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

Supporting Information

Ultrathin Nanoporous Membranes Derived from Protein-based Nanospheres for High-performance Smart Molecular Filtration

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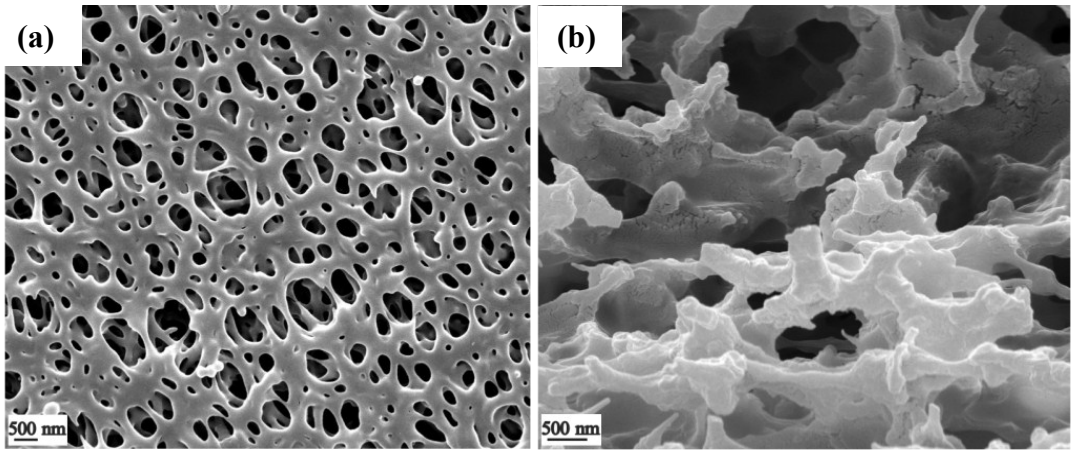


Figure S1 Top view (a) and cross-sectional (b) SEM images of the support membrane in the present study.

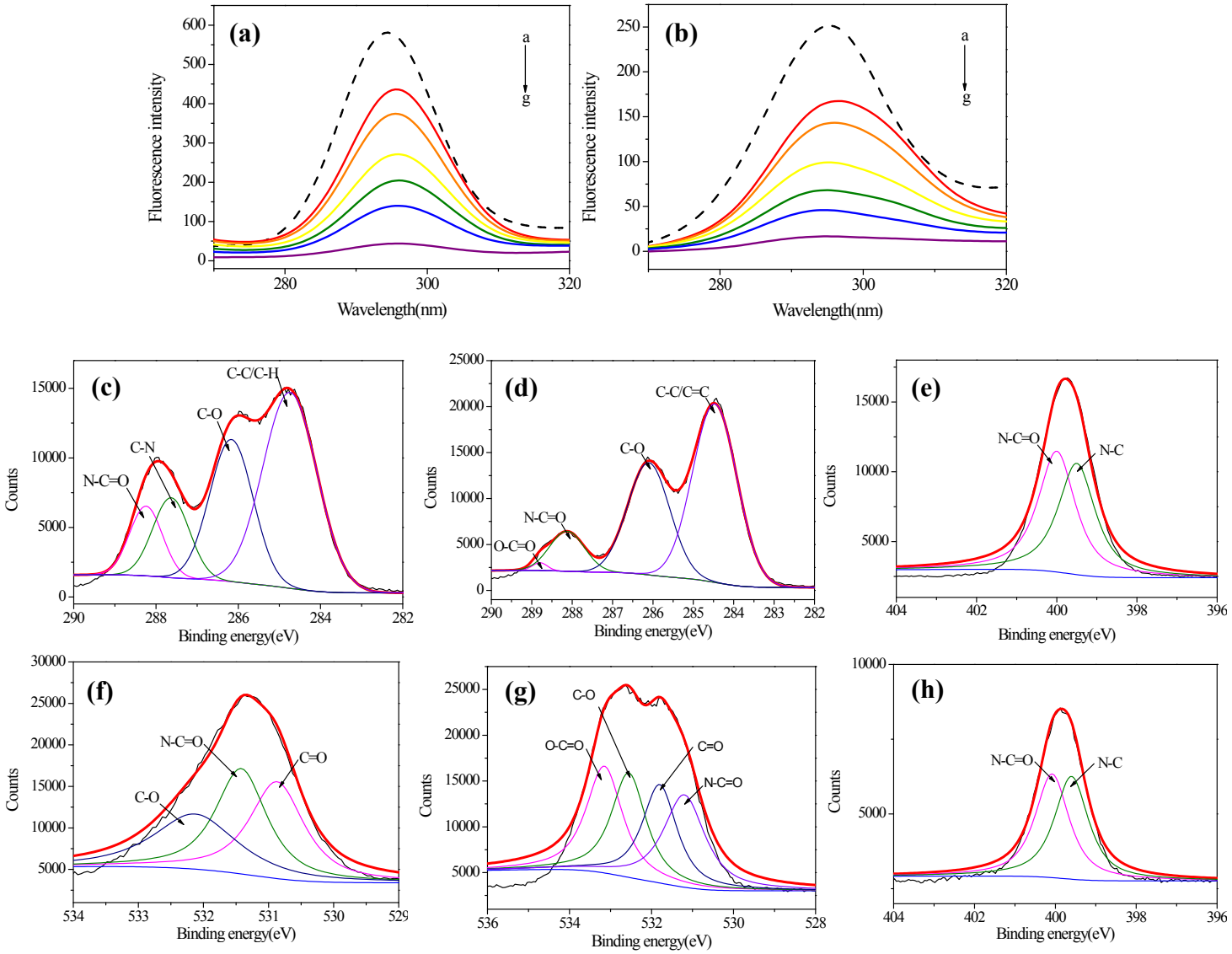
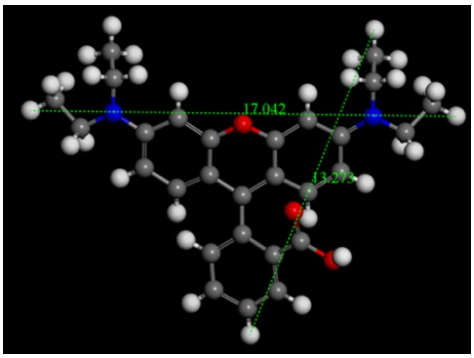
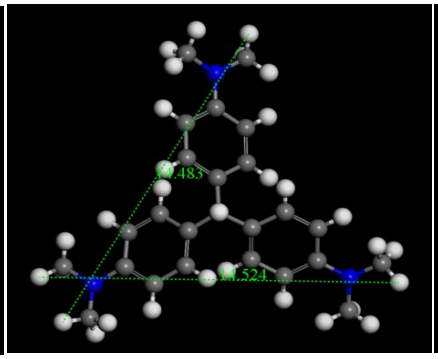


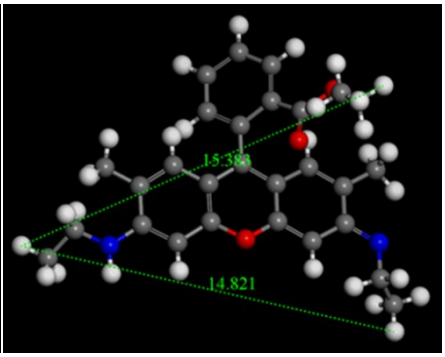
Figure S2 Synchronous fluorescence spectra with (a) $\Delta\lambda$ =60 nm and (b) $\Delta\lambda$ =20 nm of silk fibroin/tannic acid mixtures containing various concentrations of tannin acid: a control; b 0.1 mg L^{-1}; c 0.2 mg L^{-1}; d 0.5 mg L^{-1}; e 1.0 mg L^{-1} ; f 2.0 mg L^{-1}; g 3.0 mg L^{-1} ; h tannic acid. (c) C1s spectrum of pure silk fibroin and; (d) C1s spectrum of the nanoporous membrane. (e) O1s and (f) N1s XPS spectra of pure silk fibroin; (g) O1s and (h) N1s XPS spectra of the nanoporous membrane.



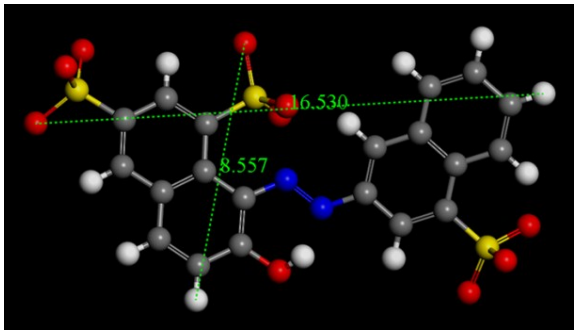
Rhodamine B



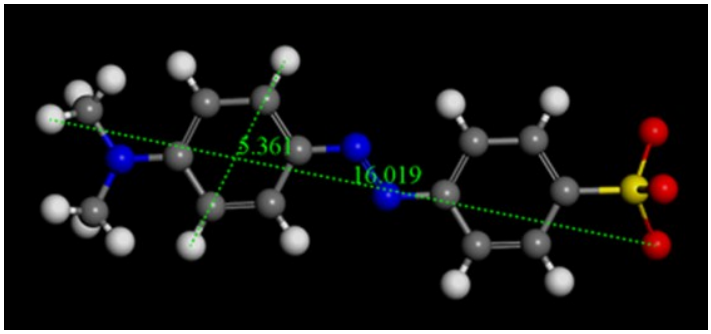
Crystal violet



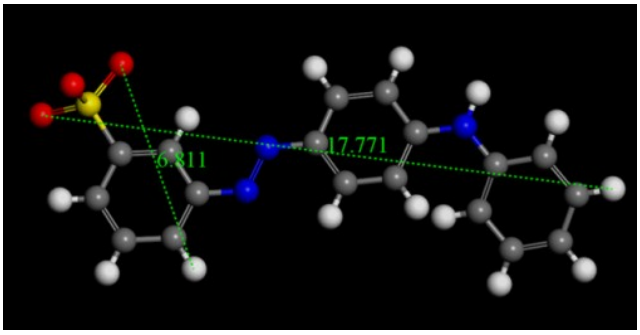
Rhodamine 6G



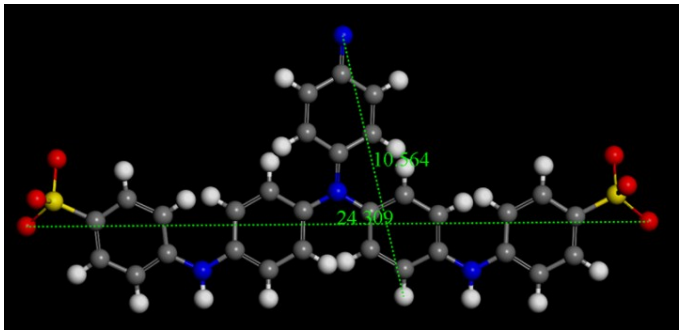
New coccine



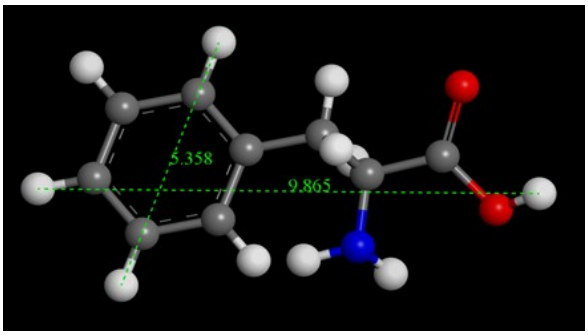
Methyl orange



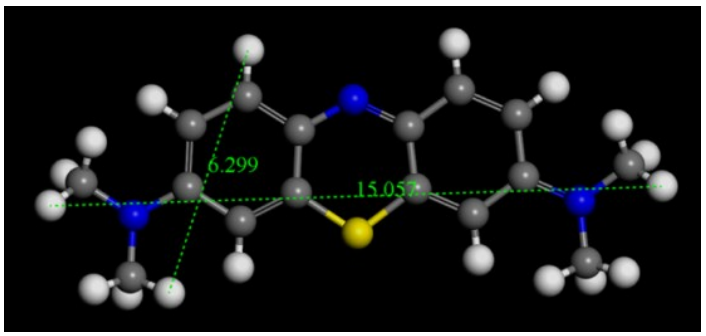
Metanil yellow



Methyl blue



L-phenylalanine



Methylene blue

Figure S3 Chemical structures and molecular sizes calculated using Materials studio 7.0 of the tested dyes. The unit of the molecular size is angstrom (Å)

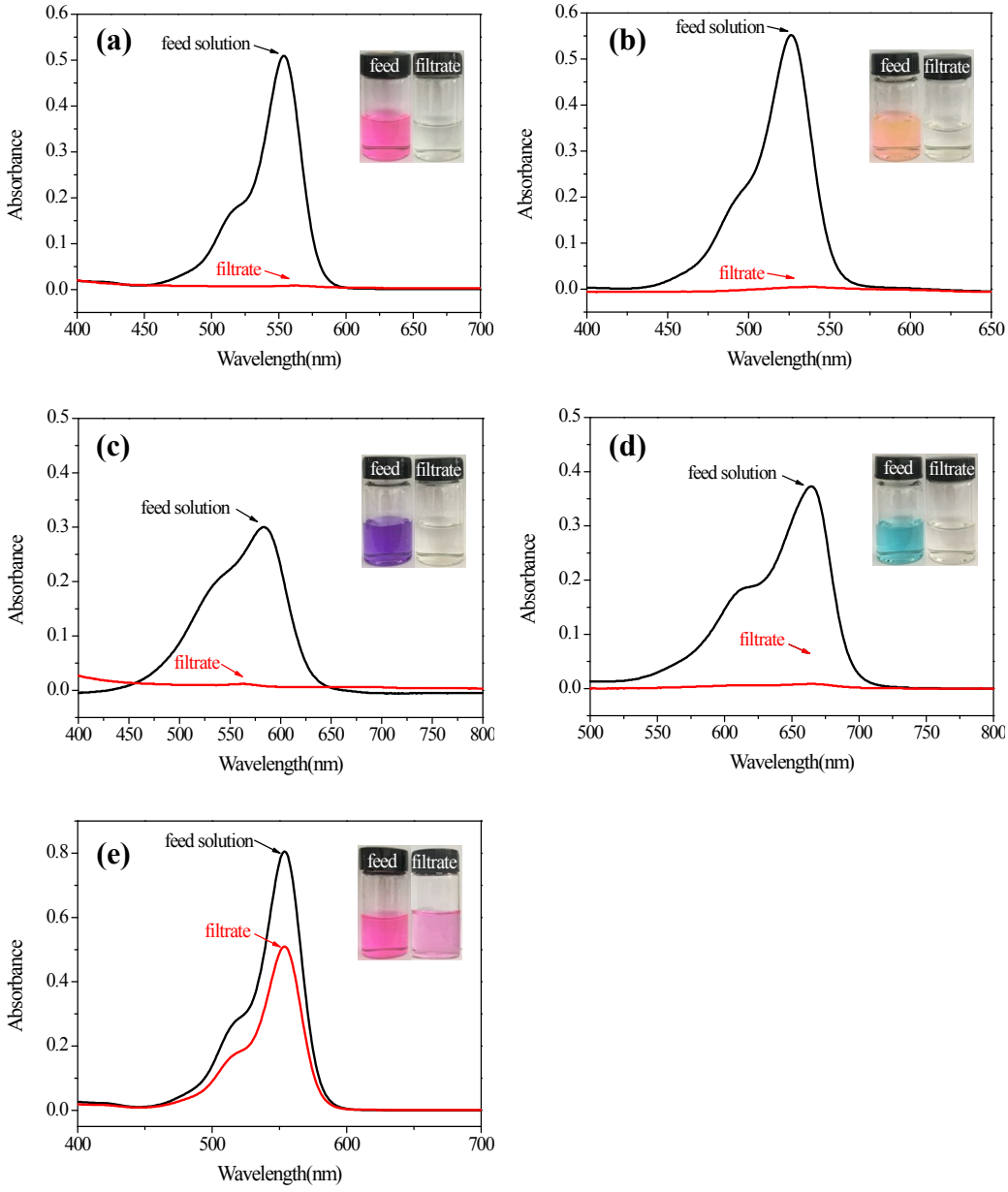


Figure S4 UV-vis spectra of the feed solution and filtrate of (a)Rhodamoine B; (b) Rhodamine 6G; (c)Crystal violet; (d)Methylene blue after filtrating across the nanoporous membrane; (e) UV-vis spectra of the feed solution and filtrate of Rhodamoine B after filtrating across the support membrane. The insets were the corresponding pictures of the aqueous solution before and after filtration. The support membrane exhibited a 36.8 % rejection of Rhodamine B, indicating that the fibroin selective layer played a dominate role in the excellent rejection performance.

Table S1 (a) Surface elemental composition of pure silk fibroin and the nanoporous membrane

Samples	Surface elemental composition (%)			N/C	O/C
	C	N	O		
Pure SF	62.56	17.08	20.35	0.273	0.325
membrane	64.34	6.67	29	0.104	0.451

Table S1 (b) Chemical composition of pure silk fibroin

C1s			N1s			O1s		
BE (eV)	Species	Content (%)	BE (eV)	Species	Content (%)	BE (eV)	Species	Content (%)
288.2	N–C=O	10.4	400.0	N–C=O	52	532.1	C–O	29.9
287.6	C–N	13.3						
286.2	C–O	28	399.5	N–C	48	531.4	N–C=O	35.4
284.7	C–C C–H	48.3				530.9	C=O	34.7

Table S1 (c) Chemical composition of the nanoporous membrane

C1s			N1s			O1s		
BE (eV)	Species	Content (%)	BE (eV)	Species	Content (%)	BE (eV)	Species	Content (%)
288.7	O–C=O	0.8	400.1	N–C=O	50.2	533.2	O–C=O	26.3
288.1	N–C=O	9.9				532.6	C–O	24.6
286.1	C–O	33.4	399.6	N–C	49.8	531.8	C=O	23.1
284.5	C–C C=O	55.9				531.2	N–C=O	26