

## S1. Detailed synthesis process of SBA-g-P(PEGMA)

In this study, hydrophilic mesoporous additive SBA-g-P(PEGMA) was synthesized by polymerizing hydrophilic organic polymer polyethylene glycol methacrylate (PEGMA) on inorganic mesoporous silicon (SBA-15) material using surface-initiated atom transfer radical polymerization (SI-ATRP), and the detailed synthesis process is shown in Figure 2.1.

(1) Preparation of SBA-15. The mesoporous SBA-15 was synthesized through a hydrothermal process using poly(ethylene glycol)-poly(propylene glycol)-poly(ethylene glycol) block polymer (P123) as the template agent and ethyl orthosilicate (TEOS) as the silicon source. The experimental procedure was carried out in a strongly acidic environment as described below: First, 80 mL of concentrated hydrochloric acid was diluted with deionized water to a total volume of 500 mL in a beaker. Then, 16 g of P123 was accurately weighed and added to the beaker. The mixture was stirred in a water bath at a constant temperature of 40 °C for 1 h until P123 was completely dissolved. Next, 16.0 g of TEOS was gradually added to the system while continuous mechanical stirring was applied for 24 hours. The resulting solution was transferred into a hydrothermal reactor and placed in a vacuum drying oven at 100 °C for 24 hours to complete the reaction. After that, the reactants were centrifuged and precipitate obtained was subjected to calcination in a muffle furnace at 600 °C for 6 hours in order to remove the pore template agent and obtain a white solid substance (SBA-15).

(2) Preparation of SBA-NH<sub>2</sub>. Firstly, 1 g of SBA-15 was mixed with 50 mL of ethanol in a beaker and dispersed by ultrasound for 30 min. Then 1 mL of 3-aminotriethoxysilane was slowly added to the dispersion solution. After thorough stirring, the solution was transferred to a 500 mL three-necked flask. The pH of the solution was adjusted to 8.0 with ammonia, and the solution was mechanically stirred at room temperature for 12 h. After the reaction, the precipitate was separated by centrifuge and dried in a vacuum freeze dryer for 6 h to obtain SBA-NH<sub>2</sub>.

(3) Preparation of elicitor SBA-Br. Firstly, 1 g of SBA-NH<sub>2</sub> was weighed and mixed with 50 mL of toluene, stirred thoroughly and then sonicated by ultrasound for half an hour. Then 1 g of 4-dimethylaminopyridine was weighed and added into the mixed solution. Control the reaction temperature to be below 10 °C in an ice bath, and slowly add 1 mL of 2-bromoisobutyryl bromide while stirring. The mixed solution first reacted at low temperature for 2 h and then at room temperature for 12 h. After the reaction was completed, the solution was separated by centrifuge, washed several times with ethanol, and finally dried in a vacuum freeze dryer for 6 h to obtain SBA-Br.

(4) Preparation of SBA-g-P(PEGMA). Firstly, 0.4 g of SBA-Br and 1 mL of PEGMA solution were measured and added to the Schlenk bottle in turn. Then 15 mL of deionized water and 0.1 mL of PMDETA were weighed and added into the mixed solution, and ultrasonically dispersed for 1 h. The mixture was frozen with liquid nitrogen and 25 mg of CuBr was added under nitrogen atmosphere. Subsequently, the Schlenk bottle was evacuated for 5 min and then filled with nitrogen at 40 °C. The same

procedure was repeated 3 times to remove the residual oxygen from the reaction system. Then the solution was separated by centrifuge. The precipitates were washed with deionized water several times to clean the unreacted PEGMA. Finally, it was dried in a vacuum freeze dryer for 6 h to obtain SBA-g-P(PEGMA).

## 2. Elemental composition of both the pristine membrane (M0) and hybrid membrane (MSP4).

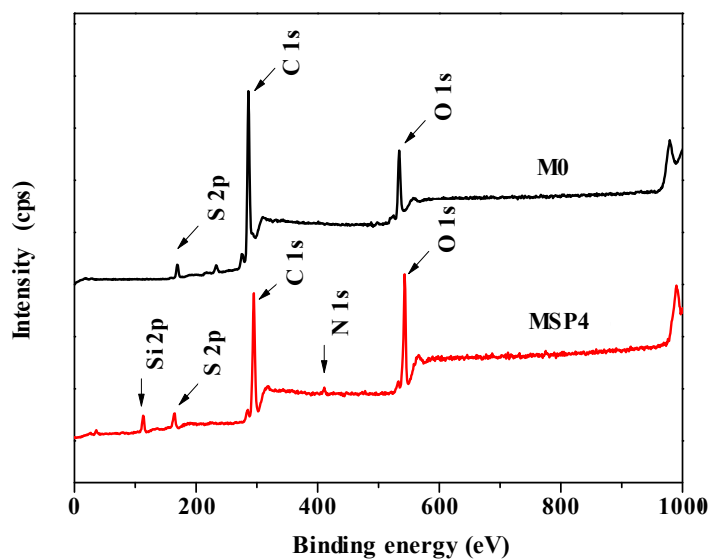


Figure S1: XPS images of the control membrane M0 and hybrid membrane MSP4.

## 3. Interception capability of hybrid membranes

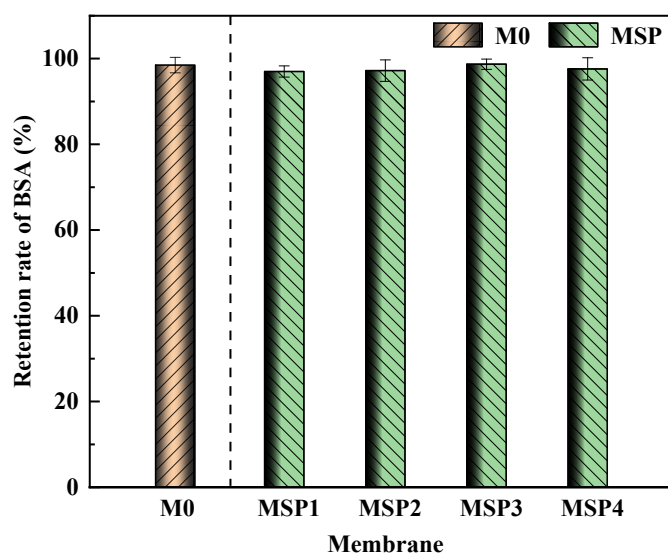


Figure S2: The BSA retention of the pristine membrane M0 and the hybrid membranes MSP.