

Supporting Information

Observation of the retarded transportation of the photogenic hole on the epitaxial graphene

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1. Experimental Section

Preparation of Photocatalysts

The SiC particles (Sigma, Inc) used in this study were semi-insulator 6H-SiC (band gap ~3.0 eV) powder with sized around 400 mesh size. The SiC powder was ultrasonically washed with the deionized water and the pure ethanol respectively for 30 minutes. After drying in a vacuum drying furnace, the powder was transferred to a silica boat, and loaded into a tube furnace. The synthesis process was performed under pressure about 0.2 atmosphere pressures at 1100 °C for 30 minutes.

Synthesis and reduction of graphene oxide

Graphene oxide (GO) was synthesized from the purified graphite by using the modified Hummers method.¹ Firstly, the graphite (0.1 g) and the NaNO₃ (0.5 g) was simply mixed and then put into a 250 mL beaker. The high concentrated H₂SO₄ was measured around 24 mL and dropped into the beaker slowly under ice water bath. After the sulfur acid engineering for an hour, the KMnO₄ was precisely weighed 3 g and carefully put into the beaker followed by

a 2 h-reaction. The reaction system was transferred to a 250 mL round-bottom flask, and an oil bath was carried out at around 38 °C for 30 min. The temperature was slowly increased to 96 °C and maintained for around 30 min under a constant stirring. During the temperature-rising process, the deionized water around 80 mL was slowly added into the flask. After reacting at the high temperature, an additional batch of the deionized water around 60 mL was instantly added to quench the reaction followed by a 30% H₂O₂ (15 mL) adding to remove the remnants of KMnO₄ until the solution turned into the golden yellow. Then diluted HCl was added and the mixture was washed by deionized water until the PH was close to 7. The sediment was re-dispersed in deionized water and ultra-sonicated for 3 h followed by a centrifugation at the speed of 3000 r/min. The GO powder can be obtained after freeze-drying of supernatant.

The GO around 0.1 g was dispersed into deionized water (100 mL) followed by the hydrazine hydrate (1.5 mL) added to the solution and then the mixture was heated for 24 h around 98 °C in an oil bath under a water-cooled condenser. The black suspension was collected by the centrifugation at the speed of 11000 r/min for 15 min and washed by deionized water. The loose black RGO powder can be obtained after the freeze-drying.

Characterization

The powder X-ray diffraction (XRD) measurements were performed on a Rigaku D/MAX-RB diffractometer (Philips, X'pert Pro MPD, Netherlands), and the excitation wavelength is Cu K α radiation ($\lambda = 0.15443$ nm). The field-emission scanning electron microscope (FE-SEM) was performed with a Hitachi S-4800, and the transmission electron microscopy (TEM)

images were collected by adopting American FEI company Tecnai G2 F20 S-TWIN. As for TEM sample preparation, the powder was dispersed in ethanol, and then dropped on a copper micro-grid covered by a carbon film. The specimen for TEM was set statically and dried naturally in air before its characterization.

Photocatalytic Activity Test

The photocatalytic activity was tested by using a 500 W UV light lamp for degradation of the dye RhB, and the photosensitization test was performed by adopting a 300 W Xe arc lamp, and a 400 nm cutoff filter as the light source. Typically, the RhB powder around 0.04 g was dissolved into deionized water around 30 mL in a container, and stirred for 1 minute. The resolution was then transferred into a glass bottle, and diluted into 100 mL with deionized water (A). The obtained resolution around 2 mL was transferred into a container, and diluted by 97.4 mL deionized water (B). After that, the hydrogen peroxide around 0.6 mL with 30 wt % in concentration was transferred to the B resolution. Totally the B resolution around 100 mL was obtained. On the basis of the B resolution, three kinds of suspensions could be obtained. (1) The photocatalyst SiC around 0.1 g was dispersed into 100 mL aqueous solution B. (2) The photocatalyst GSSC around 0.1 g was dispersed into 100 mL aqueous solution B. (3) The photocatalyst rGO around 0.01 g was dispersed into 100 mL aqueous solution B. The HCl and NaOH resolution were used to control the PH of the solution. Prior to irradiation, the B resolution and all of the three kinds of suspensions were stirred in dark for 15 min to ensure the adsorption/desorption equilibrium. During the degradation process, the suspensions were magnetically stirred continuously. The concentration of RhB was monitored by a Uv-vis

spectrophotometry, Mapada UV-1800 PC.

2. The kinetic plot of the Rhodamine degradation without the hydrogen peroxide

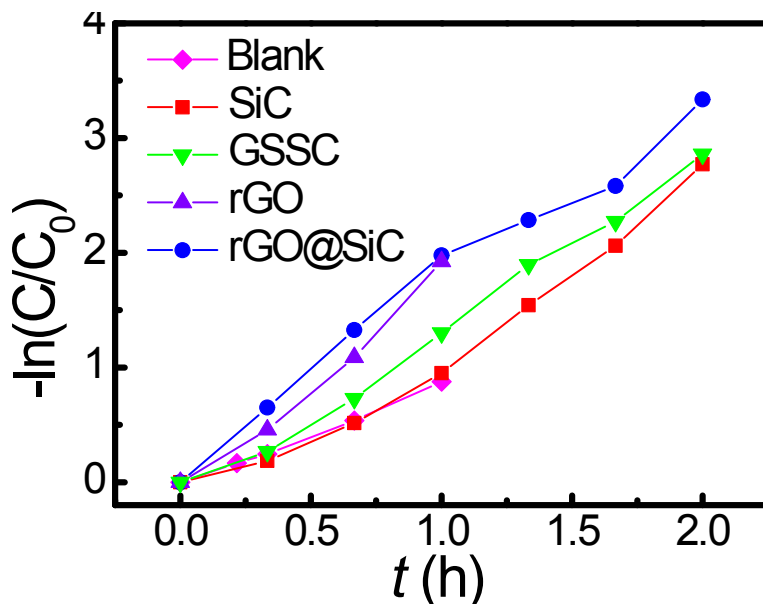


Fig. S1 The Langmuir-Hinshelwood model² for the degradation kinetics of the Rhodamine B without the hydrogen peroxide

3. The photo-degradation of RhB by the hydrogen peroxide diluted about 0.0001 times of the aqueous solution B (58.7 mM).

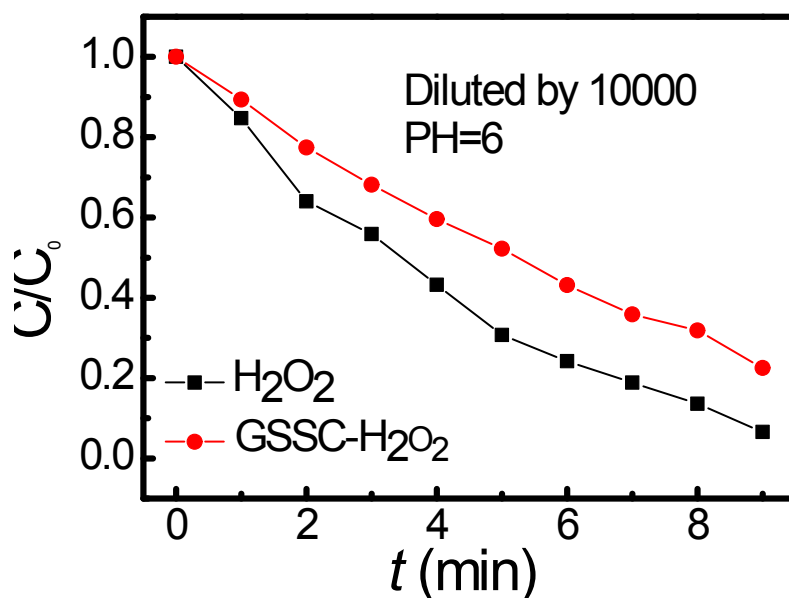
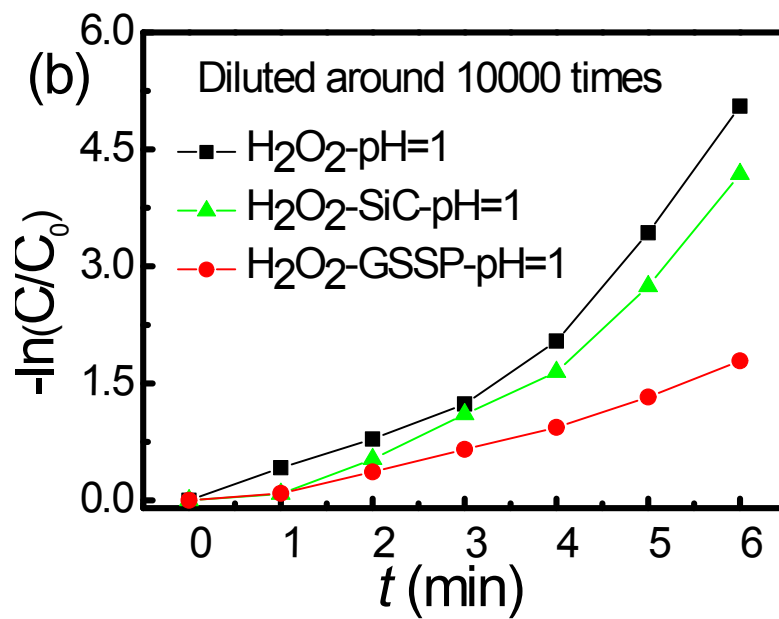
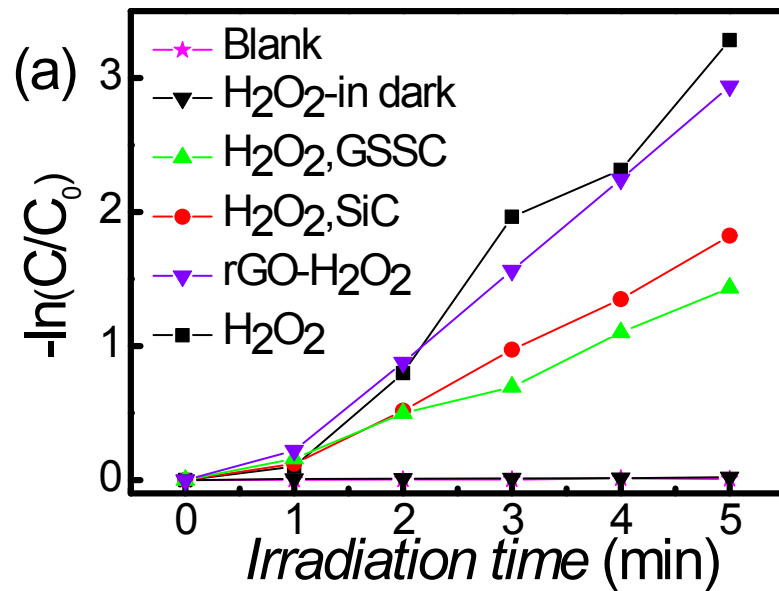
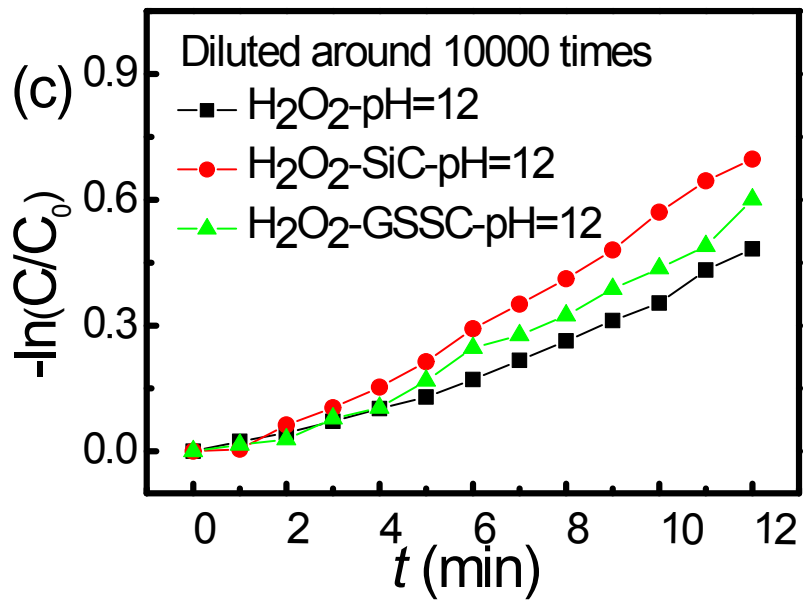
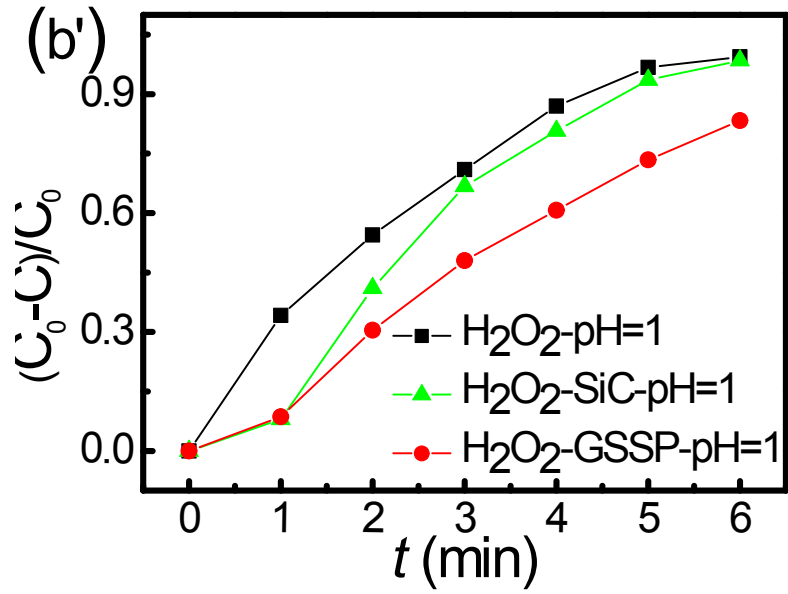


Fig. S2 The photo-catalysis of RhB performed in a hydrogen peroxide diluted about 0.0001 times. When the GSSC introduced, the degradation performance is reduced when the PH

value equals 6.

4. The Langmuir-Hinshelwood model is adopted for studying the degradation kinetics of the dye Rhodamine B





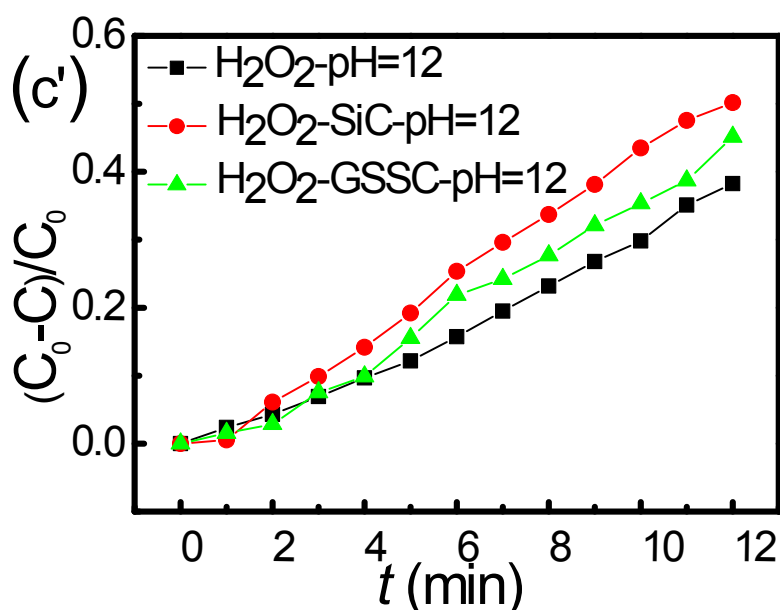


Fig. S3 The kinetics plot of degradation of the dye RhB ($C_{\text{RhB}}=1.67 \times 10^{-2}$ mM) with Langmuir-Hinshelwood model in different PH value, (a) PH=6 and $C_{\text{H}_2\text{O}_2}=58.7$ mM. (b, b') PH=1 and $C_{\text{H}_2\text{O}_2}=5.87 \times 10^{-3}$ mM, the b' is the average degradation rate plot. (c,c') PH=12 and $C_{\text{H}_2\text{O}_2}=5.87 \times 10^{-3}$ mM. and C' is the average degradation rate plot.

5. The degradation plots of the dye RhB under Xe lamp

The graphene on SiC can prevent the ASH species from absorbing on the surface, which can be inferred from the photosensitization process of RhB by visible light (Fig. S4). When a hydrogen peroxide degradation process is performed, the additive of SiC powder can induce a lower degradation performance, suggesting the concentration of ASH species is reduced by the absorption of the SiC powder (Fig. S4a), because the SiC can not be excited by the visible light with wavelength larger than 400 nm. When the graphene grown on the surface of the SiC powder, the graphene can mask the SiC particles and the adsorption of ASH is interrupted, so that the photosensitization of the GSSC powder can restore the degradation performance of the pristine hydrogen peroxide (Fig. S4). If we tune the PH=12, a same phenomenon can be observed (Fig. S4b)

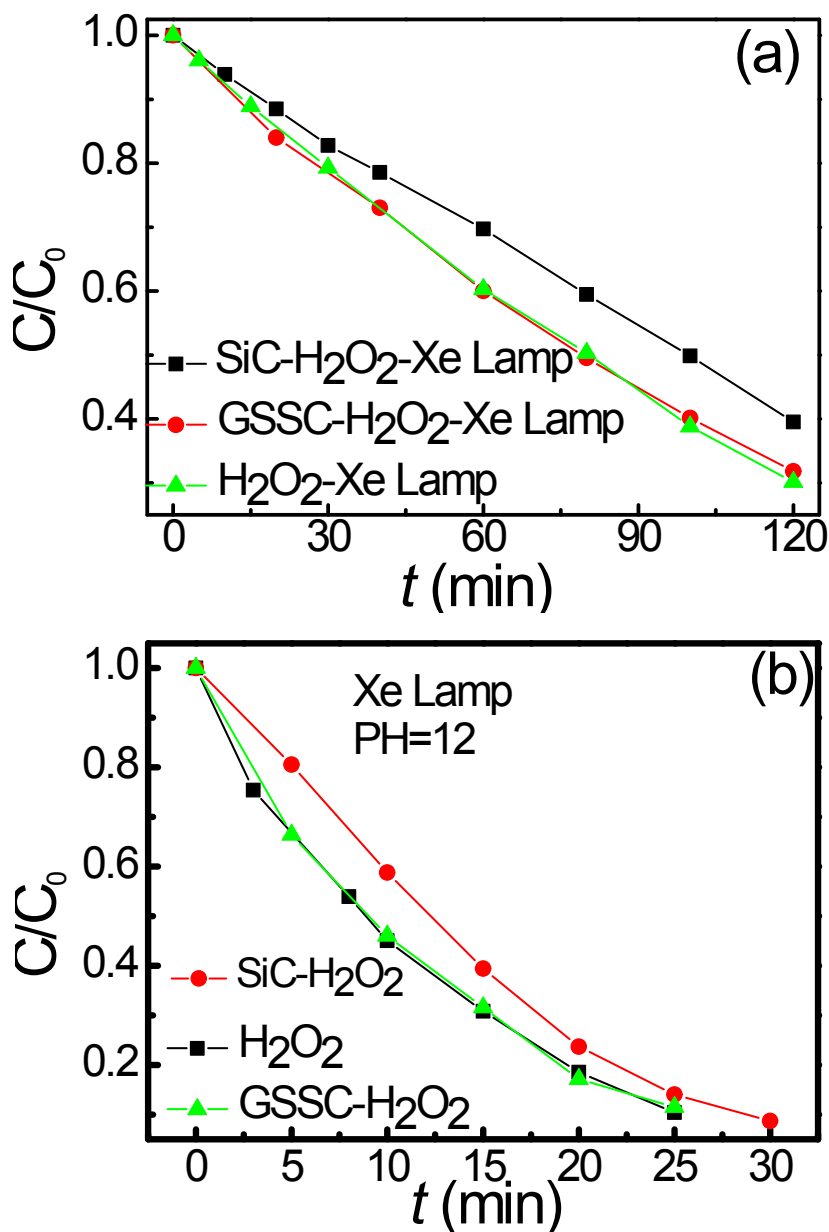


Fig. S4 The degradation of RhB under Xe lamp with the visible light ($\lambda > 400$ nm) under different PH value. (a) PH=1 and (b) The PH value=12.

6. The influence of the dye concentration on the degradation process

When the concentration of the hydrogen peroxide is kept as the 5.87×10^{-2} M, the same retarding effect of graphene on the photogenic hole can also be observed in the different concentration of dye RhB, e.g. double (Fig. S5a) and half (Fig. S5b) of the original one ($C_{\text{RhB}} = 1.67 \times 10^{-2}$ mM). Interestingly, the degradation rate of GSSC/ H₂O₂ is ever slower than

that of the hydrogen peroxide only, when the concentration of the RhB is half of the original one ($C_{\text{RhB}}=1.67\times 10^{-2}$ mM) (Fig. S5b). When the concentration of the RhB is reduced, the photoinduced electrons from the SiC substrate become easier to be released to resolution than before.

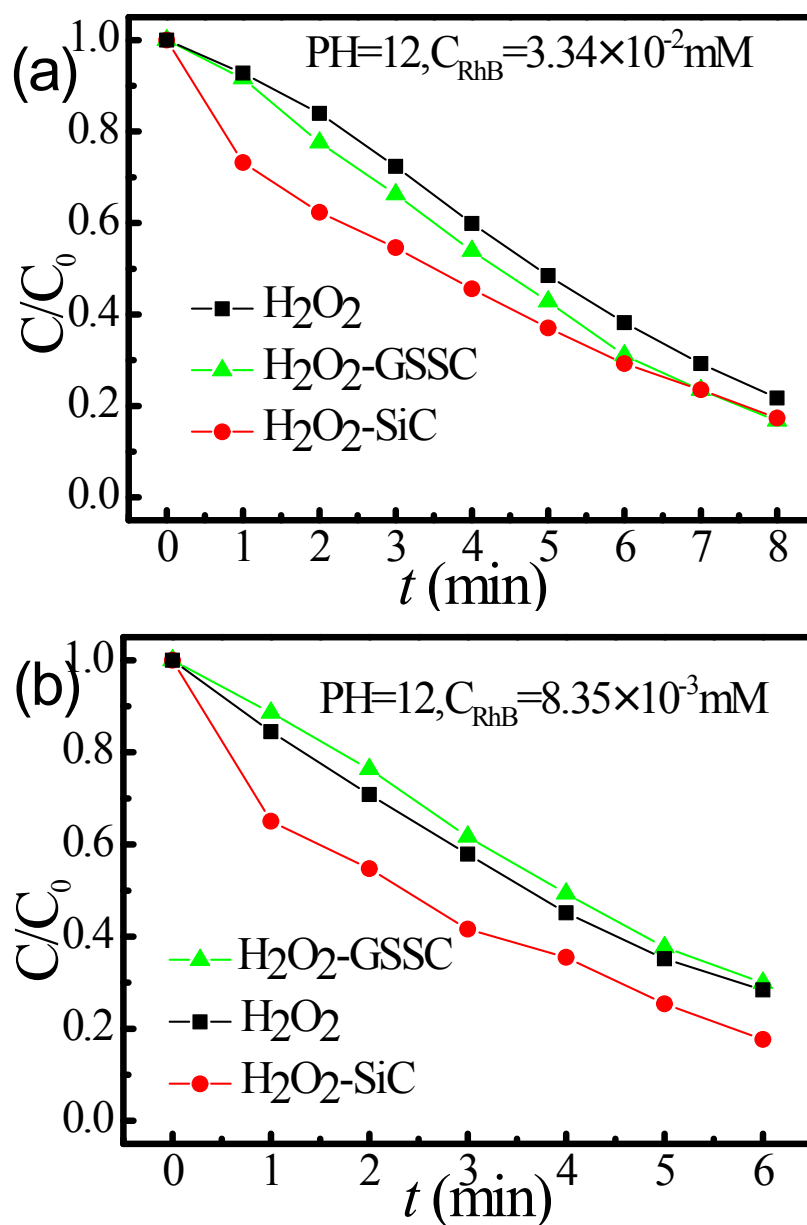


Fig. S5 The photo-degradation kinetic plots with the hydrogen peroxide kept as 5.87×10^{-2} M, and the concentration of the RhB controlled as double (a) and half (b) of the original one ($C_{\text{RhB}}=1.67\times 10^{-2}$ mM).

7. Reference

- [1] Hummers W. S. , Offeman R. E. J. Am. Chem. Soc. **1958**, *80*, 1339-1339
- [2] Kumar K. V., Porkodi K., Rocha F. Catal. Commun. **2008**, *9*, 82-84