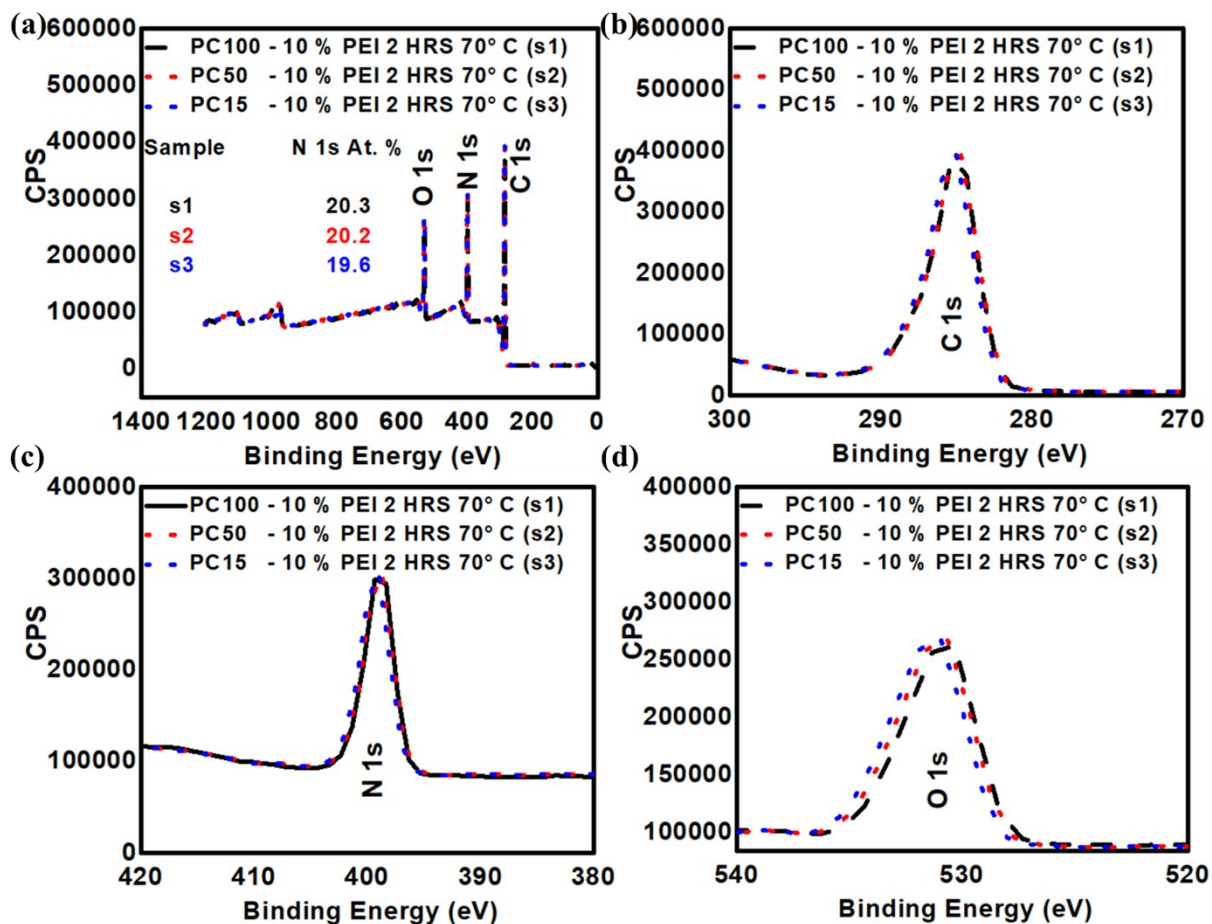
Sample	Atomic %						
	O 1s	C 1s	N 1s	S 2p	Cl 2p	Na 1s	Si 2p
PC100-Blank	14.8	81.6	3.4	0.2	-	-	-
PC100-HMDA, 1 % w/v, 72 h at RT	12.5	77.7	9.7	0.1	0.1	-	-
PC100-HMDA, 2.5 % w/v, 72 h at RT	11.3	76.1	12.5	0.1	-	-	-

**Table S4.** Summary of elemental quantification obtained from XPS survey spectra, for TETA functionalised PCs.

Sample	Atomic %						
	O 1s	C 1s	N 1s	S 2p	Cl 2p	Na 1s	Si 2p
PC100-Blank	14.8	81.6	3.4	0.2	-	-	-
PC100-TETA, 1 % w/v, 74 h at RT + 2 h at 70 °C	14.5	72.3	12.1	0.1	0.4	0.6	-
PC100-TETA, 5 % w/v, 2 h at 70 °C	13.1	64.0	22.6	0.1	0.2	-	-
PC-50-Blank	16.4	81.0	2.1	0.3	0.3	-	-
PC50-TETA, 5 % w/v, 2 h at 70 °C	13.9	64.0	21.4	0.1	0.4	0.1	-
PC15 Blank	16.0	80.5	2.6	0.2	0.7	-	-
PC15-TETA, 5 % w/v, 2 h at 70 °C	14.5	64.8	20.1	0.1	0.3	0.2	-

**Table S5.** Contact angles of PC membranes (0.1, 0.05, and 0.015  $\mu\text{m}$ ) for untreated (blank) samples and for those treated with 5 % w/v PEI (0.8 kDa) for 72 h at room temperature, followed by heating at 70  $^{\circ}\text{C}$  for 2 h.

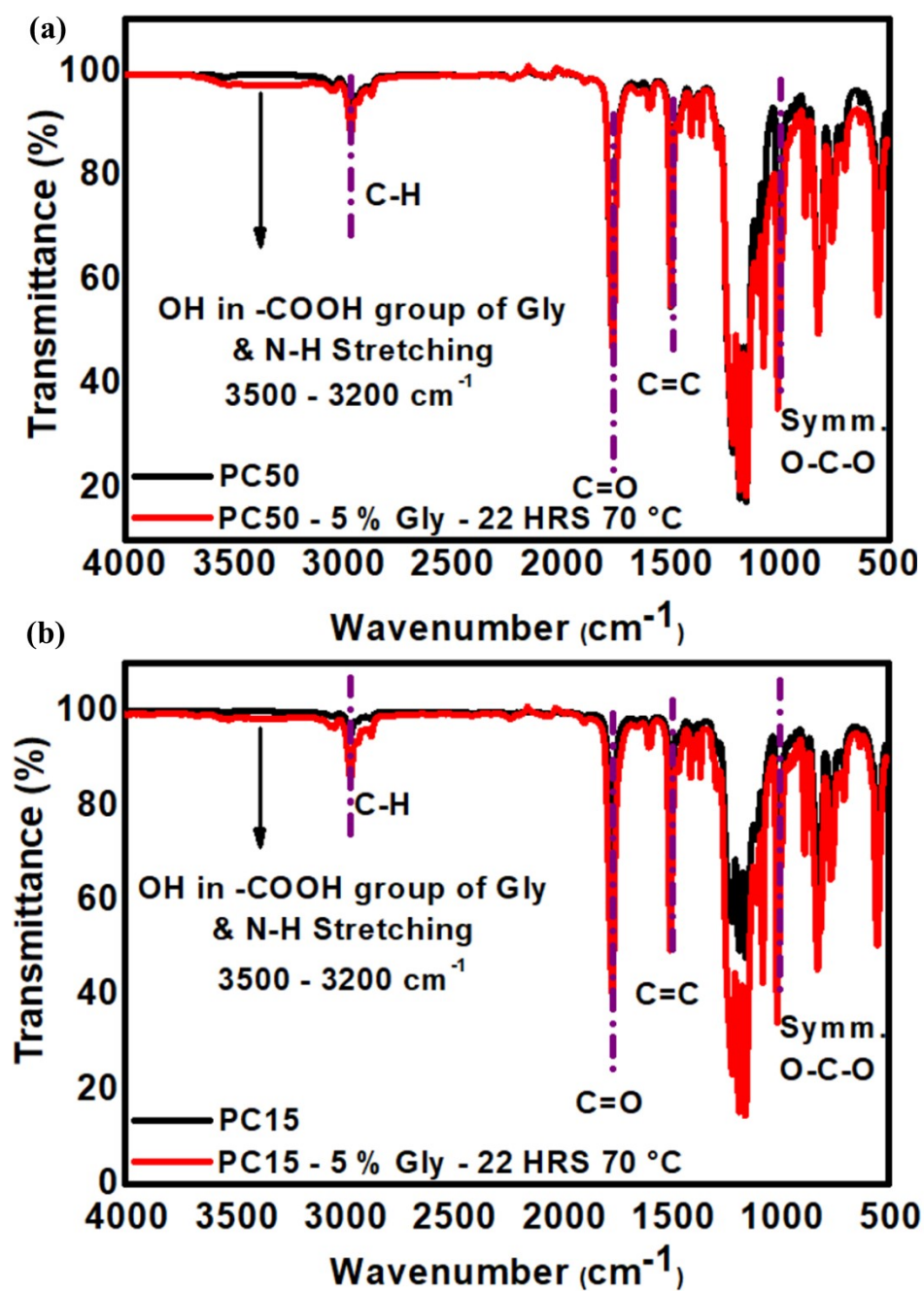
Membrane	Contact Angle Value ( $^{\circ}$ )
100 nm pore size:	
- PC100-BLANK	68.4
- PC-100-PEI, 72 h at RT	63.3
- PC-100-PEI, 72 h at RT + 2 h at 70 $^{\circ}\text{C}$	48.6
50 nm pore size:	
- PC50-BLANK	67.8
- PC-50-PEI, 72 h at RT	58.2
- PC-50-PEI, 72 h at RT + 2 h at 70 $^{\circ}\text{C}$	36.1
15 nm pore size:	
- PC15-BLANK	64.5
- PC-15- PEI, 72 h at RT	59.5
- PC-15-PEI, 72 h at RT + 2 h at 70 $^{\circ}\text{C}$	34.3



**Figure S6.** (a)XPS survey spectra of PC100, PC50 and PC15 membranes before and after functionalisation with 10 % w/v PEI 800D (72 h at 70 °C), with N 1s atomic % indicated. High-resolution spectra of (b) C 1s (270-300 eV), (c) N 1s (380-420 eV), and (d) O 1s (520-545 eV) regions.

**Table S6.** Summary of elemental quantification obtained from XPS survey spectra, for PEI functionalised PCs.

Sample	Atomic %						
	O 1s	C 1s	N 1s	S 2p	Cl 2p	Na 1s	Si 2p
PC100-PEI, 5 % w/v, 72 h at RT + 2 h at 70 °C	13.3	70.5	16.0	0.1	0.1	-	-
PC100-PEI, 10 % w/v, 2 h at 70 °C	12.9	66.3	20.3	0.1	0.2	0.1	-
PC50-PEI, 10 % w/v, 2 h at 70 °C	13.8	65.0	20.2	0.1	0.5	0.3	-
PC15-PEI, 10 % w/v, 2 h at 70 °C	13.5	65.9	19.6	0.1	0.6	0.2	-



**Figure S7.** FTIR spectra of (a) PC50 and (b) PC15 membranes before and after functionalisation with Gly 5 % w/v.

**Table S7.** Summary of elemental quantification obtained from XPS survey spectra, for GLY functionalised PCs.

Sample	Atomic %						
	O 1s	C 1s	N 1s	S 2p	Cl 2p	Na 1s	Si 2p
PC100-Glycine, 1 % w/v, 72 h at RT + 2 h at 70 °C	16.1	81.4	2.2	0.1	-	-	0.2
PC100-Glycine, 5 % w/v, 22 h at 70 °C	16.3	81.0	2.3	0.1	0.3	-	-
PC50-Glycine, 5 % w/v, 22 h at 70 °C	24.6	66.9	2.5	-	4.8	-	-
PC15-Glycine, 5% w/v, 22 h at 70 °C	16.7	80.0	2.2	0.2	0.7	0.1	0.2