

Supplementary Information

Superparamagnetic high-magnetization composite spheres with highly aminated ordered mesoporous silica shell for biomedical applications

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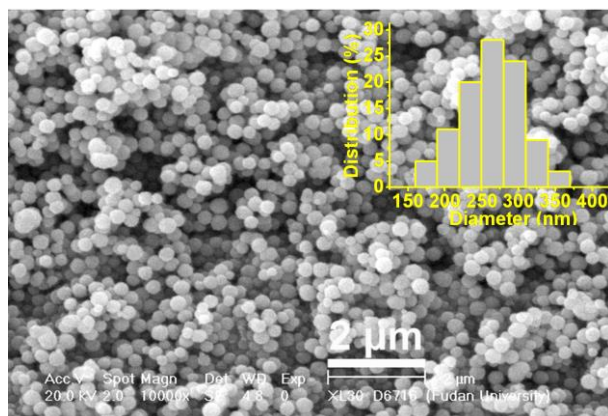


Figure S1. SEM image of the magnetite particles. Inset is the size distribution of the particles by measuring about 100 particles. The magnetite particles were synthesized by a solvothermal reaction. Briefly, 0.65 g of FeCl_3 , 0.20 g of trisodium citrate dehydrate, and 1.20 g of sodium acetate were dissolved in 20 ml of ethylene glycol under magnetic stirring. The obtained homogeneous yellow solution was transferred to a Teflon-lined stainless-steel autoclave with a capacity of about 30 ml. The autoclave was heated to 200 °C and maintained for 10 h, and then cooled down to room temperature. The obtained black magnetite particles were washed with water for five times, and then dried in vacuum at 60 °C for 12 h.

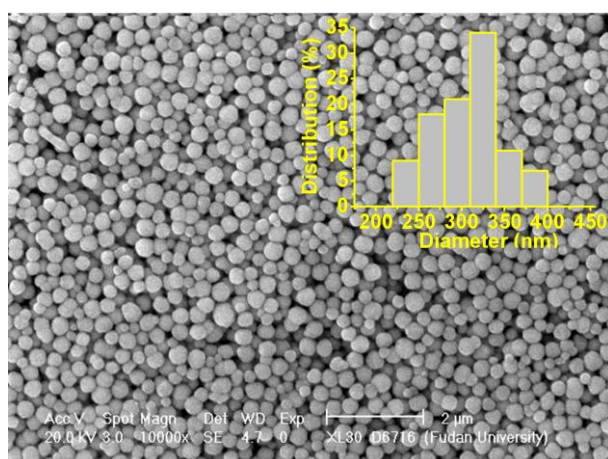


Figure S2. SEM image of the $\text{Fe}_3\text{O}_4@\text{nSiO}_2$ spheres prepared by coating the magnetite particles with silica in a Stöber solution. Inset is the size distribution of the $\text{Fe}_3\text{O}_4@\text{nSiO}_2$ spheres by measuring about 100 particles.

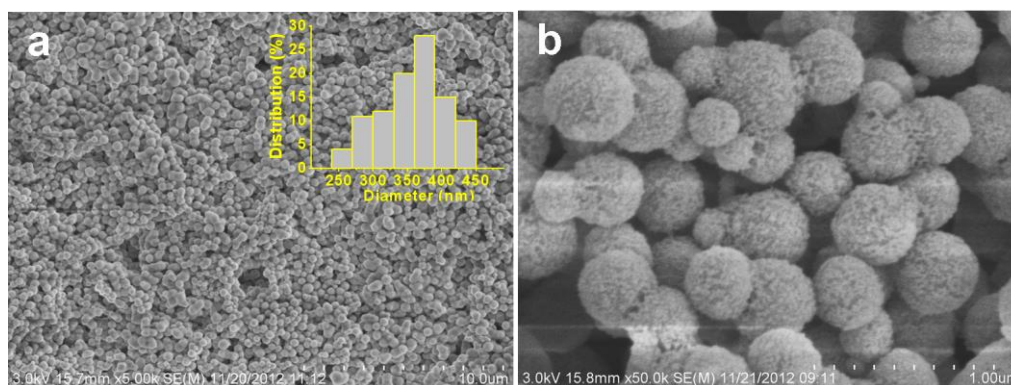


Figure S3. SEM images of the $\text{Fe}_3\text{O}_4@\text{nSiO}_2@\text{mSiO}_2\text{-NH}_2$ spheres at (a) low and (b) high magnification. Inset in (a) is the size distribution of the highly aminated superparamagnetic mesoporous composite spheres by measuring about 100 particles.

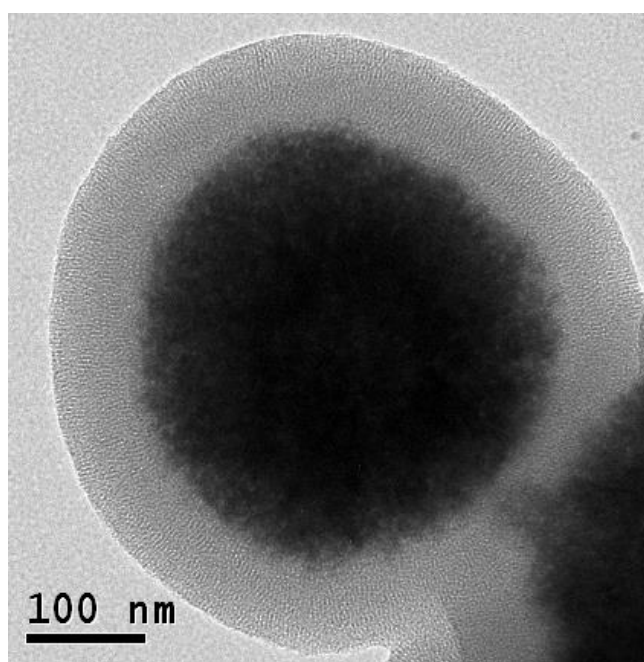


Figure S4. TEM image of non-aminated magnetic mesoporous particle. The core-shell structured magnetic mesoporous particles were prepared through slightly modified two-step coating procedure reported previously.¹ Typically, 0.04 g of Fe_3O_4 particles prepared according to the foregoing described solvothermal reaction were homogeneously dispersed in the mixture of ethanol (160 mL), deionized water (40 mL), and concentrated ammonia aqueous solution (2.0 mL, 25 wt%), followed by the addition of TEOS (64 μL). After stirring at room temperature for 6 h, nonporous amorphous silica coated Fe_3O_4 particles were obtained and washed five times with water, and then re-dispersed

in a mixed solution containing CTAB (0.24 g), deionized water (160 mL), concentrated ammonia aqueous solution (2.00 mL, 25 wt %), and ethanol (120 mL). The mixed solution was homogenized for 0.5 h to form a uniform dispersion. 0.32 mL of TEOS was added to the dispersion with a stirring speed of 300 rpm. After reaction for 6 h, the product was collected with a magnet and washed repeatedly with ethanol and water, respectively, and then re-dispersed in 60 mL of acetone for refluxing at 80 °C for 48 h to remove CTAB templates. The product was collected and washed with acetone twice. The extraction process was repeated for three times to ensure a complete removal of CTAB molecules. Finally, non-aminated magnetic mesoporous particles were obtained.

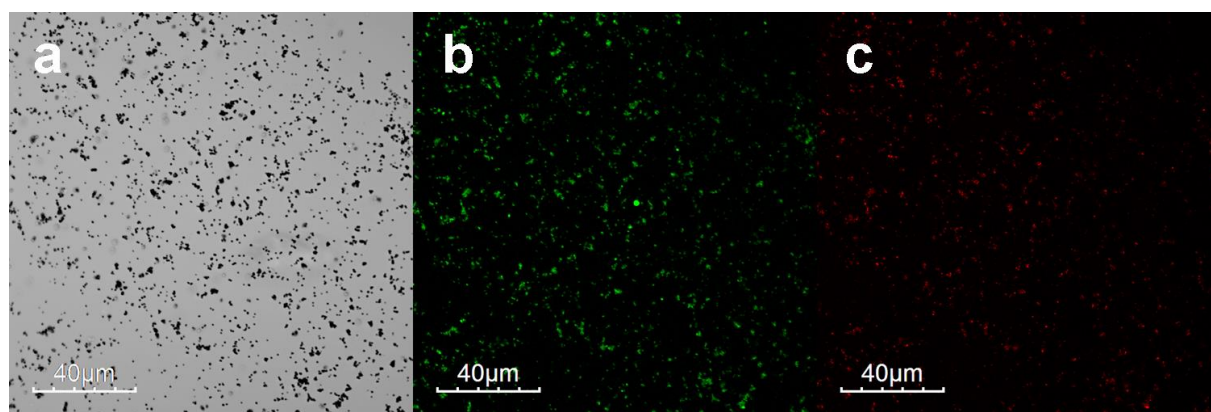


Figure S5. Fluorescence confocal micrographs of FITC/RhB-Fe₃O₄@nSiO₂@mSiO₂-NH₂ particles. (a) Bright field image. (b) The green and (c) the red fluorescence originate from the FITC/RhB-Fe₃O₄@nSiO₂@mSiO₂-NH₂ particles under FITC filter ($\lambda_{\text{ex}} = 488 \text{ nm}$) and RhB filter ($\lambda_{\text{ex}} = 550 \text{ nm}$), respectively.

1 Z. Teng, X. Zhu, G. Zheng, F. Zhang, Y. Deng, L. Xiu, W. Li, Q. Yang and D. Zhao, *J. Mater. Chem.*, 2012, **22**, 17677.