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Supporting Information

Co-deposition towards mussel-inspired antifouling and antibacterial membranes by using zwitterionic polymer and silver nanoparticles

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Protein adsorption

Firstly, the membrane with an area of 1 × 1 cm^2 was immersed in PBS (pH=7.2) containing 1 mg mL-1 BSA or LYZ, and incubated at 37 ^oC for 1 h; subsequently rinsed slightly with PBS and deionized water. Then, the membrane was placed in a washing solution (2 wt. % sodium dodecyl sulfate (SDS)) at 37 ^oC, and shaken for 2 h to remove the adsorbed protein. The adsorption and desorption time were carefully determined in preliminary experiments. The protein concentration in the washing solution was determined by using the Micro BCA^{TM} Protein Assay Reagent Kit (PIERCE), and then the adsorbed protein amount was calculated.

Gel Permeation Chromatogram Analysis (GPC)

Aqueous gel permeation chromatography (GPC) (PL-GPC 50, Agilent Technologies) was used for the detection of PEI-SBMA molecular weight. The deionized water was used as the eluent with a flow rate of 1 mL/min at 25 ^oC. The system was calibrated with narrow molecular weight dextran standards.

Polymer characterization

PEI and PEI-SBMA were characterized by ^{1}HNMR using D_2O as the solvent and the results were shown in **Fig.S1**. As shown in the figure, compared with the spectrum of PEI, new peaks appeared in that of PEI-SBMA. The protons b (δ=3.36 ppm), c (δ=2.80 ppm) and d (δ=3.00 ppm) were held by the carbon atoms in α-position of the quaternary ammonium ion; while the protons e (δ=2.51) and f (δ=1.80) were held by the carbon atoms in α- and β-positions of the sulfonate groups, respectively.

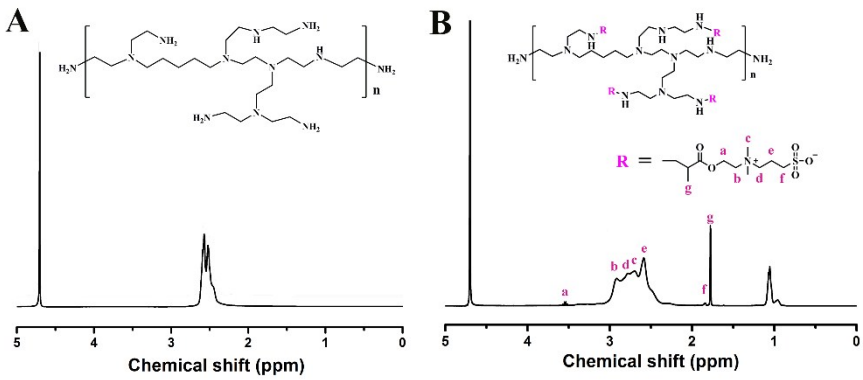


Fig. S1. ^{1}HNMR spectra of the PEI and PEI-SBMA.

As shown in the **Table S1**, the weight-average molecular weight (M_w) of PEI is 12311 and the M_w of synthesized polymer (PEI-SBMA) is 13925, which were obtained via GPC measurement. The ^{1}HNMR and GPC results indicated the SBMA was successfully grafted on the PEI.

Table S1. GPC characterization of PEI or PEI-SBMA.

Polymer	M_w[a]	M_w[b]
PEI	12311	10000
PEI-SBMA	13925	-

[a] The weight-average molecular weight of the polymer.
[b] The merchant given M_w of PEI.

Mechanism of the polymer co-deposition on the membrane surfaces

As shown in Fig.S2, DA molecules are firstly oxidized to form reaction intermediates such as indole species (5,6-dihydroxyindole) via intramolecular cyclization, oxidation, and rearrangement. The intermediates further react through covalent bonding and/or physical assembly to form PDA. Then, the PDA couples with PEI-SBMA by two possible synthesis mechanisms: (A) the PEI-SBMA grafts on the PDA via the Michael

addition; and (B) the PEI-SBMA reacts with the quinone (oxidated catechol groups) of the PDA via the Schiff-base reaction. [1, 2]

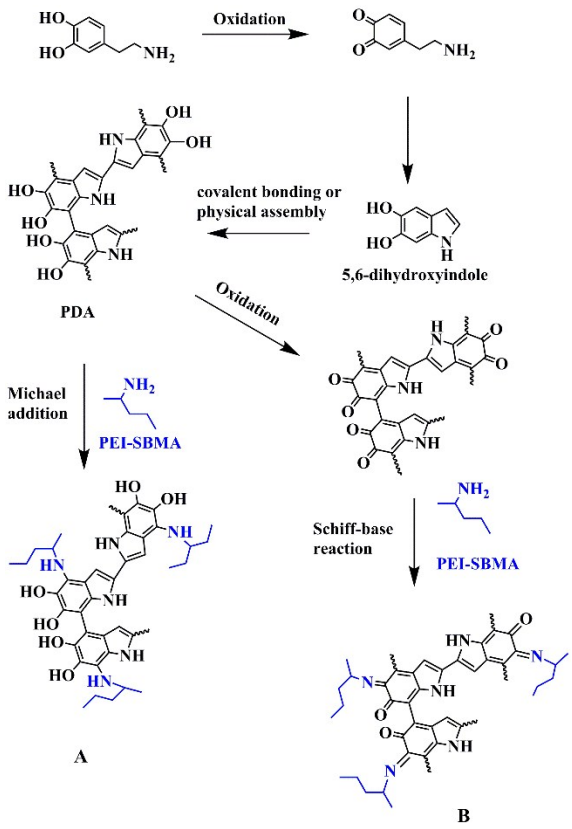
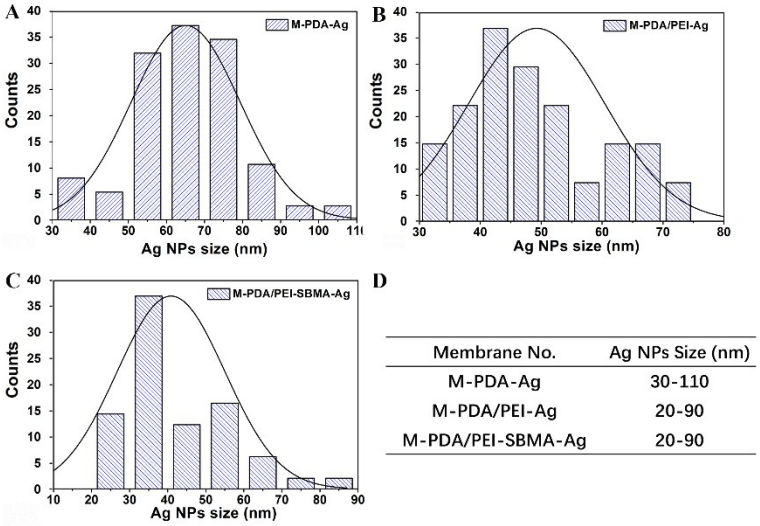


Fig. S2. Schematic illustration of the two possible formation processes of the PDA/PEI-SBMA (A: PEI-SBMA is grafted on PDA via the Michael addition, B: PEI-SBMA was grafted on PDA via the Schiff-base reaction).

Ag NPs distribution on the membrane surfaces

The size of the Ag NPs was measured from the SEM observations by the software of Nano-measure and the results were shown in **Fig. S3**. The size of the Ag NPs on M-PDA surface was about 30-110 nm; and those on the M-PDA/PEI-Ag and M-PDA/PEI-SBMA-Ag were about 20-90 nm. Therefore, with the introduction of PEI or PEI-SBAM, the Ag NPs average particles size and size distribution decreased.



Membrane No.	Ag NPs Size (nm)
M-PDA-Ag	30-110
M-PDA/PEI-Ag	20-90
M-PDA/PEI-SBMA-Ag	20-90

Fig. S3. The Ag NPs sizes distributions on the (A) M-PDA-Ag, (B) M-PDA/PEI-Ag, (C) M-PDA/PEI-SBMA-Ag and (D) the Ag NPs size ranges on the membranes surface.

References

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2. H.-C. Yang, K.-J. Liao, H. Huang, Q.-Y. Wu, L.-S. Wan and Z.-K. Xu, *J. Mater. Chem. A*, 2014, **2**, 10225.