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

Supporting Information

Nanofiltration Membranes with Cellulose Nanocrystals as An Interlayer for Unprecedented Performance

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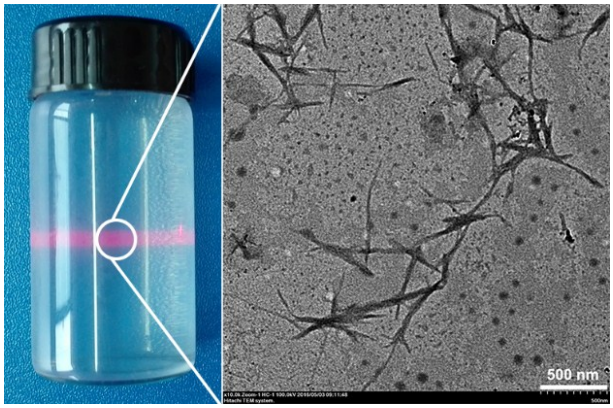

Fig. S1 Digital picture of CNC suspension and its TEM image.

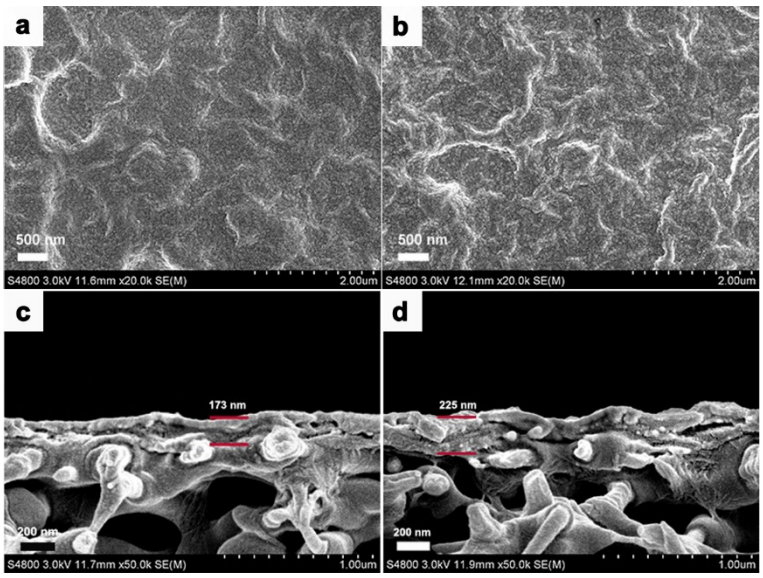

Fig. S2 SEM images of the membrane surface for a) composite nanofiltration membrane PA150/CNC/PES, b) composite nanofiltration membrane PA300/CNC/PES. SEM images of the membrane cross-section of c) composite nanofiltration membrane PA150/CNC/PES, d) composite nanofiltration membrane PA300/CNC/PES.

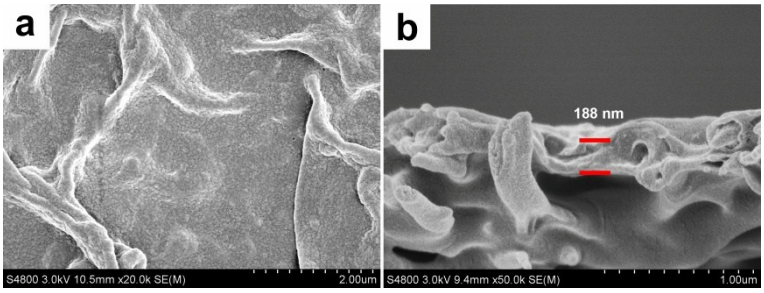

Fig. S3 SEM images of the a) membrane surface and b) cross-section for nanofiltration membrane PA50 /PES.

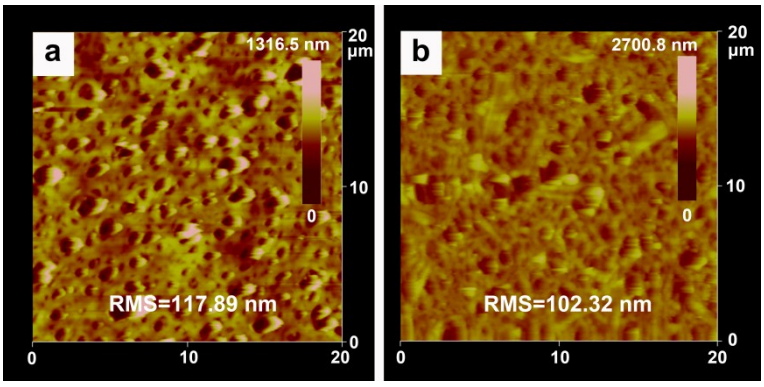

Fig. S4 AFM images of a) PES substrate, b) CNC-coated substrate for an area of 20 µm × 20 µm.

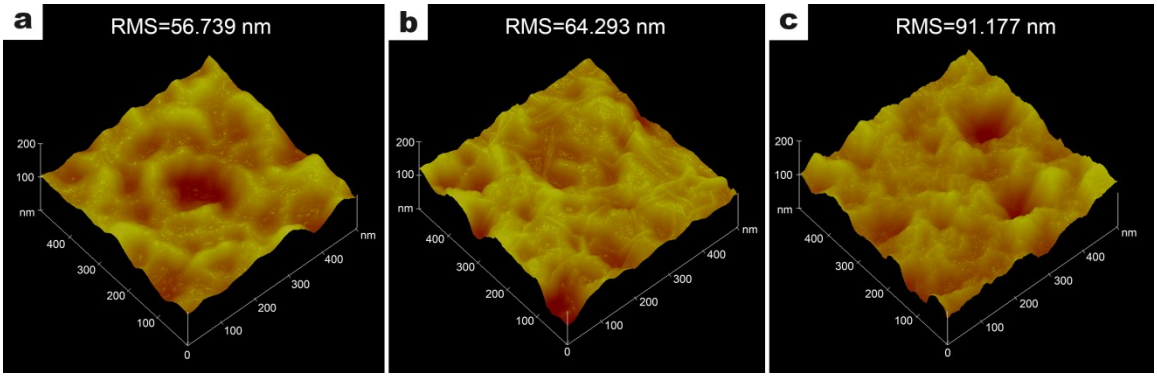

Fig. S5 AFM images of the membrane surface for a) composite nanofiltration membrane PA50/CNC/PES, b) composite nanofiltration membrane PA150/CNC/PES, c) composite nanofiltration membrane PA300/CNC/PES.

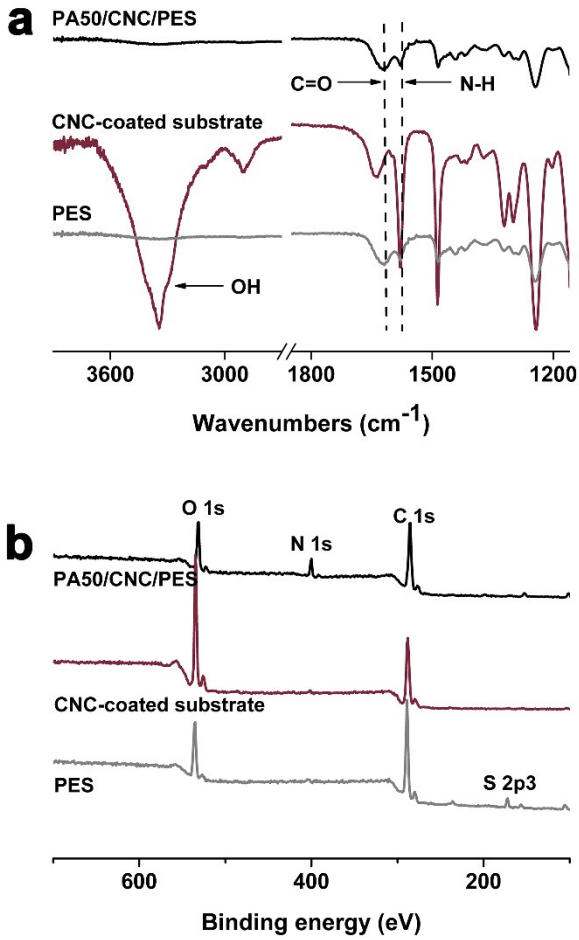

Fig. S6 a) FT-IR/ATR spectra and b) XPS spectra of PES substrate, CNC-coated substrate and composite nanofiltration membrane (PA50/CNC/PES).

Table S1 Surface compositions of PA150/PES and PA300/PES nanofiltration membranes from XPS (in atomic percent).

Sample	C	O	N	O/N
PA150/PES	69.49	18.55	11.96	1.55
PA300/PES	70.07	17.97	11.77	1.53

Table S2 XPS results from composite nanofiltration membranes. Binding energies and plausible species were determined from the deconvolution of C1s, O1s and N1s core level XPS spectra.

	C1s			O1s			N1s		
	Energy (eV)	Species	(%)	Energy (eV)	Species	(%)	Energy (eV)	Species	(%)
PA50/PES	285	C-H,C-C, C=C	48	532	N-C=O	58.5	400	N-C=O	68.6
	285.7	C-CONH, C-COO	22.9						
	286.3	C-N	20.2	533.5	O-C=O	41.5	401	NH	31.4
	288.2	N-C=O, O-C=O	9						

	C1s			O1s			N1s		
	Energy (eV)	Species	(%)	Energy (eV)	Species	(%)	Energy (eV)	Species	(%)
PA50/CNC/PES	285	C-H,C-C, C=C	42.9	532	N-C=O	64.3	400	N-C=O	69.5
	285.7	C-CONH, C-COO	28.3						
	286.3	C-N	18.2	533.5	O-C=O	35.7	401	NH	30.5
	288.2	N-C=O, O-C=O	10.6						

	C1s			O1s			N1s		
	Energy (eV)	Species	(%)	Energy (eV)	Species	(%)	Energy (eV)	Species	(%)
PA150/CNC/PES	285	C-H,C-C, C=C	44.3	532	N-C=O	62.1	400	N-C=O	62.8
	285.7	C-CONH, C-COO	25						
	286.3	C-N	20.5						
	288.2	N-C=O, O-C=O	10.2	533.5	O-C=O	37.9	401	NH	37.2

	C1s			O1s			N1s		
	Energy (eV)	Species	(%)	Energy (eV)	Species	(%)	Energy (eV)	Species	(%)
PA300/CNC/PES	285	C-H,C-C, C=C	44.3	532	N-C=O	60.1	400	N-C=O	70.4
	285.7	C-CONH, C-COO	232.						
	286.3	C-N	22.3						
	288.2	N-C=O, O-C=O	10.1	533.5	O-C=O	39.9	401	NH	29.6

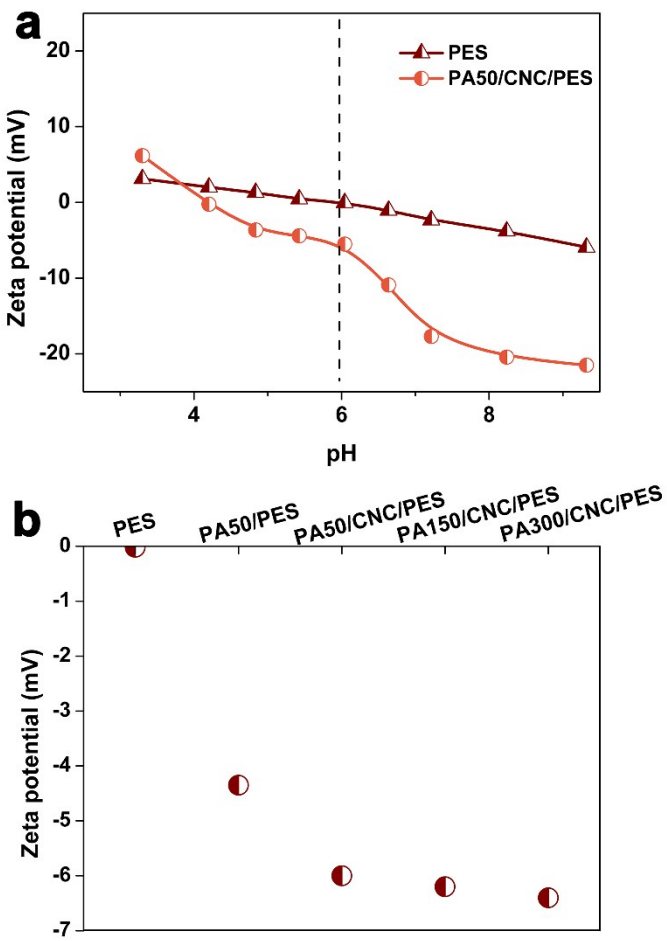

Fig. S7 Zeta potential of a) PES substrate and composite nanofiltration membrane PA50/CNC/PES at different pH values and b) PES substrate and different composite nanofiltration membranes at pH=6.

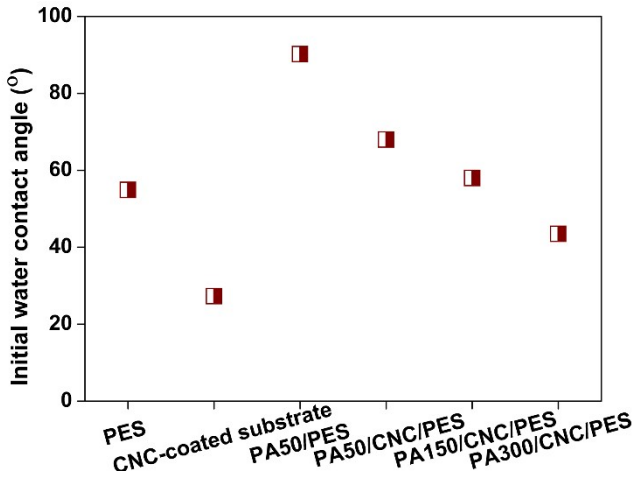

Fig. S8 Initial water contact angles of PES substrate, CNC-coated substrate and different composite nanofiltration membranes.

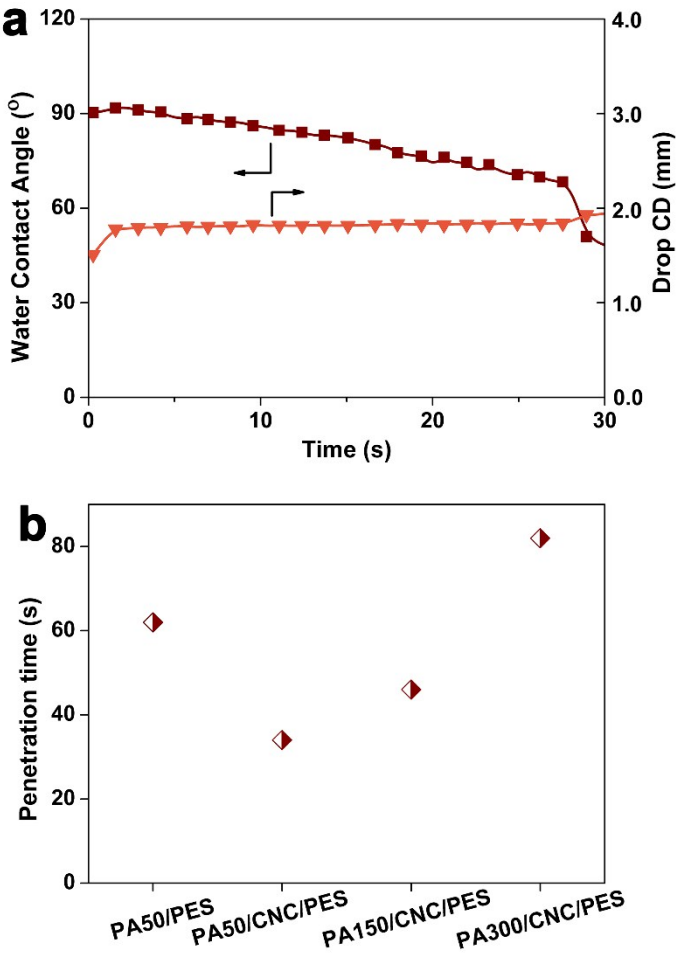

Fig. S9 a) Dynamic water contact angle and drop CD of membrane PA50/PES. b) Water penetration time of different nanofiltration membranes.

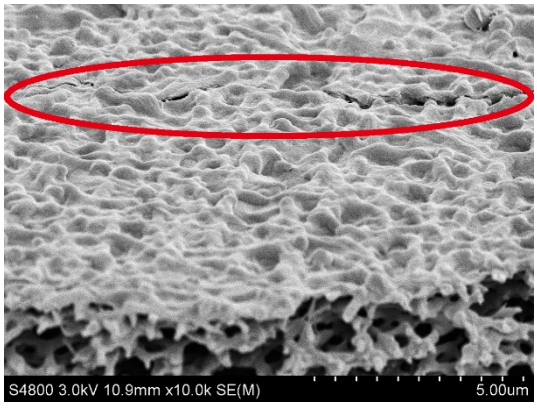

Fig. S10 Cross-sectional SEM image of composite nanofiltration membrane PA25/CNC/PES.