

Electronic Supplementary Information

Fe₂O₃/Carbon Quantum Dots Complex Photocatalysts and Their Enhanced Photocatalytic Activity under Visible Light

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Experimental

Catalyst Preparation

All chemicals were purchased from Sigma–Aldrich. CQDs were synthesized through a alkali-assisted electrochemical method: In a typical experiment, the electrolyte of the electrochemical process was prepared by mixing ethanol/H₂O (100 mL; volume ratio=99.5:0.5) with a suitable amount (0.3-0.4 g) of NaOH. By using graphite rods (diameter about 0.5 cm) as both anode and cathode, we synthesized CQDs with a current intensity in the range of 10–200 mAcm⁻². Typically, the rate of production of CQDs was about 10 mg per hour for each setup. CQDs were separated by column chromatography. Firstly, the raw CQDs solution was treated by adding a suitable amount of MgSO₄ (5-7 wt%), stirred for 20 min, and then stored for 24 h to remove the salts and water. Afterwards, the purified CQDs solution was separated by silica-gel column chromatography with a mixture of petroleum ether and diethyl ether as the developing solvent.²⁶

To synthesize Fe₂O₃/CQDs nanocomposites, a simple hydrothermal method was used. In a typical experiment, 0.6570 g FeCl₃•6H₂O and 0.2712 g (NH)₂CO were well dissolved in 12 mL CQDs aqueous solution with constant magnetic stirring for 10 min, then all the reactants were transferred to an autoclave. The autoclave was maintained at 180 °C for 24 h and then cooled to room temperature. The as-fabricated products were collected out with whizzer, washed with deionized water and ethanol, respectively, and finally dried in an oven at 60°C for 12 h.

Catalyst Characterization

Scanning electron microscopy (SEM) images and energy dispersive X-ray analysis (EDX) spectroscopy were taken on a FEI-quanta 200 scanning electron microscope with acceleration voltage of 20 kV. Transmission electron microscopy (TEM) and high-resolution TEM (HRTEM) images were obtained with a FEI/Philips Techai 12 BioTWIN transmission electron microscope and a CM200 FEG transmission electron microscope, respectively. The normal TEM samples were prepared by dropping the solution onto a copper grid with polyvinyl formal support film and dried in air, respectively. The UV/Vis spectra were obtained with an Aglient 8453 UV/Vis diode array spectrophotometer. The crystal structure of the resultant products was characterized by X-ray powder diffraction (XRD) by using a X'Pert-ProMPD (Holand) D/max-γAX-ray diffractometer with Cu Kα radiation (λ=0.154178 nm).

Catalyst Activity

Photodegradation of benzene: A sealed box (40 cm × 40 cm × 40 cm) equipped with three 8 W visible light lamps on top and four fans in top, bottom, left and right, the box soleplate scattered with 1 g of catalyst (Fe₂O₃ and Fe₂O₃/CQDs, respectively) powder. 1ml benzene was injected into this box with the injection temperature of 90°C, simultaneously started the fans, to let the polluted gas (15.6 ppm benzene) cycled in the box for 2 h to ensure the establishment of an adsorption – desorption equilibrium. After that, the polluted gas exposure to the visible light and during the irradiation, 10 μL aliquots were removed at intervals and

analyzed on a gas chromatography (Agilent 7890A), measuring the benzene concentration in the remaining gas. The degradation of methanol was almost the same as above.

Another parallel experiments were carried out, before the benzene injection, the O₂ air in experiment system was deaerated by a dry argon stream.

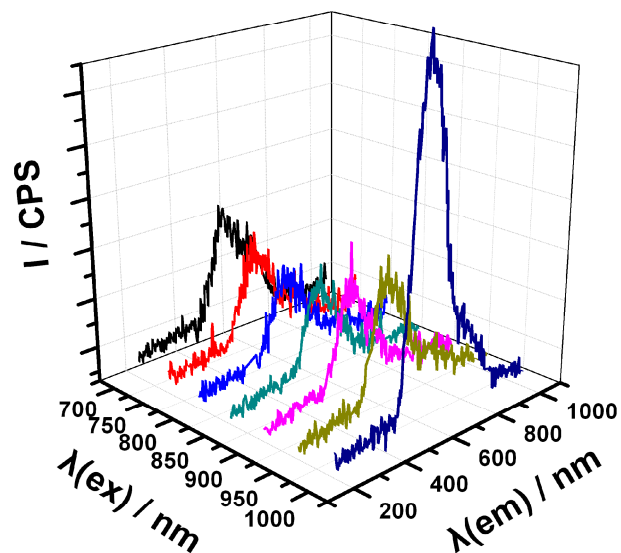


Figure. S1 Upconverted PL spectra of CQDs.