Supporting Information

Optimization of the catalytic activity of Ag@Cu_2O decorated on rGO for organic pollutant degradation

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Experimental section

Materials

Silver nitrate ($AgNO_3$), trisodium citrate dihydrate ($Na_3C_6H_5O_7·2H_2O$), polyvinylpyrrolidone (PVP, K30), trihydrate copper (II) nitrate ($Cu(NO_3)_2·3H_2O$), hydrazine hydrate ($N_2H_4·H_2O$, 85%), 4-nitrophenol (4-NP), trinitrophenol (TNP) sodium borohydride ($NaBH_4$), and trichlorogold hydrochloride hydrate ($HAuCl_4·4H_2O$) were purchased from Sinopharm Chemical Reagent Co., Ltd. All chemicals were used without further purification. Deionized water (18 MΩ·cm) was used throughout the experiments.

Fabrication of the Ag-rGO composite

First, 2 mg of graphene oxide (GO) was dispersed in 200 mL of deionized water and sonicated for 1 hour to obtain a uniformly dispersed GO aqueous solution in a three-necked flask. Then, 36 mg of $AgNO_3$ was added to the three-necked flask and magnetically stirred at 90-92 ℃ until slight boiling occurred. Finally, 4 mL of 1% $Na_3C_6H_5O_7·2H_2O$ solution was added to the three-necked flask, and the temperature was adjusted to 85 ℃. The development of a dark green color in the solution indicated that the Ag-rGO composite had been obtained.

Fabrication of ACR nanocomposites

The ACR nanocomposites were obtained by reducing $Cu(NO_3)_2·3H_2O$ with a reducing agent in a 35% $N_2H_4·H_2O$ solution using PVP as a polymerization agent. One gram of PVP was added to 50 mL of 0.05 M $Cu(NO_3)_2·3H_2O$ with vigorous stirring. After PVP was completely dissolved (approximately 10 min), V mL of Ag-rGO composite was added (V=0, 5, 10, and 15 mL). Then, 70 μL of $N_2H_4{\cdot}H_2O$ was added to the mixed solution for 90 s under magnetic stirring (350 rpm). The obtained ACR nanocomposites with different Cu_2O shells are shown in Figure 1.

Catalytic performance evaluation

We added 100 μL of 0.005 M 4-NP solution to 2 mL of deionized water and placed it in a quartz dish. Then, we added a freshly prepared 0.2 M $NaBH_4$ solution. The solution changed from colorless to light yellow. Afterward, different volumes of Ag-rGO composite solution were used to fabricate the ACR nanocomposites. Finally, the UV–Vis absorption spectra were measured in the range of 200-500 nm every 2 min. The catalytic performance of the core-shell structure was evaluated from the reduction rate of 4-NP. The optimized ACR nanocomposites were used as catalysts for the degradation of MO and TNP.

Characterization

Field emission scanning electron microscopy (SEM) and transmission electron microscopy (TEM) images were obtained using a JEOL JSM-6500F (JEOL Ltd., Tokyo, Japan) and a JEOL 2100 (JEOL Ltd., Tokyo, Japan) at an acceleration voltage of 200 kV. The UV–Vis absorption spectra and catalytic properties were monitored using a SHIMADZU 3600 spectrometer (Shimadzu Corporation, Tokyo, Japan).