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Photocatalytic Properties of Ag@AgCl-RGO Composites

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Abstract

Ag@AgCl-RGO composite photocatalyst with both graphene's special electronic state structure and Ag@AgCl's excellent visible light catalytic performance was fabricated. Phase composition of the photocatylst were characterized using X-ray diffraction. Scanning electron microscope and UV-vis absorption spectra characterize the surface morphology and spectroscopic properties. The RhB dye concentration was measured by UV-Vis spectra with the changes , the catalytic performance of different photocatalyst was tested, the mechanism of Ag@AgCl-RGO catalyzed degradation of RhB was explored in the presence of the catalyst. The research results show that the visible light absorption capacity and catalytic efficiency of Ag@AgCl-RGO was better than Ag@AgCl.

Key words: photocatalyst, Ag@AgCl, graphene oxide, reduced graphene oxide, Rhodamine B

Energy crisis and environmental pollution caused by economic development have become one of the most important challenges nowadays. The related research and development about the photocatalytic technology such as photocatalytic water splitting, photocatalytic degradation of organic pollution, photocatalytic decomposition of carbon dioxide has been concerned by the scientists around the globe[1-3]. Over the years, researchers have been being committed to the development of new types of photocatalytic materials and modifying the traditional photocatalytic materials to improve its visible visible light catalytic efficiency , which has made great progress[4,5]. Recently, it is found that nobel metal nanocrystal (such as Pt and Ag) with

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a surface plasmon resonance exhibits photocatalytic activity under visible light irradiation**,** which provide new ideas and direction for the research and development of the visible light photocatalytic materials[6, 7]. plasmonic photocatalysts such as Ag@AgCl have been be synthesized with a good catalytic performance[8, 9]. Nevertheless Ag@AgX particles with micrometers size may cause plasmon-induced electron-hole pairs recombined in a high rate in the process of transfering to the photocatalyst surface[10]. Graphene oxide (GO) as the precursor for graphene has good solution-dispersibility and can be prepared easyly . Reduced-GO (RGO) hybrids with metal oxide would improve its photocatalytic activity through modulate its electronic structure and extract the excited charge carriers [10,11].

Herein, composite photocatalyst, Ag@AgCl-RGO was designed, which has both graphene's special electronic state structure and Ag@AgCl excellent visible light catalytic performance using photoreducing AgCl/GO composites prepared by ion-exchange method. Phase composition of the photocatylst was characterized using X-ray diffraction. Scanning electron microscope and UV-vis absorption spectra characterize the surface morphology and spectroscopic properties of the samples. The catalytic performance of different sample was characterized by measuring the Rhodamine B (RhB) degradation rate in solution. Finally experimental results show that our Ag@AgCl-RGO samples have a better visible light absorption capacity and catalytic efficiency than Ag@AgCl.

1. Experimental section

1.1 Material

Silver nitrate (AgNO3) supplied from Wuhan Air Force four station; Sodium molybdate (Na2MoO4) supplied from Sinopharm Chemical Reagent Co., Ltd; Concentrated hydrochloric acid (HCl, the mass fraction of 36%-38%) supplied from Zhongping Kaifeng Dongda Chemical Reagent Co., Ltd; Natural flake graphite supplied from Qingdao Xinyuan Graphite milk company (Limited carbon content > 97%). All other chemicals used are of analytical grade, and the the deionized water was obtained by a secondary distillation.

1.2 Synthesis of Ag@AgCl-RGO Composite

1.2.1 Synthesis of Ag_2MoO_4-GO Composite

We prepared GO firstly by a modified Hummers et al. Method[12]. Ag_2MoO_4-RGO were synthesised as following: GO (20.7 mg) was dispersed to Na_2MoO_4 aqueous solution(40 ml, 0.1 mol L^{-1}) after stirred for 12 h. Next, $AgNO_3$ aqueous solution(40 ml, 0.2 mol L^{-1}) was added slowly and then diluted NaOH solution was added followed to the mixture until its pH value was adjusted to 8.0. After 0.5 h stirred of stirring, we transferred the resulting solution into a special teflon autoclave, in which the solution was heated at 180 ºC for 2 h. After natural cooled, we collected the precipitate Ag_2MoO_4-RGO composite and washed it until its pH value reached about 7.

1.2.2 Synthesis of AgCl-GO composite

AgCl-GO composites was synthesized by a ion-exchange rection. Ag_2MoO_4-GO composites was soaked in an excess of concentrated hydrochloric acid and then sonicated for 0.5 h until the ion-exchange step was completed . AgCl-GO composite could be obtained after collecting and washing the precipitate until the pH value reached about 7.

1.2.3 Synthesis of Ag@AgCl-RGO composite

We synthesize the Ag@AgCl-RGO composite through a photoreduced procedure. A mount of AgCl-GO composties was put into a water solution with a little methanol ,which was then irradiated under UV light for 10 min, through which was dried in air, Ag@AgCl-RGO was synthesized completely.