Supporting Information

Efficient photoelectrocatalytic performance of beta-cyclodextrin/graphene composite and effect of Cl^- in water: Degradation for bromophenol blue as a case study

Qiao Cong [a,1], Miao Ren [b,2], Tingting Zhang [b,3], Fangyuan Cheng [b,4], Jiao Qu [b,*]

[1] Qiao Cong

congqiao@jlju.edu.cn

[2] Miao Ren

renm677@nenu.edu.cn

[3] Tingting Zhang

zhangtt671@nenu.edu.cn

[4] Fangyuan Cheng

Chengfy310@nenu.edu.cn

[*] Jiao Qu

quj100@nenu.edu.cn

[a] School of Municipal and Environmental Engineering, Jilin Jianzhu University, Changchun 130118, China, Research Field: Environmental Chemistry.

[b] School of Environment, Northeast Normal University, NO. 2555 Jingyue Street, Changchun 130117, China, Research Field: Environmental Chemistry.

* Corresponding author. Tel: +86 431 89165617. Fax: +86 431 89165610.

Text S1 The preparation method of Graphene

Bomophenol blue is not conductive, which is an acid-base indicator. Bromophenol blue is also called 3',3",5',5"-Tetrabromophenolsulfonephthalein, its molecular formula is $C_{19}H_{10}Br_4O_5S$, and the structural formula is shown in the **Fig. S1**.

Text S2 The preparation method of Graphene

10 g of the collected grass was cut, then the particles attached to the surface were removed by water, and mixed with 10 mL H_2O_2, 5 mL HNO_3 and 5 mL H_2SO_4 in the reactor. The reactor is a corrosion-resistant stainless steel lining reactor with a volume of 100 mL. The reactor was heated to 400 °C with a heating program of 10 °C min^{-1} to synthesize GA, and then kept at the temperature for 60 min. The naturally cooled reaction solution was filtered 3-5 times with glass filter paper (0.45 μm). Then, the residue containing GA was collected, washed 3 times with ethanol, and dried at 105 °C for 2 h.

Text S3 Photoelectrocatalytic performance of graphene-based materials for the removal of organic pollutants

GR-based photoelectrocatalysts are widely used to degrade organic pollutants. Xie et al.[1] used graphene oxide/ZnO nanorods to remove Methylene blue (MB) in aqueous solution, and the removal efficiency of MB was only 90% within 450 min[2]. The researchers also used TiO_2-reduced graphene oxide to degrade BPA in water with degradation rate is 70.4%[3]. Meanwhile, the rGH-PANI/TiO_2 hydrogel electrode reported by Cui[4] could completely degrade phenol in 300 min. Although, the TiO_2-rGH hydrogel electrode reported by Zhang[5] could completely degrade BPA in 300 min through the synergistic effect of adsorption and photo-electro-catalysis. But the poor use of visible light, low quantum yield, and the easier recombination of electrons and holes limits its application in catalysis. The results were shown in **Table S1**.

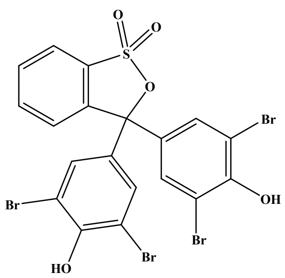

Fig. S1 BPB structural formula

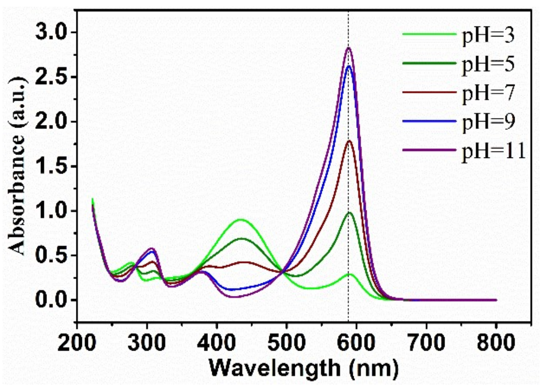

Fig. S2 UV spectra for BPB at different pH

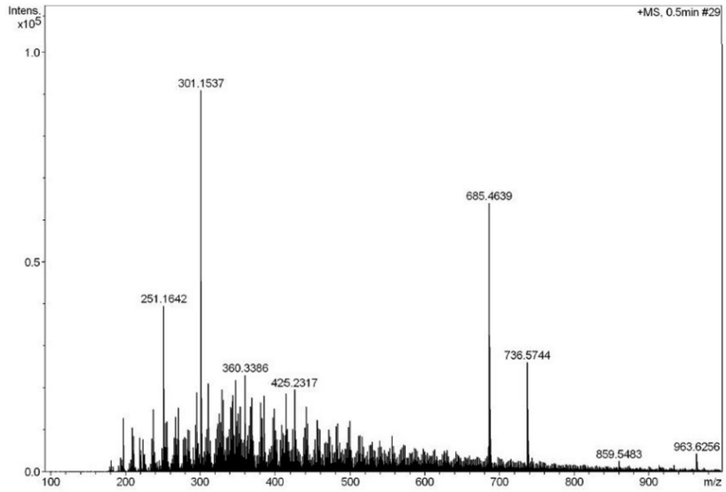

Fig. S3 UPLC-MS/MS spectra of the degradation intermediates for BPB

Table S1 Photoelectrocatalytic performance of graphene-based materials for the removal of organic pollutants

Nanomaterial	Target molecule	Degradation efficiency	Time (min)	Cycles of use	Activity maintained	Refs.
Graphene/β-cyclodextrin	BPB	100%	120	3	82.0%	This work
Graphene oxide/ZnO nanorod	MB	90%	450	-	-	1
TiO_2-Graphene	MO	90%	300	5	83%	2
TiO_2-reduced graphene oxide	BPA	70.40%	150	-	-	3
rGH-PANI/TiO_2 hydrogel	phenol	100%	420	-	-	4
TiO_2-graphene hydrogel	BPA	100%	300	-	-	5

References

1 J. Xie, Z. Ming, H. Li, H. Yang, B. Yu, R. Wu, X. Liu, Y. Bai and S.-T. J. C. Yang, 2016, **151**, 324-331.

2 B. Qiu, M. Xing and J. J. J. o. t. A. C. S. Zhang, 2014, **136**, 5852-5855.

3 L.-J. Luo, X.-J. Zhang, F.-J. Ma, A.-L. Zhang, L.-C. Bian, X.-J. Pan, F.-Z. J. R. K. Jiang, Mechanisms and Catalysis, 2015, **114**, 311-322.

4 W. Cui, J. He, H. Wang, J. Hu, L. Liu and Y. J. A. C. B. E. Liang, 2018, **232**, 232-245.

5 Y. Zhang, W. Cui, W. An, L. Liu, Y. Liang and Y. J. A. C. B. E. Zhu, 2018, **221**, 36-46.