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## Supplementary information

### 2 **Colorimetric detection of copper and efficient removal of heavy** 3 **metal ions from water by diamine-functionalized SBA-15**

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

8 **Table S2** Comparison of adsorption capacity of various sorbent for Cu<sup>2+</sup>.

9 **Table S3** Effect of stripping agents on Cu<sup>2+</sup> recovery.

10 **Table S4** Extraction recyclability through twenty adsorption/desorption cycles with  
11 10 mg of the SBA-TPED in 2 mL of 0.5 mM Cu<sup>2+</sup> solutions.

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

13 **Fig. S2.** Zeta potential distributions of SBA-TPED and SBA-TPED-Cu<sup>2+</sup> in deionised  
14 water at room temperature.

15 **Fig. S3.** Adsorption capacity of the SBA-TPED (a) and free SBA-15 (b) for Cu<sup>2+</sup> at  
16 room temperature.

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

19 **Fig. S5.** Color changes of SBA-TPED in real water samples with Cu<sup>2+</sup> (0.5 mM).

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

	<b>Zhu and coworkers' work</b>	<b>Our work</b>
Reactant	Pluronic P123, Tetraethyl orthosilicate, (aminopropyl)triethoxysilane, salicylaldehyde, acetanilide, chlorosulfonic acid	N-[3-(Trimethoxysilyl)propyl]ethylenediamine, Pluronic P123, hydrochloric acid, tetraethylorthosilicate
Synthetic route	<p>(a) <math>(\text{EtO})_3\text{Si}-\text{CH}_2\text{CH}_2\text{CH}_2-\text{NH}_2 + \text{Cl}-\text{SO}_2-\text{C}_6\text{H}_4-\text{NHCOCH}_3 \rightarrow \text{phen--Si}</math></p> <p>(b) <math>\text{phen--Si} + \text{tetraethyl orthosilicate} \rightarrow \text{phen--SBA-15}</math></p> <p>(c) <math>\text{phen--SBA-15} + \text{salicylaldehyde} + \text{acetanilide} \rightarrow \text{schiff--SBA-15}</math></p>	<p><math>\text{N-[3-(trimethoxysilyl)propyl]ethylenediamine} + \text{Pluronic P123} \rightarrow \text{functionalized silica network}</math></p>
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	<p>Chelate with <math>\text{Cu}^{2+}</math> via imino N and phenol O atoms</p>	<p>Coordinate with <math>\text{Cu}^{2+}</math> via <math>-\text{NH}_2/-\text{NH}</math> group</p>

22 **Table S2** Comparison of adsorption capacity of various sorbent for Cu<sup>2+</sup>.

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

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27 **Table S3** Effect of stripping agents on Cu<sup>2+</sup> recovery.

Stripping agents	Concentration (mol/L)	Cu <sup>2+</sup> recovery (%)
HNO <sub>3</sub>	0.1	93.3
HNO <sub>3</sub>	0.5	94.4
HCl	0.1	94.3
HCl	0.5	94.8
EDTA	0.1	92.1
EDTA	0.5	93.2

28 5 mg of the SBA-TPED and 5 mL of the stripping agent were used in each test.

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32 **Table S4** Extraction recyclability through twenty adsorption/desorption cycles with

33 10 mg of the SBA-TPED in 2 mL of 0.5 mM Cu<sup>2+</sup> solutions.

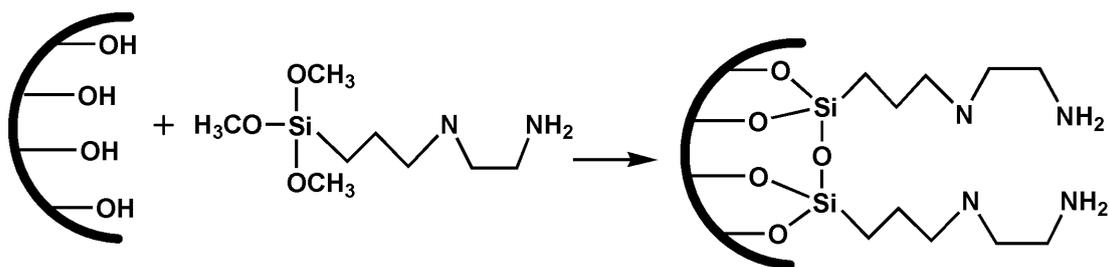
Extraction cycle	Adsorption (%)	K <sub>d</sub> (mL/g)	Capacity (mmol/g)
1	97.36	1.475×10 <sup>4</sup>	0.195
2	97.21	1.394×10 <sup>4</sup>	0.194
3	93.24	5.517×10 <sup>3</sup>	0.186
4	96.80	1.210×10 <sup>4</sup>	0.194
5	93.03	5.339×10 <sup>3</sup>	0.186
10	90.27	3.711×10 <sup>3</sup>	0.181
20	89.85	3.541×10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

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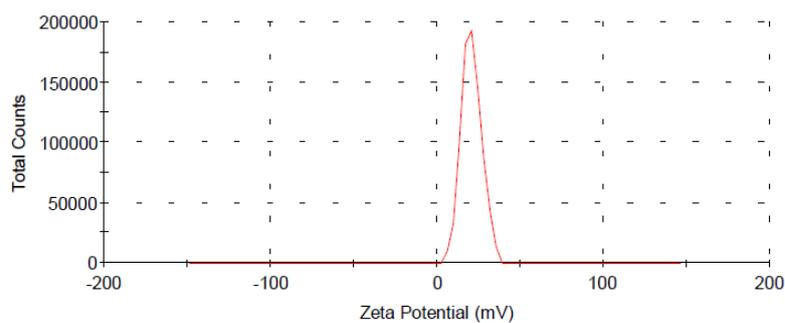
**Fig. S1.** Synthetic route of the SBA-TPED.

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	Mean (mV)	Area (%)	Width (mV)
<b>Zeta Potential (mV): 20.7</b>	<b>Peak 1: 20.7</b>	100.0	5.99
<b>Zeta Deviation (mV): 5.99</b>	<b>Peak 2: 0.00</b>	0.0	0.00
<b>Conductivity (mS/cm): 0.00415</b>	<b>Peak 3: 0.00</b>	0.0	0.00
<b>Result quality : Good</b>			

**SBA-TPED**

Zeta Potential Distribution

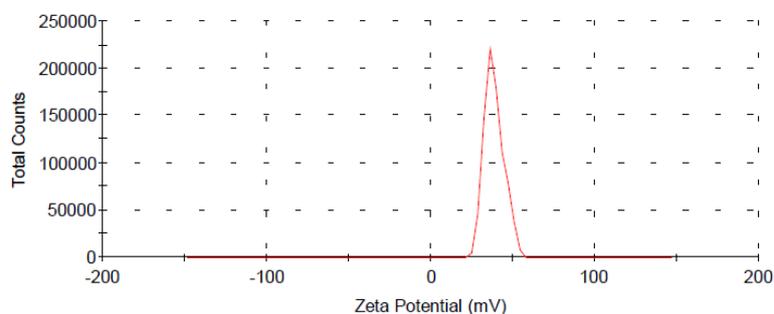


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	Mean (mV)	Area (%)	Width (mV)
<b>Zeta Potential (mV): 38.6</b>	<b>Peak 1: 38.6</b>	100.0	5.87
<b>Zeta Deviation (mV): 5.87</b>	<b>Peak 2: 0.00</b>	0.0	0.00
<b>Conductivity (mS/cm): 0.0397</b>	<b>Peak 3: 0.00</b>	0.0	0.00
<b>Result quality : Good</b>			

**SBA-TPED-Cu<sup>2+</sup>**

Zeta Potential Distribution



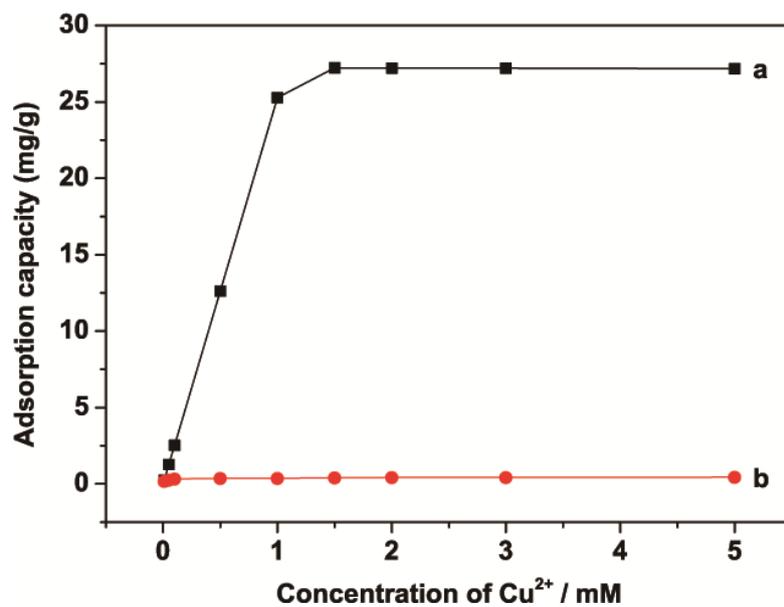
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43 **Fig. S2.** Zeta potential distributions of SBA-TPED and SBA-TPED-Cu<sup>2+</sup> in deionised

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water at room temperature.

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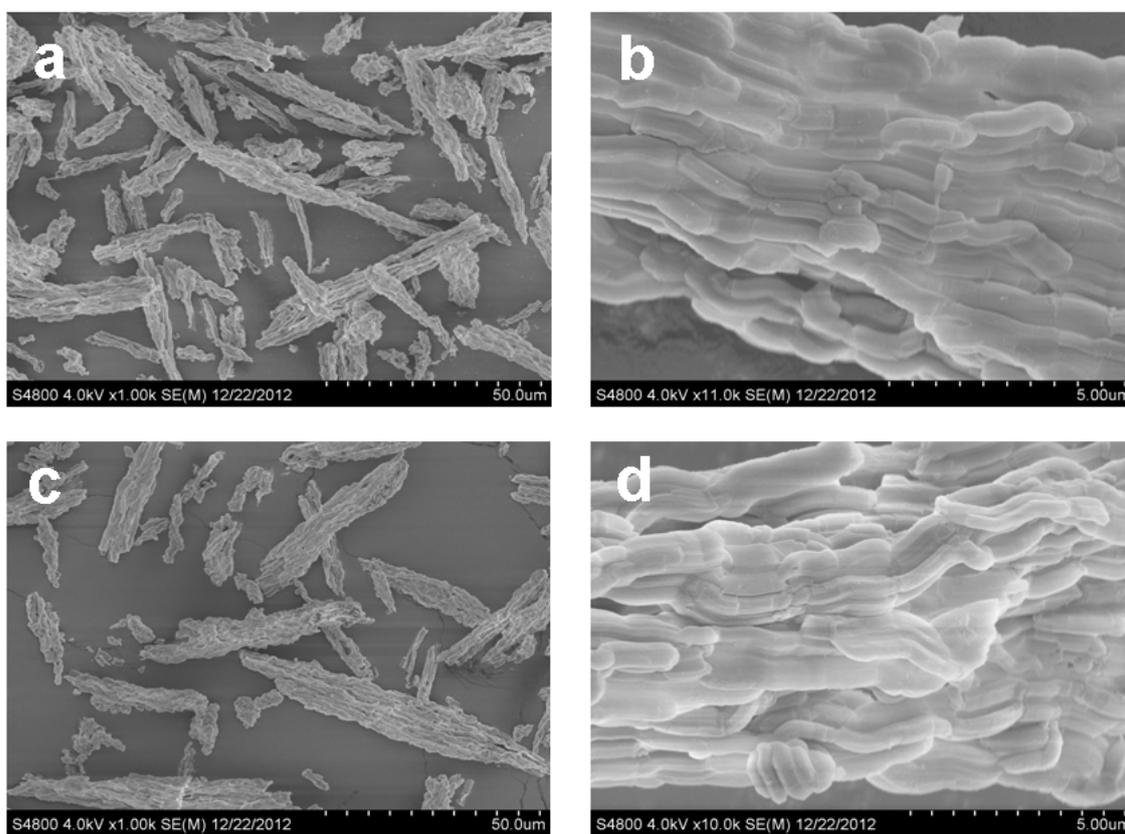


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47 **Fig. S3.** Adsorption capacity of the SBA-TPED (a) and free SBA-15 (b) for Cu<sup>2+</sup> at

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room temperature.



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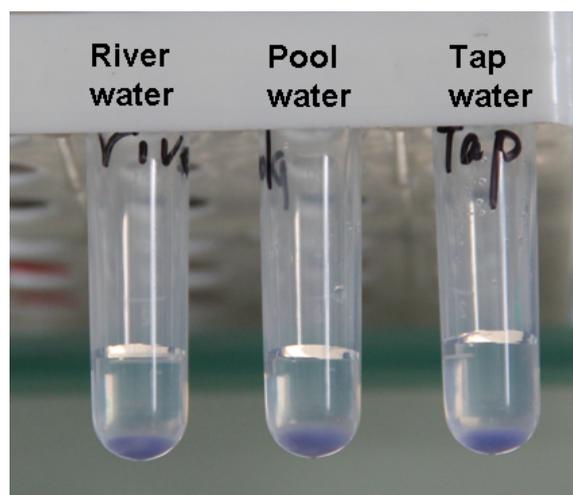
50 **Fig. S4.** SEM images of SBA-TPED sorbent before the adsorption (a, b), and after

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55 **Fig. S5.** Color changes of SBA-TPED in real water samples with Cu<sup>2+</sup> (0.5 mM).