Support Information

Designing core-shell structured carbon nanodots to guide ultraviolet-to-red conversion for preparation of healthy plant-growth LED

Yu Zhang[a, b, #], Chenkai Jin[b, #], Jinhang Yang[b], Yuxin Zhu[b], Juncheng Huang[b], Chao Fang[b,], Lixin Song[a, *], Haining Na[a, b, *], Jin Zhu[b]*

a. School of Materials Science and Engineering, Shenyang University of Chemical Technology, Shenyang, Liaoning 110142, China

b. Key Laboratory of Bio-Based Polymeric Materials of Zhejiang Province, Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, Ningbo, Zhejiang 315201, China

**Corresponding Author: nahaining@nimte.ac.cn; lxsong@syuct.edu.cn; fangchao@nimte.ac.cn*

[#] These authors contributed equally to this work and should be considered co-first authors.

Tel: +86-0660-3808144; Fax: +86-574-86685186

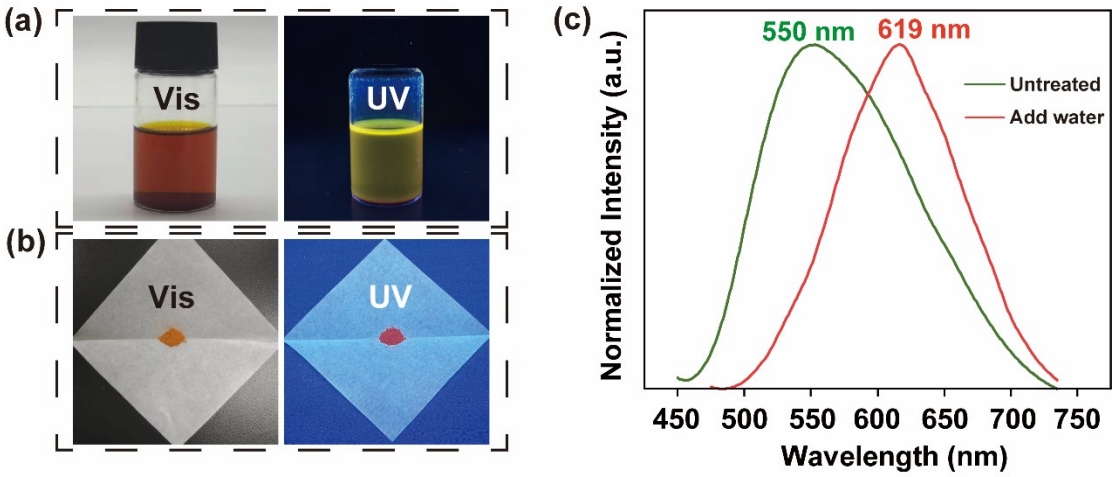

Figure S1. Digital photographs (a) and PL spectrum (b) of samples before and after deionized water treatment.

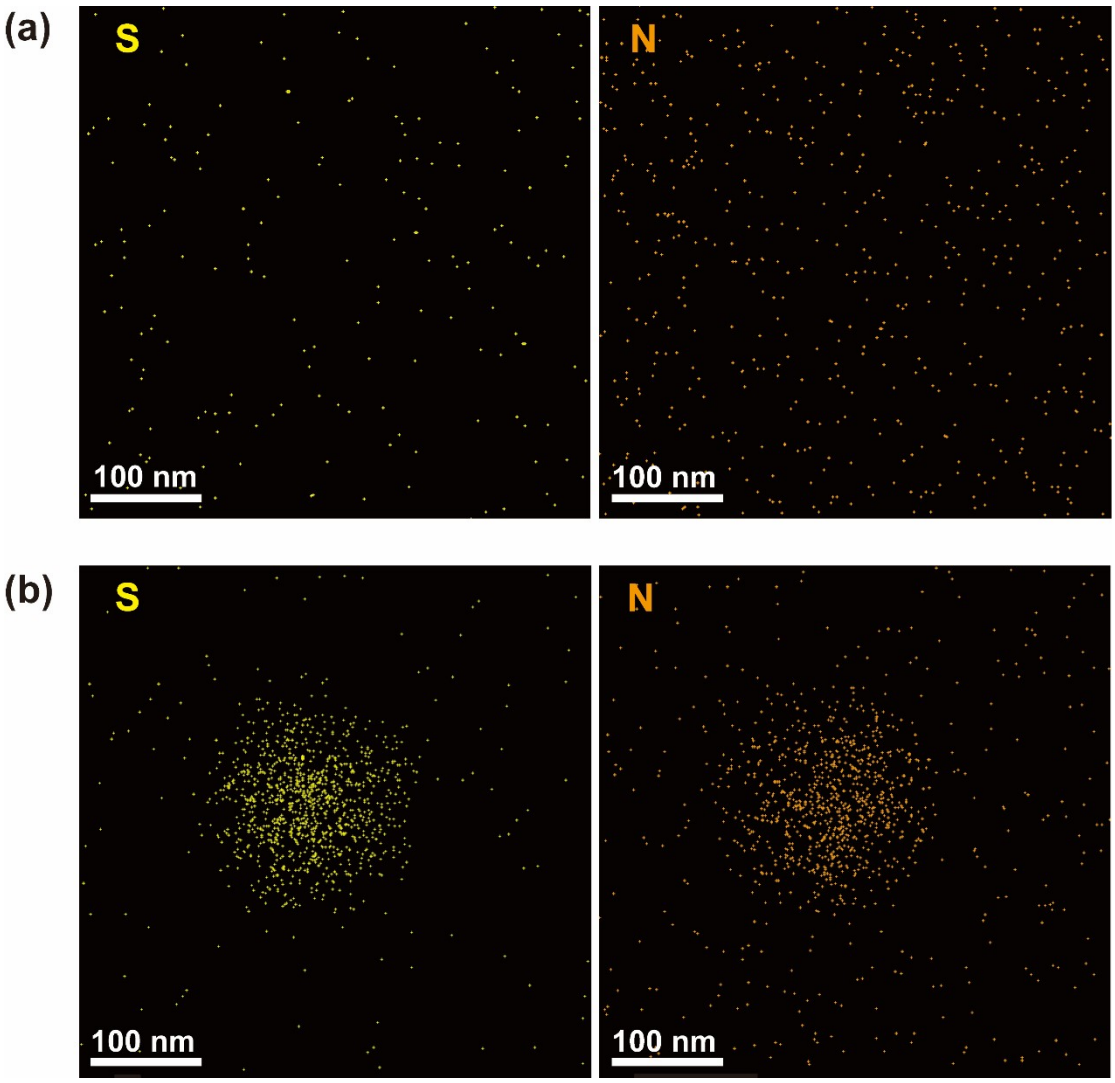

Figure S2. EDS mapping mage of samples before treatment (a) and after adding water treatment (b).

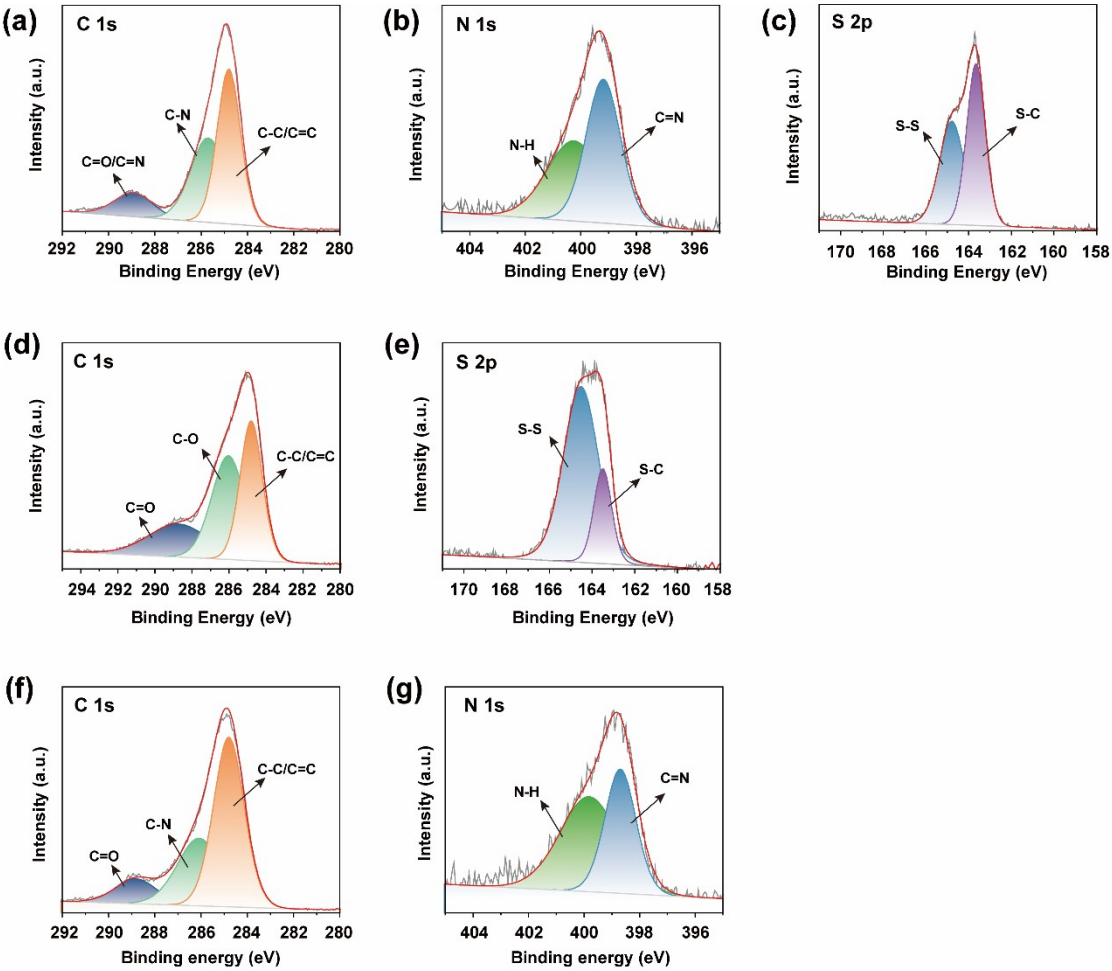

Figure S3. High-resolution XPS fitting results for core-shell-CNDs (a-c), core-CNDs (d-e), shell-CNDs (f-g).

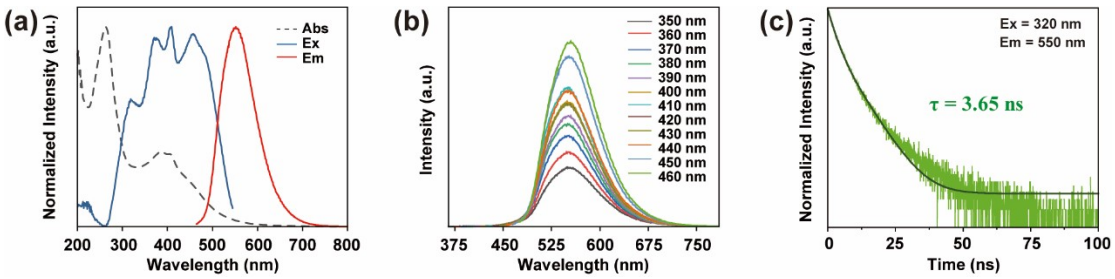

Figure S4. (a) UV-vis spectrum and (b) PL spectrum under different excitation wavelengths of shell-CNDs solutions, (c) fluorescence lifetime test of shell-CNDs solutions.

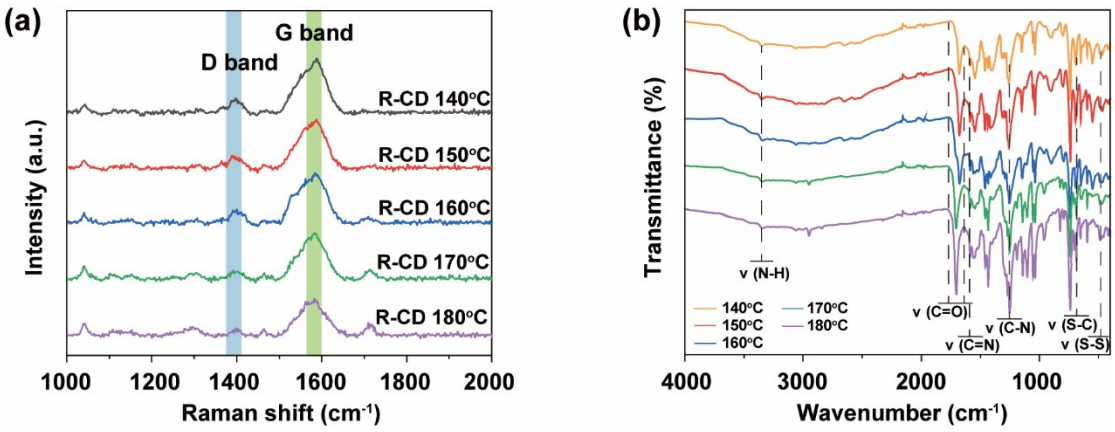

Figure S5. (a) Raman and (b) FT-IR of core-shell-CNDs obtained with different reaction temperature.

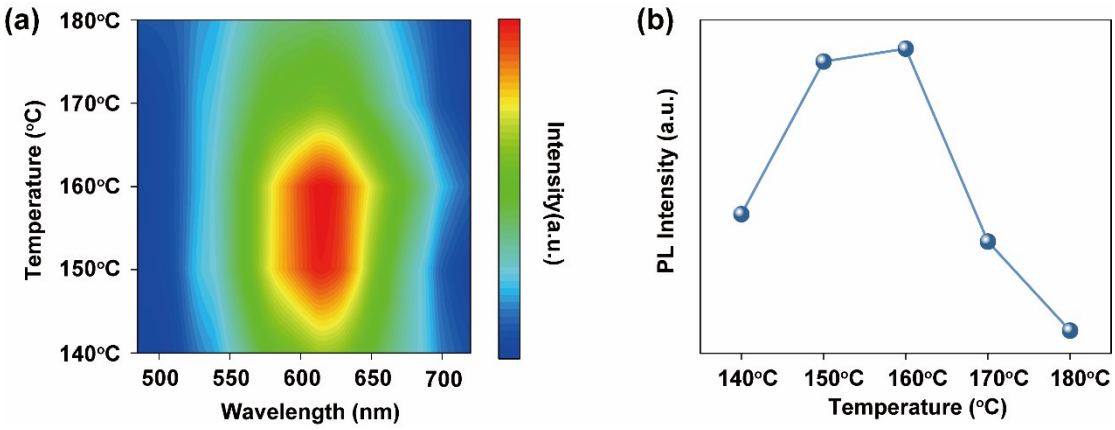

Figure S6. PL spectrum (a) and fluorescence intensity (b) of core-shell-CNDs obtained with different reaction temperature.

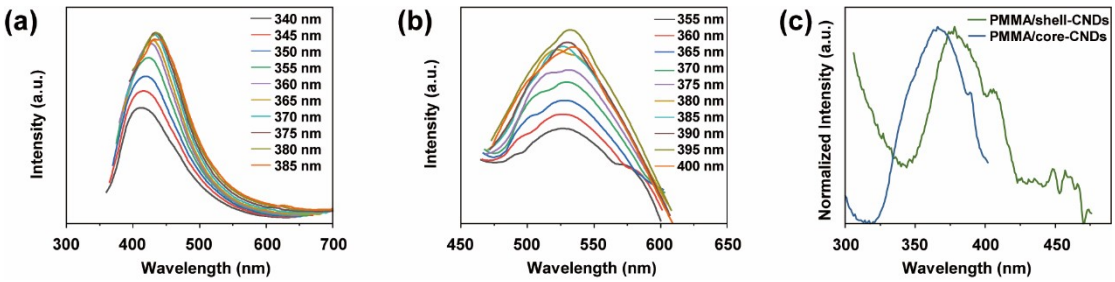

Figure S7. PL spectrum under different excitation wavelengths of PMMA/core-CNDs (a) and PMMA/shell-CNDs. (b) Excitation spectra of PMMA/core-CNDs and PMMA/shell-CNDs (c)

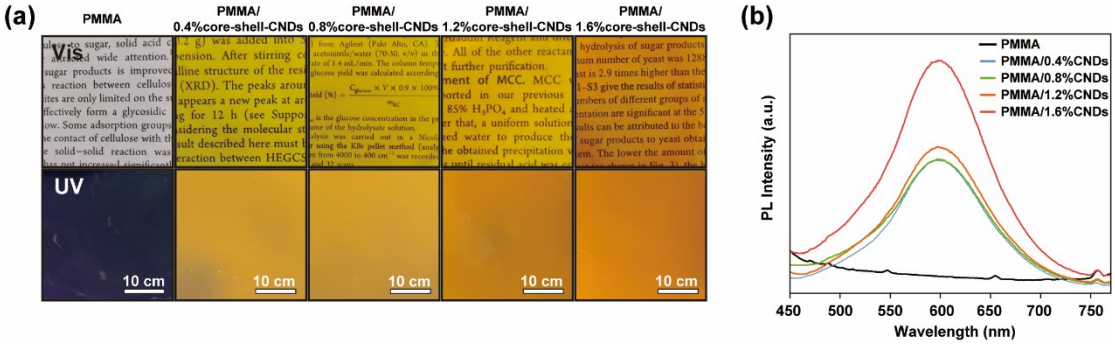

Figure S8. (a) Digital photos of LCFs with different mass fractions of core-shell-CNDs under sunlight and their photos under ultraviolet light. (b) PL spectrum under 380 nm excitation of LCFs with different amounts of core-shell-CNDs.

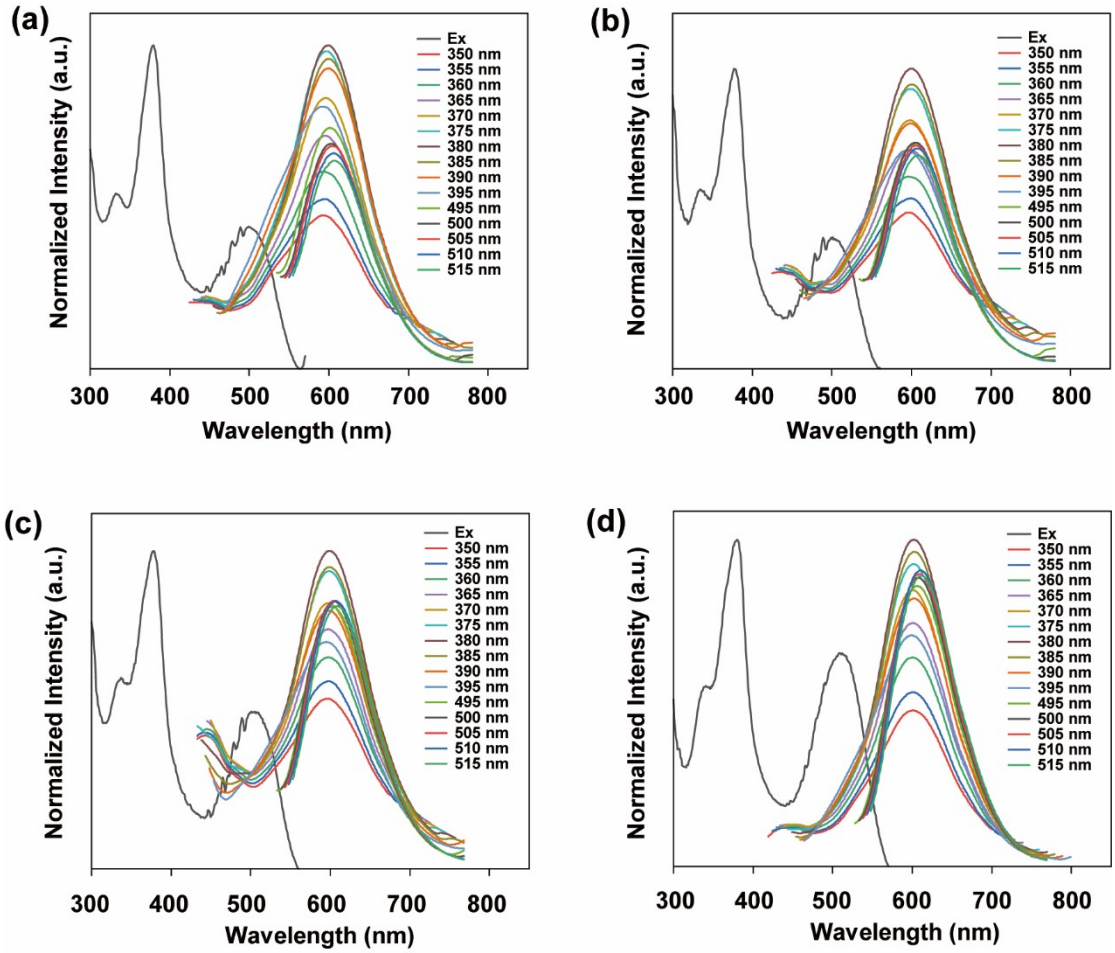

Figure S9. PL spectrum of LCFs with different amounts of core-shell-CNDs. (a) 0.4 wt%, (b) 0.8 wt%, (c) 1.2 wt%, (d) 1.6 wt%.

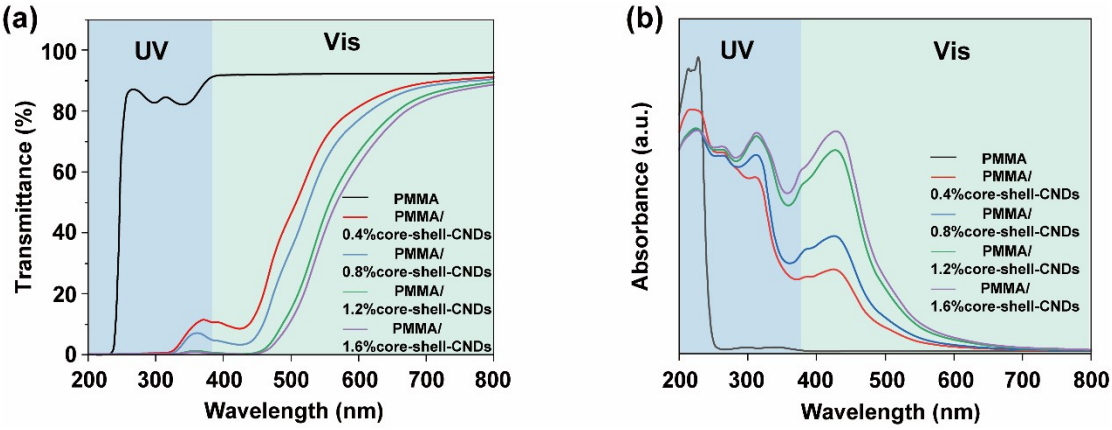

Figure S10. UV-vis transmittance (a) and absorbance (b) of LCFs with different mass fractions of core-shell-CNDs.

Table S1. Element content of CNDs obtained with different structures.

Samples	C 1s (%)	O 1s (%)	N 1s (%)	S 2p (%)
Core-CNDs	78.87	16.52	-	4.61
Core-shell-CNDs	78.04	13.72	4.64	3.60
Shell-CNDs	74.57	18.39	7.04	-

Table S2. Comparison of different solid-state red-emitting CDs.

Name	Excitation (nm)	Emission (nm)	Stokes shift (nm)	Reference
Core-shell-CNDs	362	619	257	This Work
H-CDs	559	620	61	1
CD_5	555	620	65	2
Mn-CDs	550	590	90	3
R-CDs	540	620	80	4
R-CDs	525	613	88	5
CD_{220}	510	615	105	6
O-CDs	560	620	60	7
RT-CDs	460	637	177	8
R-CDs210	480	660	180	9
F-CDs	600	676	76	10

References

1 H. Yang, Y. Liu, Z. Guo, B. Lei, J. Zhuang, X. Zhang, Z. Liu and C. Hu, *Nat Commun*, 2019, **10**, 1789.

2 X. Xu, L. Mo, Y. Li, X. Pan, G. Hu, B. Lei, X. Zhang, M. Zheng, J. Zhuang, Y. Liu and C. Hu, *Advanced Materials*, 2021, **33**, 2104872.

3 X. Gong, Q. Xu, J. Li, Y. Ma, X. Li, W. Wu and H. Wang, *Small*, 2024, **20**, 2304673.

4 X. Niu, T. Song and H. Xiong, *Chinese Chemical Letters*, 2021, **32**, 1953–1956.

5 H. Ding, R. Zhao, Z.-H. Zhang, J.-J. Yang, Z. Wang, L.-L. Xiao, X.-H. Li, X.-J. He and H.-M. Xiong, *Chemical Engineering Journal*, 2023, **476**, 146405.

6 L. Fu, C. Zhang, H. Li, K. Jian, Y. Han and X. Zhao, *Microchemical Journal*, 2024, **202**, 110765.

7 X. Xu, L. Mo, W. Li, Y. Li, B. Lei, X. Zhang, J. Zhuang, C. Hu and Y. Liu, *Chinese Chemical Letters*, 2021, **32**, 3927–3930.

8 M. Zheng, H. Jia, B. Zhao, C. Zhang, Q. Dang, H. Ma, K. Xu and Z. Tan, *Small*, 2023, **19**, 2206715.

9 D. Gao, A. Liu, Y. Zhang, Y. Zhu, D. Wei, J. Sun, H. Luo and H. Fan, *Chemical Engineering Journal*, 2021, **415**, 128984.

10 H. Ding, J. Xu, L. Jiang, C. Dong, Q. Meng, S. U. Rehman, J. Wang, Z. Ge, V. Yu. Osipov and H. Bi, *Chinese Chemical Letters*, 2021, **32**, 3646–3651.