Supplementary information

Colorimetric detection of copper and efficient removal of heavy metal ions from water by diamine-functionalized SBA-15

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Table S1. The differences between Zhu and coworkers' work and our work

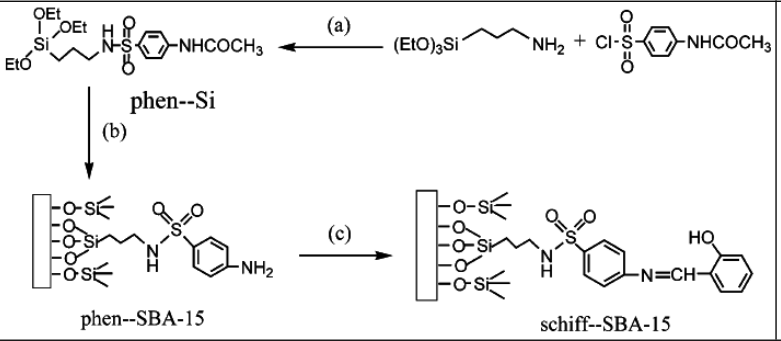
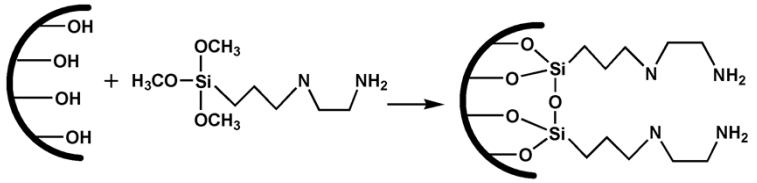
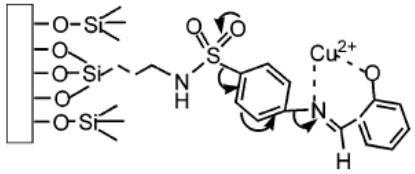
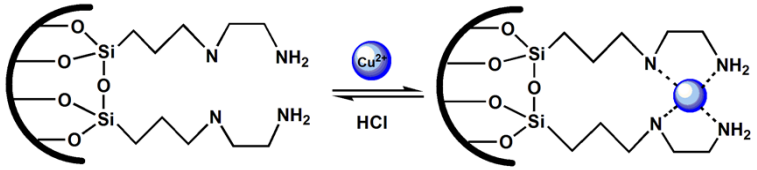
	Zhu and coworkers' work	Our work
Reactant	Pluronic P123, Tetraethyl orthosilicate, (aminopropyl)triethoxysilane, salicylaldehyde, acetanilide, chlorosulfonic acid	N-[3-(Trimethoxysilyl)propyl]ethylenediamine, Pluronic P123, hydrochloric acid, tetraethylorthosilicate
Synthetic route		
Functions of material	To detect	To detect To remove
Applied media	in ethanol-water mixed solution	in water
Detection instrument	fluorescence spectrometer	Naked eye
Reusability	-	yes
Reaction mechanism	Chelate with Cu^{2+} via imino N and phenol O atoms 	Coordinate with Cu^{2+} via $-NH_2$/-NH group 

Table S2 Comparison of adsorption capacity of various sorbent for Cu^{2+}.

Sorbents	Capacity (mg/g)	References
Carbon nanotubes	24.49	27
Amino-functionalized magnetic nano-adsorbent	12.43	28
Oxidized coir	6.99	29
Silica gel microspheres encapsulated with 5-sulfosalicylic acid functionalized polystyrene	29.73	30
Maghemite nanoparticle	27.7	31
Amino-functionalized magnetic nanosorbent	25.77	32
Microorganisms immobilized on composite polyurethane foam	28.74	33
Diamine-functionalized SBA-15 sorbent	27.22	Our work

Table S3 Effect of stripping agents on Cu^{2+} recovery.

Stripping agents	Concentration (mol/L)	Cu^{2+} recovery (%)
HNO_3	0.1	93.3
HNO_3	0.5	94.4
HCl	0.1	94.3
HCl	0.5	94.8
EDTA	0.1	92.1
EDTA	0.5	93.2

5 mg of the SBA-TPED and 5 mL of the stripping agent were used in each test.

Table S4 Extraction recyclability through twenty adsorption/desorption cycles with 10 mg of the SBA-TPED in 2 mL of 0.5 mM Cu^{2+} solutions.

Extraction cycle	Adsorption (%)	K_d (mL/g)	Capacity (mmol/g)
1	97.36	1.475×10^4	0.195
2	97.21	1.394×10^4	0.194
3	93.24	5.517×10^3	0.186
4	96.80	1.210×10^4	0.194
5	93.03	5.339×10^3	0.186
10	90.27	3.711×10^3	0.181
20	89.85	3.541×10^3	0.180

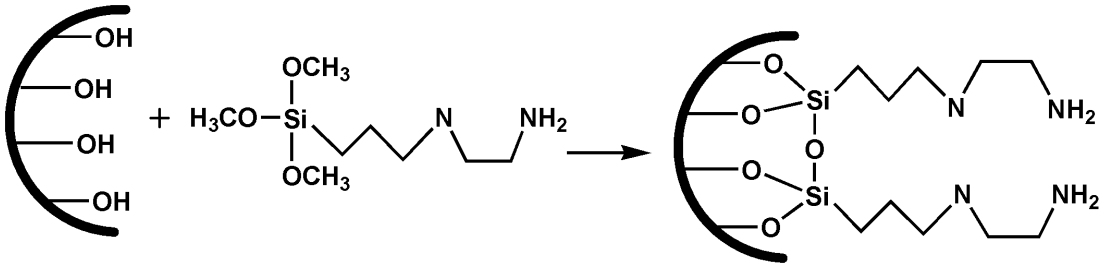


Fig. S1. Synthetic route of the SBA-TPED.

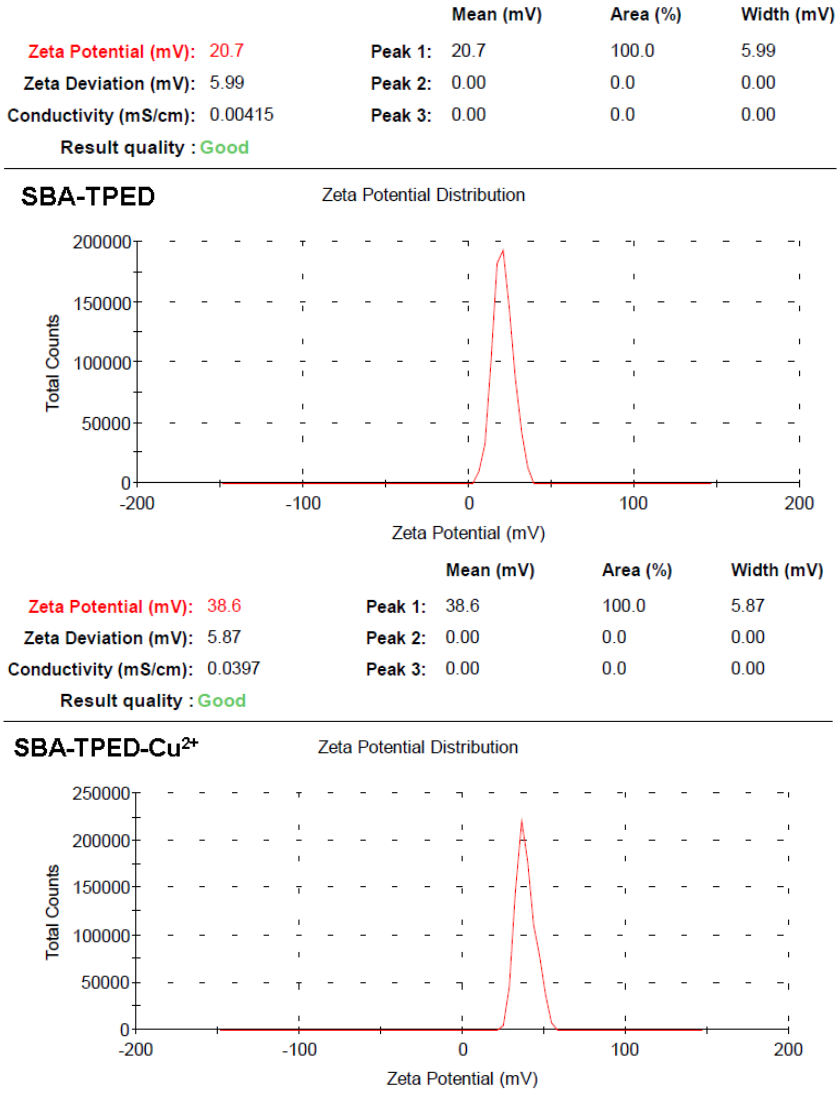


Fig. S2. Zeta potential distributions of SBA-TPED and SBA-TPED-Cu^{2+} in deionsed water at room temperature.

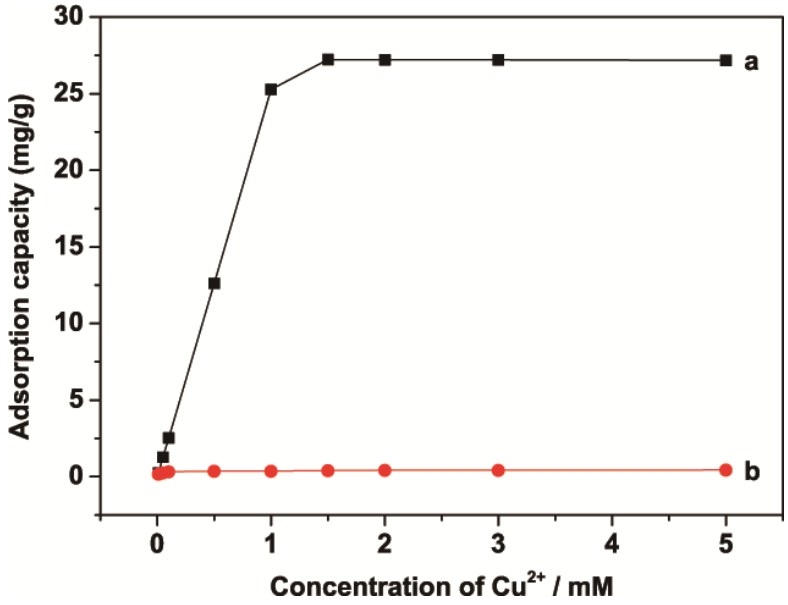


Fig. S3. Adsorption capacity of the SBA-TPED (a) and free SBA-15 (b) for Cu^{2+} at room temperature.

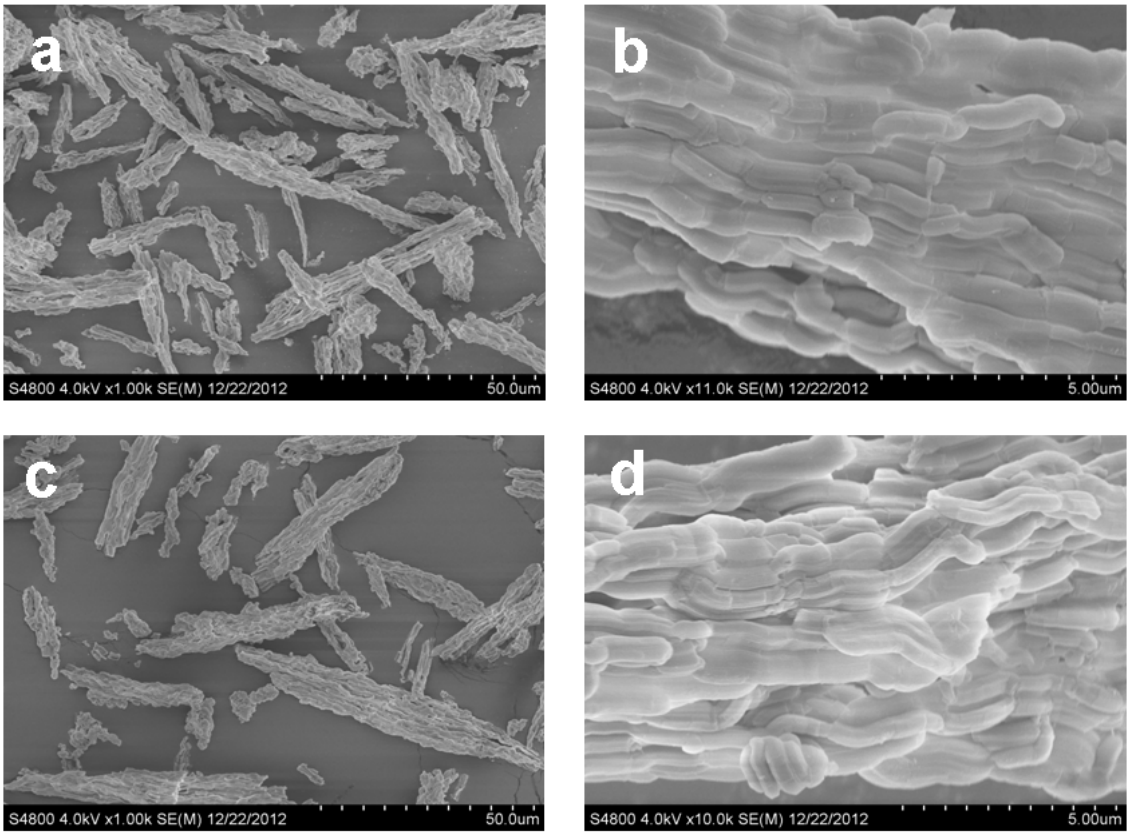


Fig. S4. SEM images of SBA-TPED sorbent before the adsorption (a, b), and after recycling 20 times (c, d).

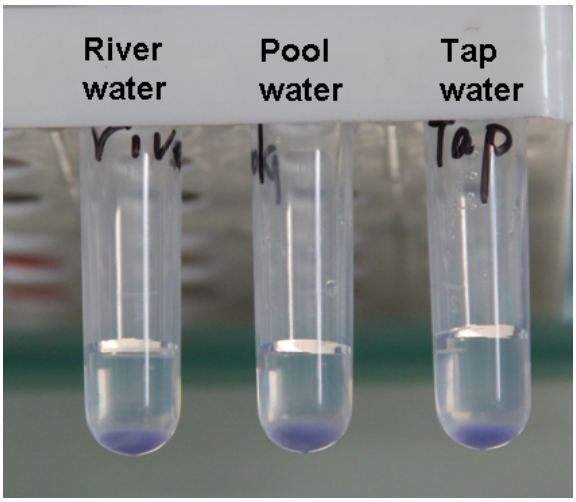


Fig. S5. Color changes of SBA-TPED in real water samples with Cu^{2+} (0.5 mM).