Electronic Supporting Material

Carbon Dot-based Inverse-opal Hydrogels with Photoluminescence: Dual-mode Sensing of Solvent and Metal Ions

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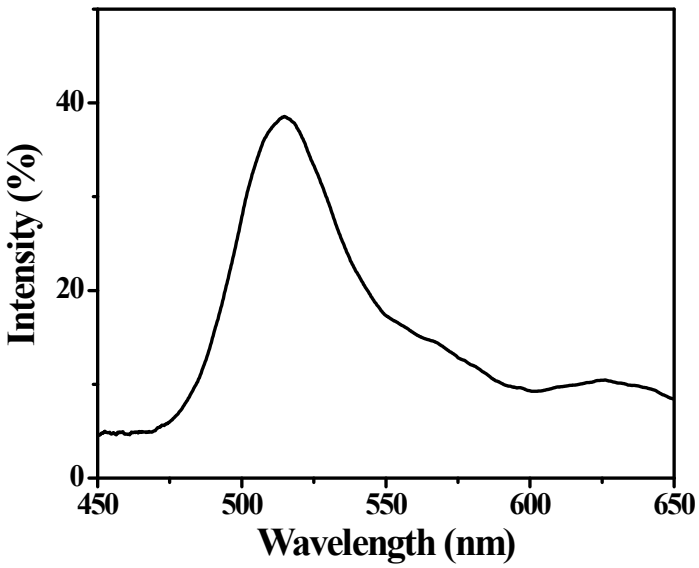

Fig. S1 The reflectance spectrum of opal template based on self-assembly of monodisperse silica colloids.

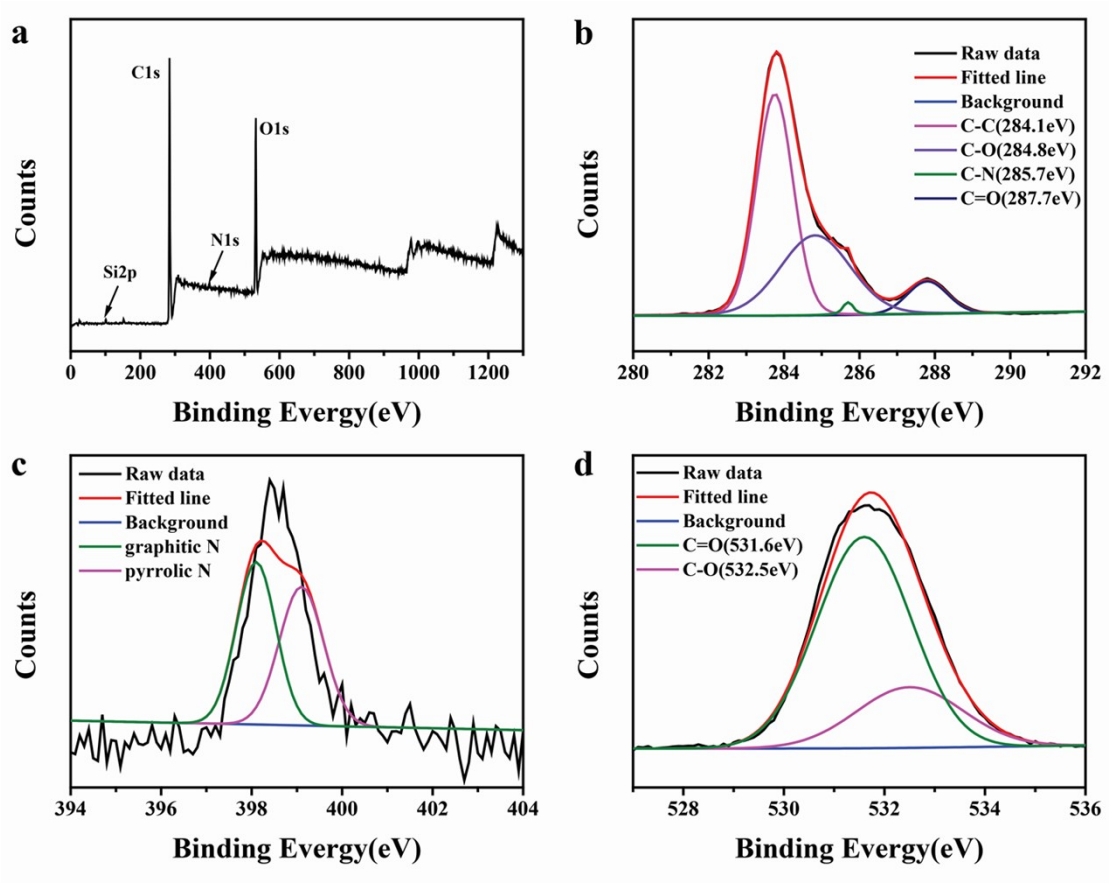

Fig. S2 XPS spectra of the CD-IOHs. (a) The wide spectra and high-resolution spectra of C1s (b), N1s (c), O1s (d).

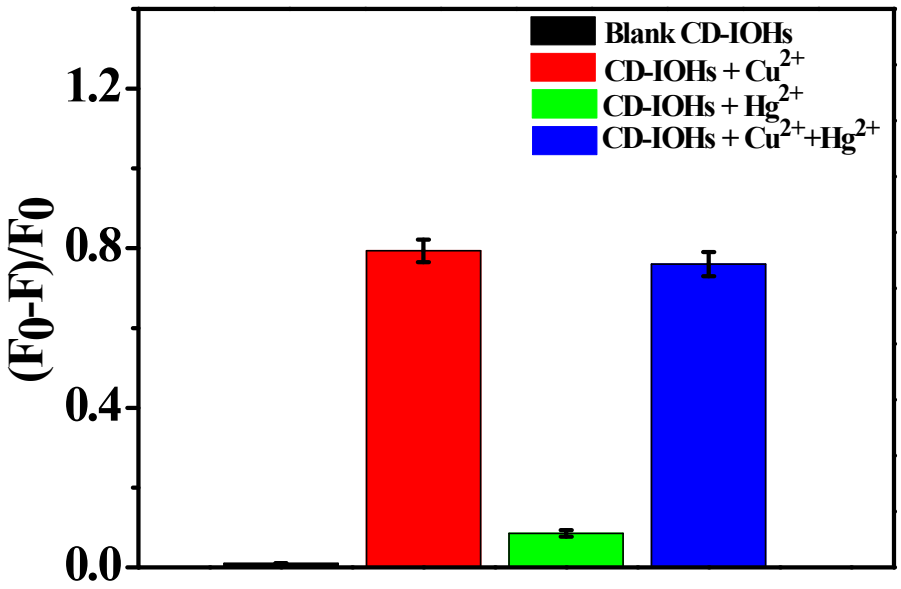

Fig. S3 Selectivity of CD-IOHs towards Cu(II) ions (30 mM) in the presence of Hg(II) metal ions (30 mM).

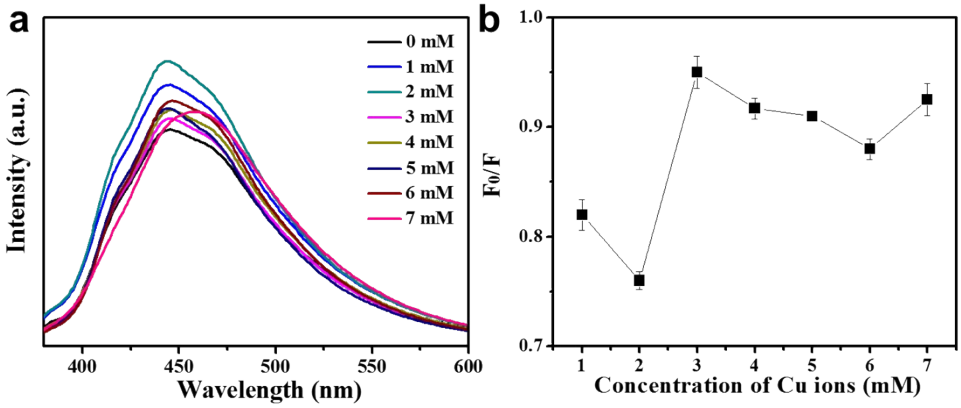

Fig. S4 (a) The fluorescence spectra of CD-IOHs based on pHEMA polymer at Cu(II) ions buffer solutions with various concentrations (from 1-7mM); (b) The relationship between the relative fluorescent intensity (F_0/F) and the Cu(II) ions concentrations.

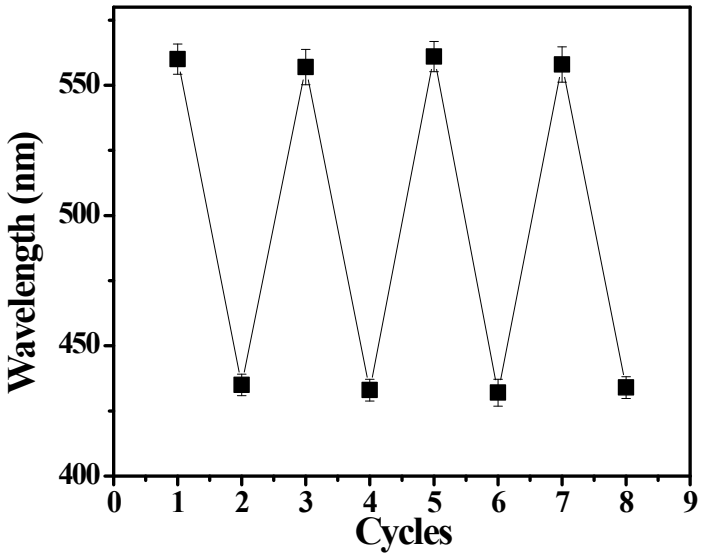

Fig. S5 The reversibility of the CD-IOHs.

Table S1 Summary of solvent sensing via various methods.

Solvents	Detection method	Linear function	Linear detection range	Refs
Ethanol	Reflection	none	none	1
Ethanol Phenol	Reflection	none	none	2
Ethanol Acetone Formaldehyde	Reflection	none	none	3
Ethanol	Reflection and Fluorescence	$\lambda = 3.26[\text{ethanol}]+ 549.18$	0-45%	This work

Table S2 The results of the determination of Cu(II) ions in real water samples. (n=3)

Sample	Method	Adding	Found	Recovery (%)
Tap Water	PL			
1		5 mM	4.94 mM	98.8
2		5 mM	4.93 mM	98.6
3		5 mM	4.67 mM	93.4
Sample	Method	Adding	Found	Recovery (%)
Tap Water	Ref			
1		10^{-5} M	$10^{-5.03}$ M	93.3
2		10^{-5} M	$10^{-4.99}$ M	102.2
3		10^{-5} M	$10^{-4.99}$ M	102.2

Tap water was chosen as real samples. Tap water was collected from our university. Aqueous buffer solutions containing 5 mM and 10 μM Cu(II) ions, respectively, were prepared for the dual-mode sensing measurement. For the PL method, the CD-IOHs were immersed into 5 mM Cu(II) ions solutions for 40 min, then their fluorescence spectra were excited under UV light of 380 nm and recorded by fluorescence spectrometer. For the reflection method, the CD-IOHs were immersed into 10 μM Cu(II) ions solutions, then reflection spectra were recorded by fiber optic spectrometer.

Table S3 Summary of metal ions sensing via various methods.

Metal ion	Detection method	Linear function	Linear detection range	LOD	Number of metal ions for selectivity	Refs
Cu^{2+} ions	Reflection	none	none	1 nM	6	4
Hg^{2+} ions	Reflection	none	none	10 nM	6	5
Pb^{2+} ions	Reflection	$\Delta\lambda$ = 17.95Log [Pb(II)]+ 117.5	1 μM-10 mM	none	5	6
Cu^{2+} ions	Fluorescence	none	0.4 -180 μM	250 nM	15	7
Cu^{2+} ions	Reflection and Fluorescence	$\Delta\lambda$ = 13.08Log [Cu(II)]+ 126.96 F_0/F = 0.143 [Cu(II)]+ 0.947	0.1 μM-7 mM	30 nM	11	This work

References

1. Z. Pan, J. Ma, J. Yan, M. Zhou and J. Gao, J. Mater. Chem., 2012, 22, 2018-2025.
2. G. Huang, Y. Yin, Z. Pan, M. Chen, L. Zhang, Y. Liu, Y. Zhang and J. Gao, Biomacromolecules, 2014, 15, 4396-4402.
3. H. Zhao, J. Gao, Z. Pan, G. Huang, X. Xu, Y. Song, R. Xue, W. Hong and H. Qiu, J. Phys. Chem. C, 2016, 120, 11938-11946.
4. W. Hong, W. Li, X. Hu, B. Zhao, F. Zhang and D. Zhang, J. Mater. Chem., 2011, 21, 17193-17201.
5. M. Zhang, F. Jin, M. Zheng and X. Duan, RSC Adv., 2014, 4, 20567-20572.
6. S. Liu, L. Qin, Z. Ni and M. Chen, Anal. Methods, 2017, 9, 5791-5796.
7. C. Shen, S. Ge, Y. Pang, F. Xi, J. Liu, X. Dong and P. Chen, J. Mater. Chem. B, 2017, 5, 6593-6600.