

Electronic Supplementary Information

Complexes of Magnetic Nanospheres with Amphiprotic Polymer- Zn Systems for Selective Isolation of Lactoferrin

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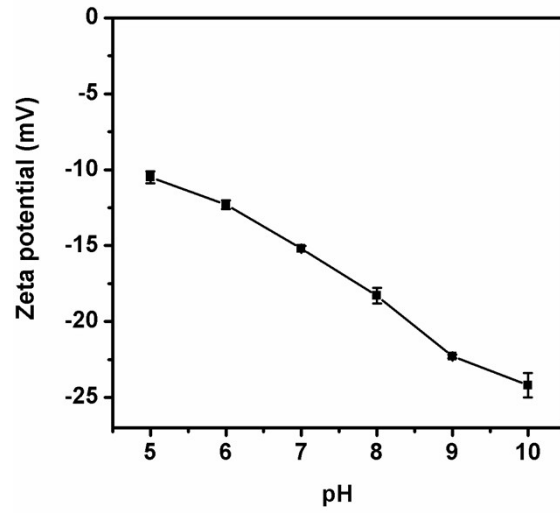


Figure S1. Zeta potentials of the $\text{Fe}_3\text{O}_4@$ PCL- CMC-Zn complex nanospheres at pH 5-10.

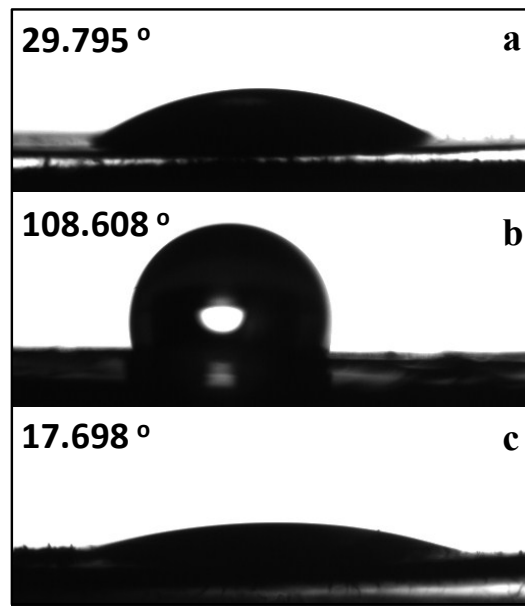


Figure S2. Contact angles of Fe_3O_4 NPs (a), $\text{Fe}_3\text{O}_4@$ PCL nanospheres (b) and $\text{Fe}_3\text{O}_4@$ PCL-CMC-Zn complex nanospheres (c).

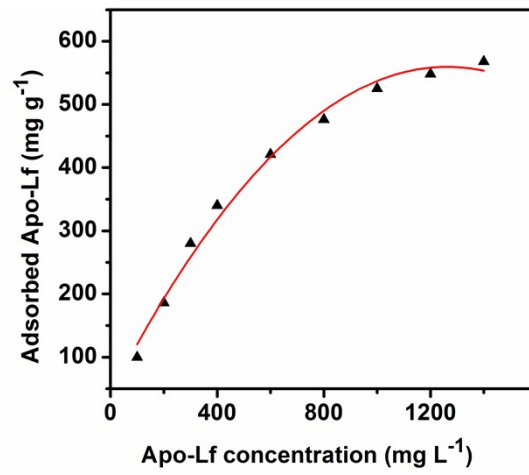


Figure S3. The adsorption isotherm of apo-Lf on Fe₃O₄@ PCL-CMC-Zn complex nanospheres. Protein solution: 50-700 mg L⁻¹, pH 9; adsorption time: 10 min; the mass of nanospheres: 0.5 mg.

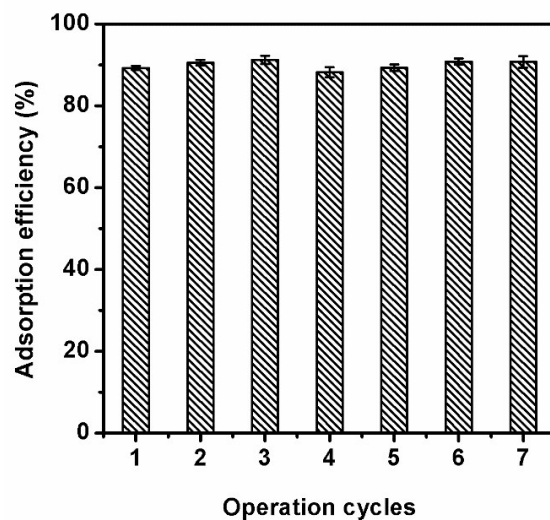


Figure S4. The reusability of Fe₃O₄@ PCL-CMC-Zn complex nanospheres for the circulation of adsorption and desorption of apo-Lf. Protein solution: 1.0 mL, 100 mg L⁻¹, pH 9; adsorption time: 10 min; magnetic nanospheres: 1.0 mg.

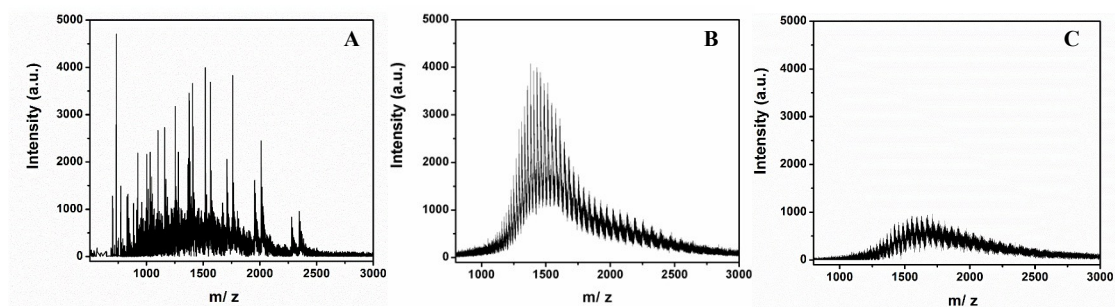


Figure S5. QTOF MS assay results: A: 10-fold diluted human colostrum whey sample without pretreatment; B: 10-fold diluted human colostrum whey sample after pretreatment with the $\text{Fe}_3\text{O}_4@\text{PCL-CMC-Zn}$ complex nanospheres and recovery with FeCl_3 ; C: apo-Lf standard solution (100 mg L^{-1}) after pretreatment with the $\text{Fe}_3\text{O}_4@\text{PCL-CMC-Zn}$ complex nanospheres and recovery with FeCl_3 .

Table S1. The comparison of adsorption capacities for lactoferrin with various adsorbents.

Adsorbents	Adsorption capacity (mg g ⁻¹)	Reference
Lactoferrin MIPs	179.9	[32]
Hydroxyapatite nanocrystals	112.5	[35]
Supermacroporous continuous cryogel	308.8	[36]
Con A-bound Fe ₃ O ₄ MNPs	59.2	[37]
Fe ₃ O ₄ @PCL-CMC-Zn ²⁺ nanospheres	615.3	this work