Supporting Information of

Engineering a FeOOH/g-C_3N_4/CA Composite Photocatalytic Membrane for Enhanced Water Treatment: Synergistic Photocatalysis and Fenton-like Processes

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Text S1. Chemicals and materials.

Isopropanol (IPA), polyvinylpyrrolidone (PVP), hydrochloric acid (HCl), ethylenediaminetetraacetic acid disodium salt (EDTA-2Na), and tert-butanol (TBA) were purchased from Tianjin Damao Chemical Reagent Factory. Melamine and ammonium bicarbonate were purchased from China National Pharmaceutical Chemical Reagent Co., Ltd. Rhodamine B (RhB) and p-benzoquinone (p-BQ) were purchased from Xiya Chemical Reagent Co., Ltd. Ferric chloride ($FeCl_3$) was purchased from Macklin Biochemical Co., Ltd. (Shanghai). Humic acid (HA) was purchased from Maya Reagent (USA). All chemicals mentioned above were of analytical reagent grade. In addition, cellulose acetate membranes (pore size 0.45 μm) were purchased from Haining Defu New Material Technology Co., Ltd.

Text S2. Theoretical calculations.

Models of FeOOH, g-C_3N_4 (denoted as C_3N_4), the FeOOH/g-C_3N_4 heterojunction, RhB, and RhB adsorbed on FeOOH/g-C_3N_4 (at Fe and N sites) were constructed in Materials Studio. All calculations were performed based on ground-state structures. Geometry optimization was carried out using the Dmol^3 module, followed by electronic property analysis within the same module. The results were visualized on molecular surfaces with a color-coded electrostatic potential map (red for positive and blue for negative).The adsorption energy (E_{ads}) was calculated as:

$$E_{ads} = E_{ad/sub} - E_{ad} - E_{sub}$$

where $E_{ad/sub}$, E_{ad}, and E_{sub} denote the total energy of the optimized adsorbate-substrate system, the isolated adsorbate, and the clean substrate, respectively.

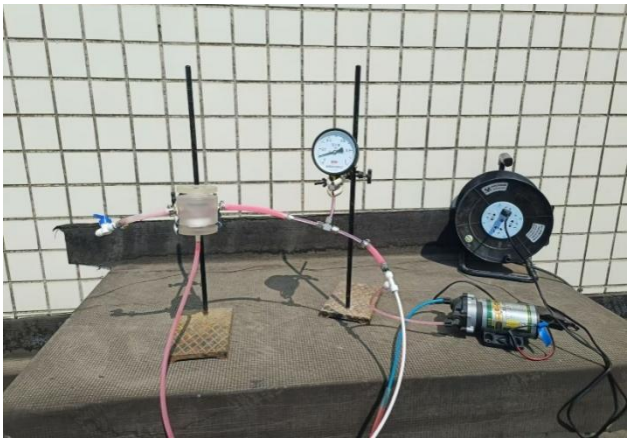

Fig. S1. Water treatment performance of the FeOOH/g-C_3N_4/CA catalytic membrane system under sunlight.

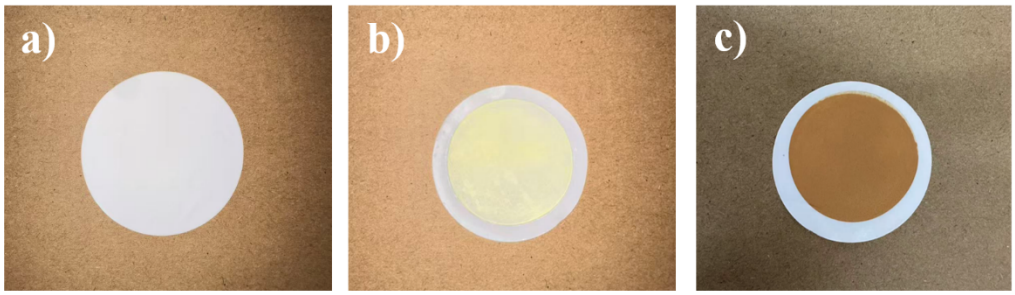

Fig. S2. a-c) Photographs of the CA membrane, g-C_3N_4/CA membrane, and FeOOH/g-C_3N_4/CA membrane

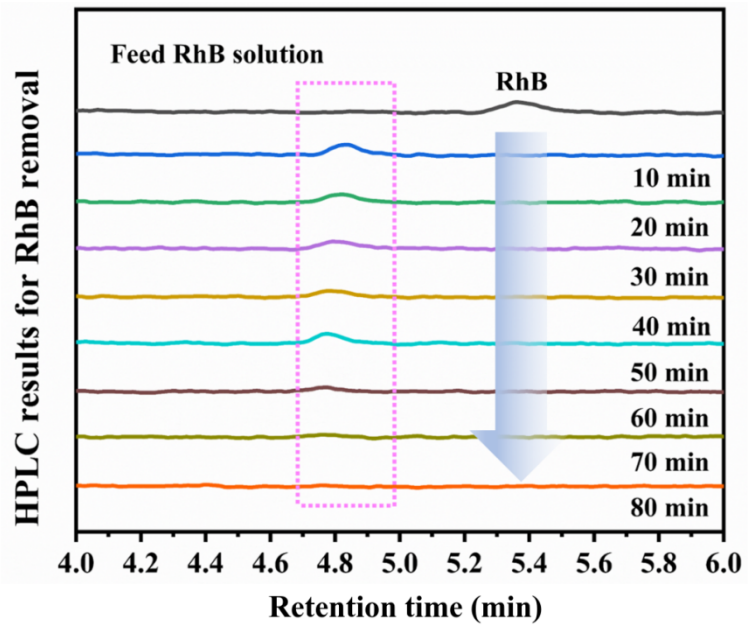

Fig. S3. HPLC analysis of RhB intermediates.

Table S1. EDS mapping elemental distribution of FGCM.

Element	Wt%
C	32.01
N	43.43
O	10.55
Fe	14.01

Table S2. Comparison of different catalytic membrane systems for RhB removal.

Catalytic membrane system	**RhB ($mg \cdot L^{-1}$)**	**RhB removal (%)**	**Flux ($L \cdot m^{-2} \cdot h^{-1}$)**	**Reference**
SSC700 membrane	20	91	368	**[1]**
Ti/SnO_2-Sb membrane	50	90.29	2.17	**[2]**
g-C_3N_4/Ag_3PO_4/PVDF membrane	10	97	1083	**[3]**
g-C_3N_4/FeOCl/PVDF membrane	50	90	1100	**[4]**
FGCM	10	93.2	30012	**This work**

Table S3. The peak area of FeOOH/g-C_3N_4 evaluated by XPS.

Price trend	XPS (%)	
	Fe(II)	Fe(III)
Before	23.2	76.8
After	38.5	40.3

References

[1] Liang, J., Gao, K., Zhou, A., Fang, Y., Su, S., Fu, L., Sun, M., & Duan, X. (2023). Long-lasting performance of high-flux perovskite membrane for catalytic degradation of organic pollutants. Applied Catalysis B: Environmental, 327, 122440.

[2] Hu, J., Zhu, H., Lin, M., Wu, D., Yao, J., Sun, T., Ma, X., & Xia, Y. (2023). Highly-efficient removal of Rhodamine B using a flow-through electrocatalytic filtration system: Characteristics, efficiency and mechanism. Journal of Electroanalytical Chemistry, 946, 117742.

[3] Cui, Y., Yang, L., Meng, M., Zhang, Q., Li, B., Wu, Y., Zhang, Y., Lang, J., & Li, C. (2019). Facile preparation of antifouling g-C_3N_4/Ag_3PO_4 nanocomposite photocatalytic polyvinylidene fluoride membranes for effective removal of rhodamine B. Korean Journal of Chemical Engineering, 36(2), 236-247.

[4] Zheng, H., Xiao, C., Jiang, S., Li, M., Zhu, M., Zhou, Y., Sun, X., Zhang, D., & Zhang, L. (2024). Fabrication of PVDF membrane loaded with ultra-thin g-C_3N_4/FeOCl nanomaterials and study on catalytic and antifouling properties. Separation and Purification Technology, 331, 125641.