

Electronic Supplementary Information

Facile synthesis of magnetic $\text{Bi}_{25}\text{FeO}_{40}/\text{rGO}$ catalyst with efficient photocatalytic performance for phenolic compounds under visible light

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Materials and Reagents: Solvents and all other chemicals were obtained from commercial sources and were used as received unless otherwise noted. Bismuth Nitrate ($\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$), Ferric Nitrate ($\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$), and ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) were provided by Sinopharm Chemical Reagent Co., Ltd. (Shanghai, China); Graphite powder, nitric acid (HNO_3), hydrochloric acid (HCl), sulfuric acid (H_2SO_4), sodium nitrate (NaNO_3), potassium nitrate (KNO_3), potassium hydroxide (KOH), hydrogen peroxide (30% H_2O_2), and potassium permanganate (KMnO_4) were obtained from Sinopharm Chemical Reagent Co., Ltd. (Shanghai, China). Phenol and p-chlorophenol were obtained from Damao Chemical Reagent Co., Ltd. (Tianjin, China). Deionized water was obtained from a Sartorius arium611DI water purification system.

Preparations:

Synthesis of graphene oxide (GO): GO was synthesized from natural graphite by a modified Hummers method according to our previous reports. Graphite (5.0 g) and NaNO_3 (2.5 g) were mixed with 120 mL of H_2SO_4 (98%) in a 500 mL beaker. The mixture was stirred for 30 min in ice bath. While maintaining vigorous stirring, potassium permanganate (15.0 g) was added to the suspension. The rate of addition was carefully controlled to keep the reaction temperature lower than 288 K. After 90 min, the ice bath was removed and the mixture was stirred at 308 K for 30 min. As the reaction progressed, the mixture gradually became pasty and the color turned into light brownish. At the end, 230 mL of deionized water was slowly added to the paste with vigorous agitation. The reaction temperature rapidly increased, and the color changed to yellow. The diluted suspension was stirred at 371 K for 30 min. Then, 30 mL of 30% H_2O_2 was added to the mixture. For purification, the mixture was centrifuged with 5% HCl then deionized water several times, and finally freeze-dried under vacuum for 24 h.

Characterization: Scanning electron microscope (SEM) images were obtained using a JEOL (Japan) S-3700N SEM at different magnifications with an accelerating voltage of 15 kV. The X-ray diffraction (XRD) patterns were recorded using a Bruker D8-advance X-ray diffractometer at 40 kV and 40 mA. A $\text{Cu K}\alpha$ radiation ($\lambda=1.5418 \text{ \AA}$) source was used in the X-ray tests. All patterns were collected at a scanning rate of $0.020^\circ/\text{step}$ and 17.7 s/step , 2θ ranging from 5° to 90° . The X-ray photoelectron spectroscopy (XPS) measurements were conducted with an Axis Ultra DLD spectrometer (Kratos Analytical Ltd., England) with a monochromatized $\text{Al K}\alpha$ X-ray source ($h\nu=1486.6 \text{ eV}$). Raman spectra were recorded with Renishaw R-3000QE system in the backscattering configuration using an Argon ion laser with wavelength 785 nm. UV-vis diffuse reflectance spectra (DRS) were measured over the spectral range 200–800 nm on a Cary 300 UV/Vis spectrophotometer (Agilent, USA). The magnetic properties of the photocatalysts were determined by means of a vibrating sample magnetometer (VSM, Lake Shore 7410, USA). The surface area of $\text{Bi}_{25}\text{FeO}_{40}$ and $\text{Bi}_{25}\text{FeO}_{40}/\text{rGO}$ was determined from the corresponding N_2 adsorption/desorption isotherms obtained at 77 K with an automatic instrument (ASAP2020, Micromeritics, USA).

Photocatalytic reaction experiment: The photocatalytic activities of $\text{Bi}_{25}\text{FeO}_{40}$ and $\text{Bi}_{25}\text{FeO}_{40}/\text{rGO}$ composite photocatalysts for phenol and p-chlorophenol, were evaluated in a photo-reactor under visible-light irradiation using a 500 W xenon lamp through UV cut-off filters to completely remove any irradiation below 420 nm and to ensure illumination by visible-light only. The photocatalytic experiment was performed in natural atmosphere, without any external source of aeration. The photocatalytic experiments were conducted in triplicate and the final data used for mapping were the average of the collected experimental data. The maximum errors were less than 5%. In each experiment, 40 mg catalyst was added into 200 mL aqueous solution of phenol (10 mg L^{-1}) or p-chlorophenol (10 mg L^{-1}). Prior to the photocatalytic reaction, the suspension was placed in the dark for 30 min with magnetic stirring before irradiation to reach the adsorption/desorption equilibrium. The suspension was sampled at a given interval of time and analyzed by recording phenol or p-chlorophenol concentration with high-performance liquid chromatography (HPLC, SHIMADZU, Japan). The normalized concentration of phenol or p-chlorophenol after irradiation was calculated as C_t/C_0 , where C_0 is the initial concentration of phenol or p-chlorophenol and C_t is the concentration of phenol or p-chlorophenol measured after irradiation at a particular interval of time.