Supplementary information

Selective removal of IgG from proteinuria using a polymer coated core-shell magnetic nanoparticle

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Experimental section

Synthesis of N-*methacryloyl-L-aspartic acid (MAsp) monomer*

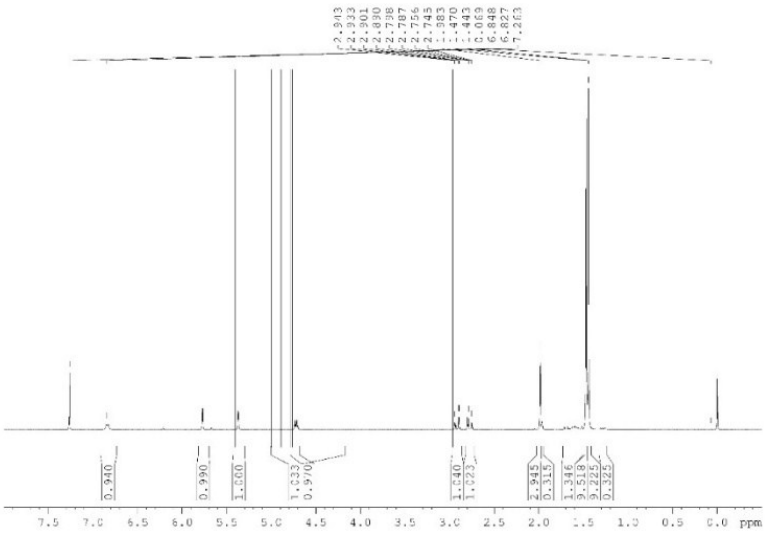

Fig. S1 ^{1}HNMR spectrum of product a

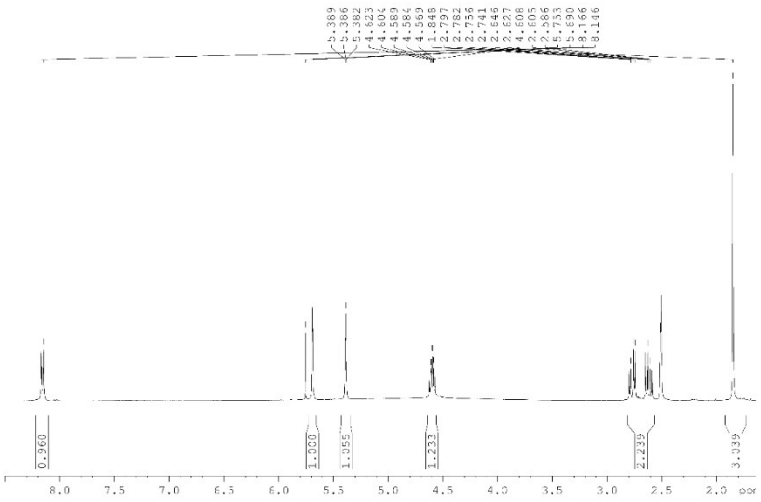

Fig. S2 ^{1}HNMR spectrum of MAsp

Preparation of Fe_3O_4, Fe_3O_4@SiO_2, Fe_3O_4@SiO_2@KH-570

The Fe_3O_4 nanoparticles were prepared by means of solvothermal synthesis. A typical procedure was: $FeCl_3 \cdot 6H_20$ (2.7 g) was dissolved in EG (80 mL) under

ultrasonication, and subsequently NaAc (7.2 g), PEG (1 g) were added to the solution. After vigorous stirring for 0.5 h, the solution was transferred to a teflon-lined stainless steel autoclave (100 mL capacity), push N_2 for 15 min to remove oxygen, then heated at 200 °C for 12 h, and then cooled to room temperature. The nanoparticles were collected with a magnet, washed with ethanol and H_2O. For characterization, dry it under vacuum at 30 °C, about 0.7 g Fe_3O_4 nanoparticles can be obtained.

The obtained Fe_3O_4 from the first step was put into use for preparation of Fe_3O_4@SiO_2 directly without drying. They were dispersed evenly in 700 mL mixture of ethanol-H_2O (4:1) and 5.25 mL $NH_3 \cdot H_2O$ with ultrasonication for 30 min, then the mixture was stirred for 30 min at room temperature. 2.8 mL TEOS was added into it and stirred for another 10 h under N_2 protection. The product was washed with ethanol and water successively.

Redisperse the obtained wet Fe_3O_4@SiO_2 in 200 mL solvent of ethanol-H_2O (4:1) and 6 mL $NH_3 \cdot H_2O$, then 1.6 mL KH-570 was added and stirred under 40 °C for 24 h. The product Fe_3O_4@SiO_2@KH-570 was collect with a magnet and washed with ethanol, dry under vacuum at 30 °C.

Preparation of Fe_3O_4@SiO_2@ MAsp-HEMA

Mini-emulsion polymerization method was adopted to prepare Fe_3O_4@SiO_2@MAsp-HEMA. HEMA was monomer, EGDMA was cross-linker, SDS and PVA consist of complex emusifier.

The first aqueous phase was prepared by dissolving PVA (0.2 g), SDS (0.030 g),

and $NaHCO_3$ (0.025 g) in 10 mL water, ultrasonic degassing. The second aqueous phase was prepared by dissolving PVA (0.1 g), SDS (0.1 g) in 200 mL water, ultrasonic degassing. The oil phase was prepared by mixing HEMA (0.7 mL), EGDMA (1.4 mL) and MAsp (0.25 mmol). Then Fe_3O_4@SiO_2@KH-570 (0.70 g, 0.1 mmol) was added into the first aqueous phase under ultrasonic and mechanical stirring, after 30 min, drop the oil phase into the magnetic fluid. The second aqueous phase was lastly added under mechanical stirring. Flow N_2 for 30 min, then added $(NH_4)_2S_2O_8$ (0.125 g) and $NaHSO_3$ (0.125 g) into the system and heated to 40 °C, to initiate the reaction. Kept stirring for 24h. The final product of Fe_3O_4@SiO_2@MAsp-HEMA was washed by ethanol/water (v/v, 1:1), then dried it under vacuum at 40 °C for 24 h.

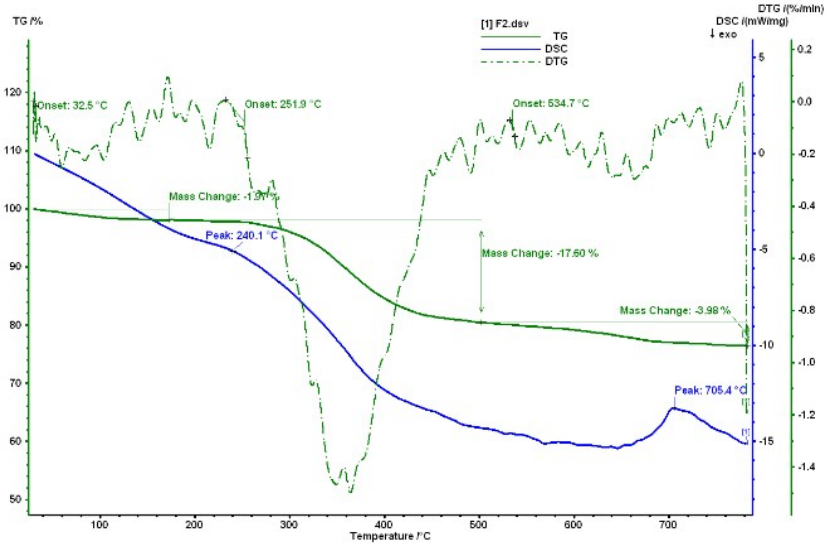

Fig. S3 Thermo gravimetric curve of Fe_3O_4@SiO_2@MAsp-HEMA

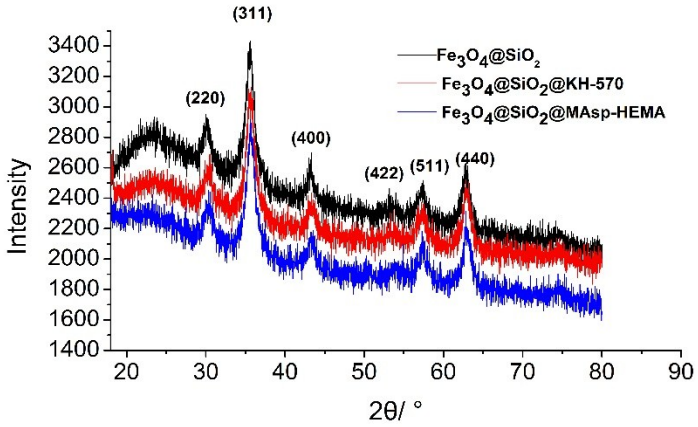

Fig. S4 XRD pattern of Fe_3O_4@SiO_2, Fe_3O_4@SiO_2@KH-570, and Fe_3O_4@SiO_2@MAsp-HEMA

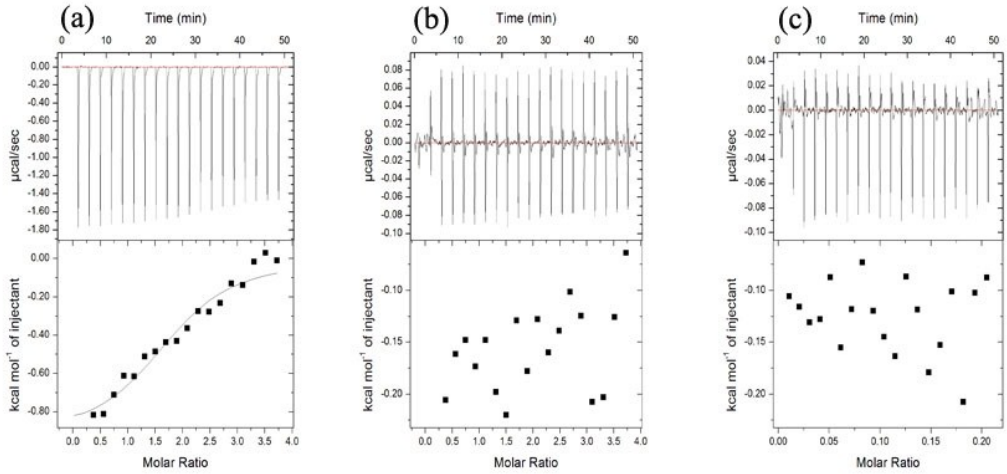

Fig. S5 ITC graphs of the MAsp titration with (a) IgG, (b) BSA and (c) no protein in PBS (0.01M, pH 7.2). Solid squares: titration data; line: fitted titration curve

Optimization of FASS-CE

Four background electrolyte solutions include 2.3M acetic acid+0.05% Tween20 (pH=2.1), 2.3M acetic acid+0.1% Tween20 (pH=2.1), 1.7M acetic acid+0.1% Tween20 (pH=2.2), and 40 mM chloroacetic acid+0.1% Tween20 (pH=2.2) were evaluated; four separation voltage levels at 10 kV, 15 kV, 20 kV and 25 kV were explored, respectively; the different sample injection pressures (+13 kV; +15 kV; +20 kV; +25 kV), time (10 s, 20 s, 25 s, 30 s, 40 s), and water-plug time (30 mbar×10 s, 30 mbar×20 s, 30 mbar×30 s) were studied. Taken the migration time, *R*s and column efficiency into consideration, the optimized conditions were 2.3M acetic acid+0.1% Tween20 (pH=2.1) of background electrolyte, 10 kV separation voltage, electrokinetic injection: 25 kV×30 s, water-plug: 30 mbar×10 s.