

Electrochemical protein recognition based on macromolecular self-  
assembly of molecularly imprinted polymer: a new strategy to mimic  
antibody for label-free biosensing

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## Characterization and Measurement

The chemical structure of PDHS and UPDHS polymer was characterized by a Bruker (400 MHz) instrument using deuterated chloroform ( $\text{CDCl}_3$ ) as solvent. Fourier-transform infrared spectroscopy (FT-IR) spectra was recorded on a Nicolet iS50 Fourier Infrared Spectrometer. The morphologies of BSA@UPDHS nanoparticles were observed using both a JEOL JEM-2100 transmission electron microscope (TEM) operating at 200 kV. Dynamic light scattering (DLS) experiment was conducted using an ALV-5000/E dynamic light scattering instrument at  $90^\circ$ , and all sample solutions were passed through 0.8 mm Millipore filters prior to load into the sample cell. Far UV circular dichroism (CD) was recorded on a MOS-450 spectropolarimeter (Biologic Co., Ltd., France). The irradiation light for photo-crosslinking was obtained from a UV-vis spot curing system (UV-100D, ANEST IWATA Co., Ltd., Japan) combined with a 365 nm filter, and was applied vertically above the electrode. The BSA@MIP coating morphologies on the electrode surface were observed using a Hitachi S-4800 field emission scanning electron microscope (FESEM).

Differential Pulse Stripping Voltammetry (DPSV), Cyclic Voltammetry (CV) and Electrochemical Impedance Spectroscopy (EIS) were performed in a three-electrode system with an electrochemical workstation (CHI660E, Shanghai, China). CV was carried out between -0.20 V and 0.60 V in a  $5 \text{ mmol L}^{-1} [\text{Fe}(\text{CN})_6]^{3-/4-}$  and  $0.2 \text{ mol L}^{-1}$  KCl solution at scan rate of  $100 \text{ mV s}^{-1}$ . EIS was also tested in a  $5 \text{ mmol L}^{-1} [\text{Fe}(\text{CN})_6]^{3-/4-}$  and  $0.2 \text{ mol L}^{-1}$  KCl solution. DPSV curves were obtained in a  $0.1 \text{ mol L}^{-1}$  PBS (pH=7.4) solution containing  $5 \text{ mmol L}^{-1} [\text{Fe}(\text{CN})_6]^{3-/4-}$  between -0.20 V and 0.40 V

after incubating in various concentrations of templates. The bare gold electrode (4 mm diameter; Aida, Tianjin, China), and the BSA@MIP sensor were used as working electrode (WE). A platinum electrode and a saturated calomel electrode (SCE, Aida) were used as counter and reference electrode, respectively. All potentials applied to WE were referred to SCE.

## Supplementary Results

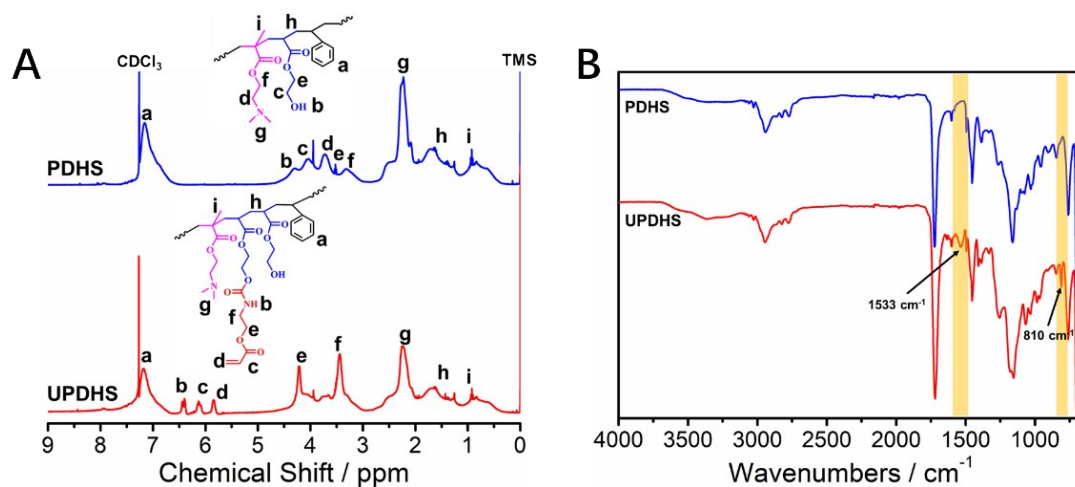


Fig.S1.  $^1\text{H}$  NMR spectra (A) and FT-IR (B) of amphiphatic copolymer PDHS and UV-crosslinkable macromonomer UPDHS.

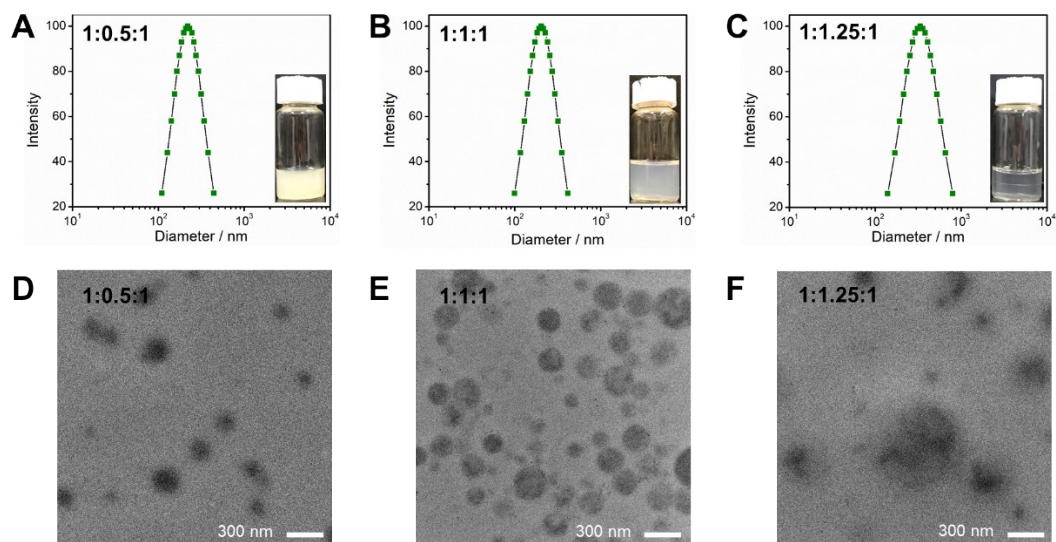


Fig.S2. The diameters and TEM images of different ratio of monomers (DMAEMA:HEA:St): (A) and (D) 1:0.5:1; (B) and (E) 1:1:1; (C) and (F) 1:1.25:1. We controlled the HEA content to obtain different UPDHS with different double bond content, because the amount of UV-crosslinkable acrylate side groups (ICEA) was determined by HEA (Scheme 2). Double bond content is the key to command the

formation of BSA@UPDHS NPs and performance of MIP sensor originated from UV-crosslinkable macromonomer. The diameters and TEM images of different BSA@UPDHS NPs were shown in Fig.S2. With the increase of HEA, double bond content increased and the average diameter of BSA@UPDHS NPs increased as well. In a general way, the degree of UV-crosslinking would increase with more double bond in UPDHS, resulting in more robust and stable MIP layer. However, the BSA@UPDHS NPs with excess double bond would be irregular and varisized as shown in Fig.S2 C and F. Therefore, the copolymer UPDHS with the molar ratio of 1:1:1 (DMEEMA:HEA:St) was chosen to investigate the performance of MIP sensor.

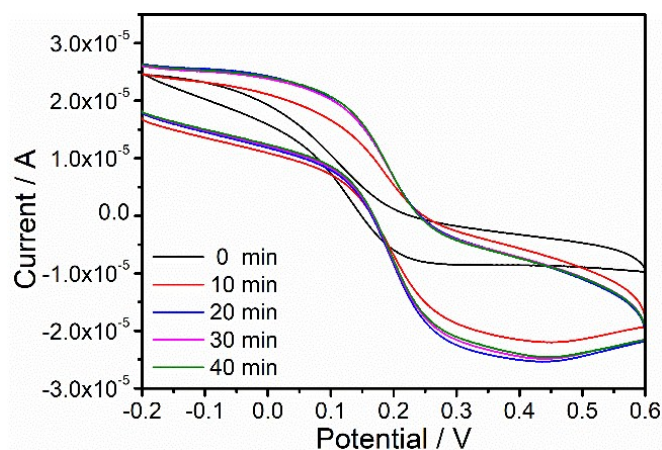


Fig.S3. CV voltammograms of BSA@MIP sensor after different extraction time.

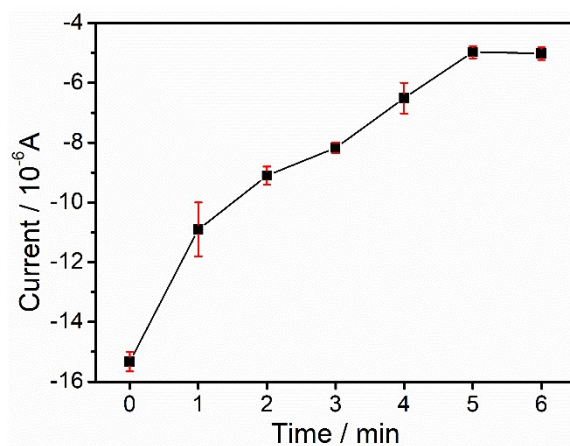


Fig.S4. DPSV peak currents of BSA@MIP sensor in PBS (pH 7.4) solution containing  $[\text{Fe}(\text{CN})_6]^{3-/4-}$  as probe after incubation in  $10^{-11}$  mg mL $^{-1}$  BSA aqueous solution for different time.

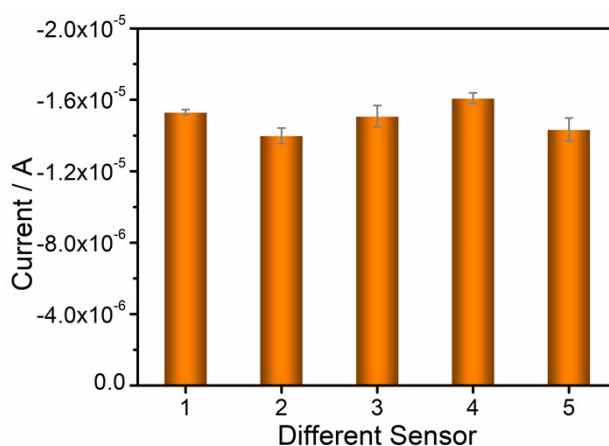


Fig.S5. DPSV response currents of different BSA@MIP sensors after protein extraction. The sensors were constructed using the same procedures.

Table S1. Comparison of sensing performance data of proposed method with other materials applied for BSA detection.

Materials	Linear range (mg mL $^{-1}$ )	References
BSA/WMMIP	$5 \times 10^{-10} \sim 5 \times 10^{-7}$	1
Epitope-based MIP/HRP amplification	$10^{-6} \sim 1.5 \times 10^{-4}$	2

MIP Microspheres	$10^{-5} \sim 5 \times 10^{-3}$	3
MIP IL/CNTs	$10^{-4} \sim 10^{-1}$	4
Chitosan/CNTs	$10^{-7} \sim 10^{-1}$	5
Graphite-based ink/MIP	$10^{-3} \sim 10^2$	6
TGA-CdTe/MIP	$4.6 \sim 1.5 \times 10^2$	7
BSA@UPDHS	$10^{-14} \sim 10^{-9}$	This work

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