Supporting Information

Mechanistic Insights into the Visible Light Photocatalytic Activity of g-C_3N_4/$Bi_2O_2CO_3$-Bi_4O_7 Composites for Rhodamine B Degradation

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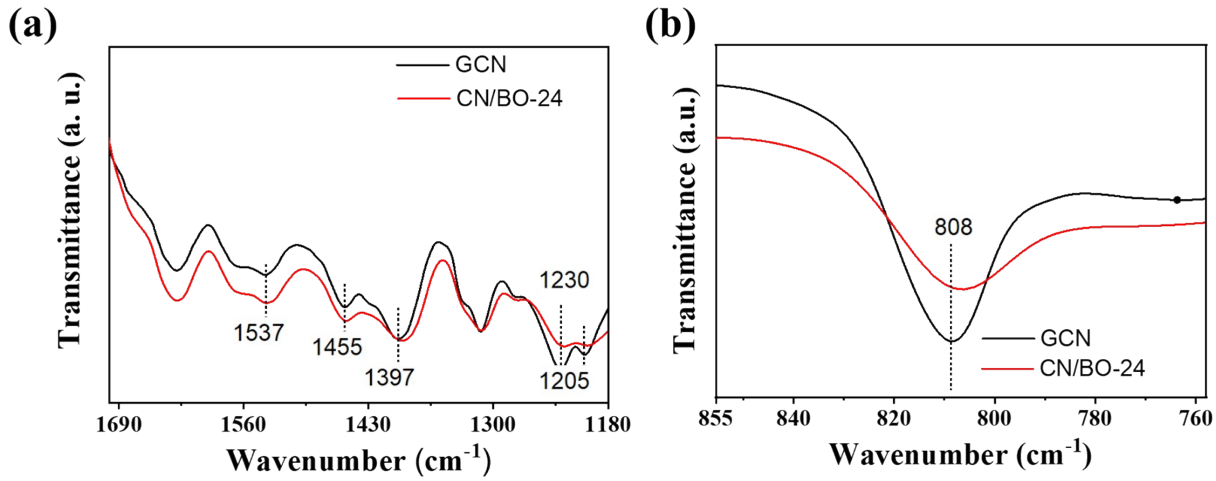

Fig. S1: FTIR patterns of GCN and CN/BO-24 in the wavenumber range of (a) 1180 to 1700 cm^{-1} and (b) 758 to 855 cm^{-1}.

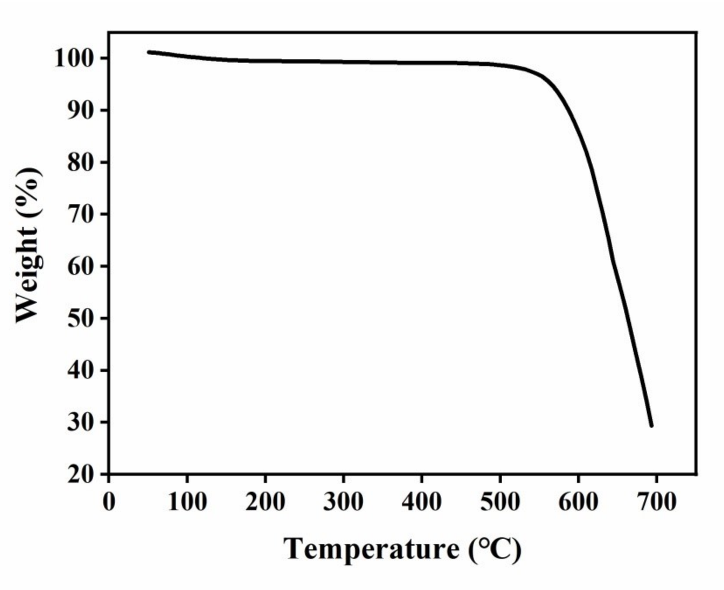

Fig. S2: Thermogravimetric analysis curve of g-C_3N_4 (GCN).

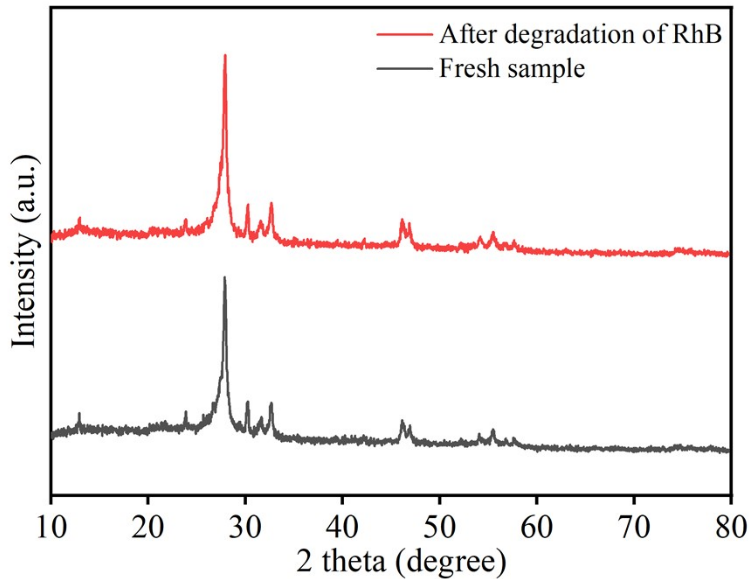

Fig. S3: XRD patterns of the CN/BO-24 sample, freshly prepared and after RhB photocatalytic degradation.

Electrochemical experiment details

Catalyst ink is prepared by sonicating 10 mg of catalyst in a mixture of 1 mL of deionized water and ethanol each (1:1), and 20 µL of Nafion solution (5%) in a beaker. The working electrode is prepared by drop casting of catalyst suspension on 7 mm x 6 mm graphite felts. After the drop casting step, the electrode is dried by heating it at 80 °C, and the catalyst loading is maintained at ≈ 20 mg/cm^2 for each electrode. The obtained performance curve versus the Ag/AgCl reference electrode is converted to RHE using the following equation:

$$E_{RHE} = E_{Ag/AgCl} + E^{\circ}_{Ag/AgCl} + 0.0591 \times pH$$

where E_{RHE} is the potential vs. RHE, $E_{Ag/AgCl}$ is the measured potential vs. the Ag/AgCl electrode, $E^{\circ}_{Ag/AgCl}$ is the standard potential of the Ag/AgCl electrode.[1]

The performance for the oxygen evolution reaction (OER) is assessed in alkaline media (1.0 M KOH) using a three-electrode setup, Ag/AgCl as the reference electrode, platinum wire as the counter electrode, and the above-prepared graphite felt as a working electrode. The electrocatalytic OER performance of GCN, BO, and CN/BO-24 working electrodes is evaluated by linear sweep voltammetry (LSV) at a scan rate of 5 mV s^{-1}, as shown in Fig. S2(a). The GCN displays the best OER activity and displays overpotential value (η_{10}= 430 mV) for current density (J) of 10 mA cm-2, which is lower than CN/BO-24 (500 mV) and pristine BO (610 mV), respectively.

The reaction mechanism & kinetics of electrodes are determined by Tafel analysis, a plot between overpotential and log (J), as shown in Fig. S2(b). The pristine GCN exhibits a lower Tafel slope of 59 mV dec^{-1}, in contrast to the pristine BO (192 mV dec^{-1}) and CN/BO-24 composite (212 mV dec^{-1}). This indicates that all electrodes follow the Volmer–Heyrovsky mechanism in alkaline media, Moreover, a low Tafel slope of GCN indicates a fast reaction rate as compared to both pristine BO and the CN/BO-24 composite. Electrochemical impedance studies (EIS) are also carried out to assess the charge transfer resistance at the electrode-electrolyte interface. As shown in the Nyquist plots (Fig. S2(c)), the GCN has much lower charge transfer resistance in comparison to both pristine BO and CN/BO-24. From the above results, it can be concluded that the pristine GCN displays better electrochemical performance for OER, while the CN/BO-24 composite shows a good photocatalytic performance due to the suitable band alignments between the constituent elements.

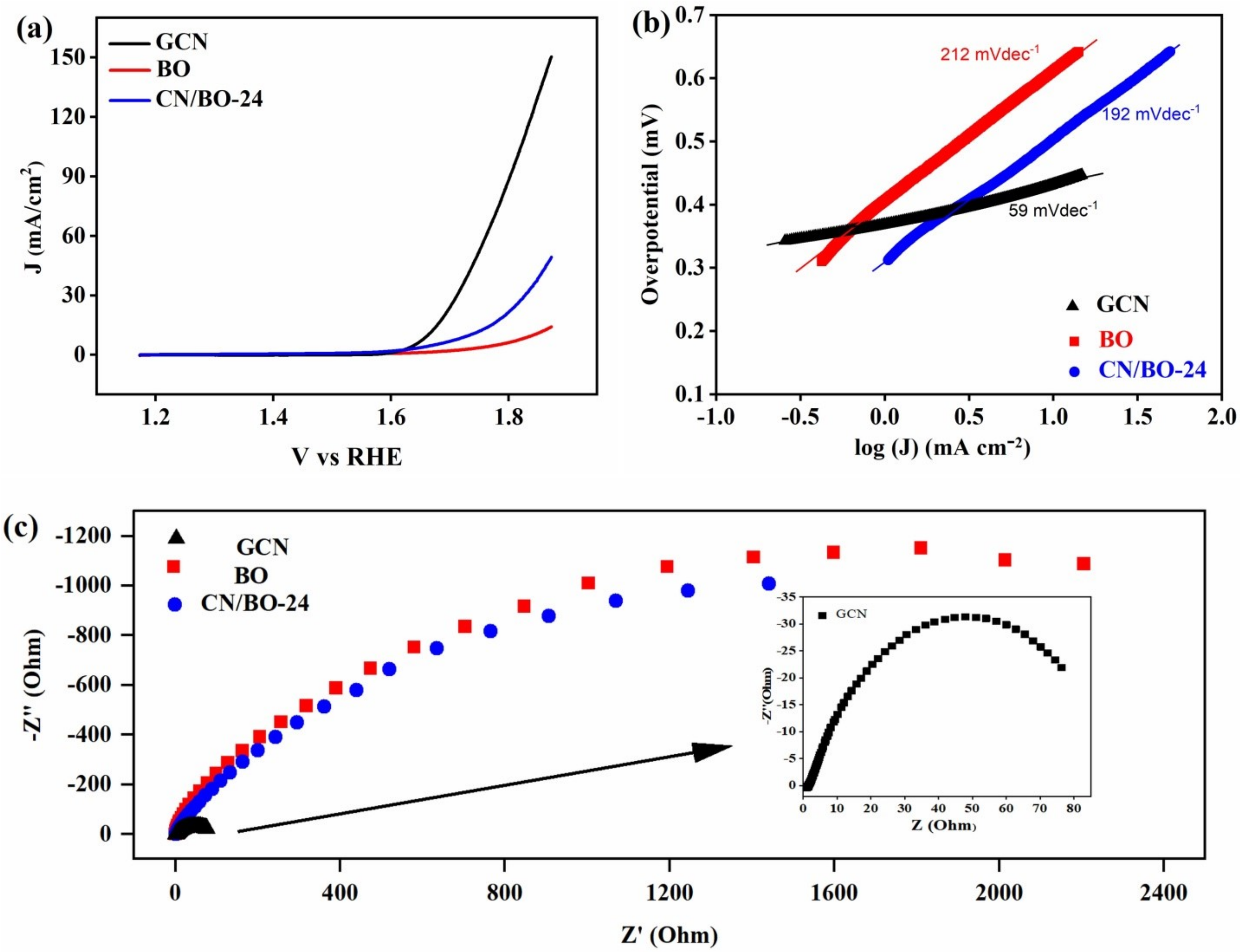

Fig. S4: OER study of GCN, BO, and CN/BO-24 catalysts, (a) LSV Analysis, (b) Tafel plots, and (c) Nyquist plot obtained from EIS analysis.

Reference

1. C. Lai, S. Ji, H. Zhou, L. Ma, H. Wang, J. Hu, J. Sun, K. Zhang, X. Liu and F. Li, *Available at SSRN 3996836*, 2022.