Fabrication of Ag_3PO_4 /g-C_3N_4 Composite: Enhanced Charge Separation and Outstanding Photoactivity under Very low Intensity Visible Light Irradiation

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Abstract: A visible light driven Ag_3PO_4/g-C_3N_4 composite photocatalyst was synthesized by a simple co-precipitaion method by changing the loadings of g-C_3N_4 for degradation of methyl orange (MO) dye under very low visible light intensity. The results revealed that the introduction of g-C_3N_4 onto Ag_3PO_4 surface greatly improved its stability and photocatalitic activity. It was found that Ag_3PO_4/g-C_3N_4 with mass ratio Ag_3PO_4:g-C_3N_4 of 1:0.03 exhibited 98% of degradation under 20 minutes of irradiation time. The study proved that h^+ played the chief role in the degradation process and a possible heterojunction mechanism was proposed.

Keywords**:** Ag_3PO_4/g-C_3N_4, low intensity visible light, heterojunction

INTRODUCTION

Herein, we present a simple chemical route for the successful synthesis of Ag_3PO_4/g-C_3N_4 composite. The catalytic performance of the composite materials were tested against very low intensity visible light with methyl orange (MO) dye aqueous phase as the substrate. It was hypothesized that the synthesized materials could improve its photo-stability in degradation activity for several cycles without subjected to any regeneration process.

MATERIALS AND METHODS

g-C_3N_4 powder was prepared by direct thermal polycondensation method [1]. The synthesis of Ag_3PO_4/g-C_3N_4 photocatalyst was as follows: An appropriate amount of g-C_3N_4 was dispersed into 100 mL distilled water and sonicated for an hour. Then, 10.18 g $AgNO_3$ was suspended in this solution and stirred for 1 h at room temperature. Na_2HPO_4 aqueous solution (3.56 g in 100 mL) was added dropwise into the suspended solution and stirred for 2 h. The obtained product was collected, washed with distilled water and ethanol before dried overnight (60ºC). Ag_3PO_4/g-C_3N_4 with a different weight ratio of g-C_3N_4 was prepared. The weight ratio of Ag_3PO_4 to g-C_3N_4 were 1: 0.03, 1: 0.05, 1: 0.07, and 1: 0.1 and denoted as Ag_3PO_4/g-C_3N_4 3, 5, 7, and 10% respectively.

RESULTS AND DISCUSSION

Fig 1(a) displays the photocatalytic degradation of MO as a function of irradiation time over Ag_3PO_4/g-C_3N_4 composites with different g-C_3N_4 loadings. Among the composites, Ag_3PO_4/g-C_3N_4(3%) exhibited the highest photocatalytic activity (98%) and amount of degraded 10.46 mg/g in 10 minutes of visible-light irradiation compared to other composites. The amount of degradation

was increased as the g-C3N4 mass percent increased from 0 to 3% (wt) and slightly decreased afterwards. Fig 1 (b) shows that the degradation of MO over all catalysts followed the pseudo-first–order kinetics $ln\left(\frac{C_o}{C_t}\right) = -kt$ where k and t represent the reaction rate constant and time, respectively. The rate of reaction has been enhanced for all Ag_3PO_4/ g-C_3N_4 composites. Especially for Ag_3PO_4/ g-C_3N_4 (3%), the rate constants were up to 0.35 min^{-1} which is 8.8 times higher than the pure Ag_3PO_4. This result revealed that the combination between Ag_3PO_4 and g-C_3N_4 could significantly enhance the photocatalytic activity under visible light irradiation [1-2].

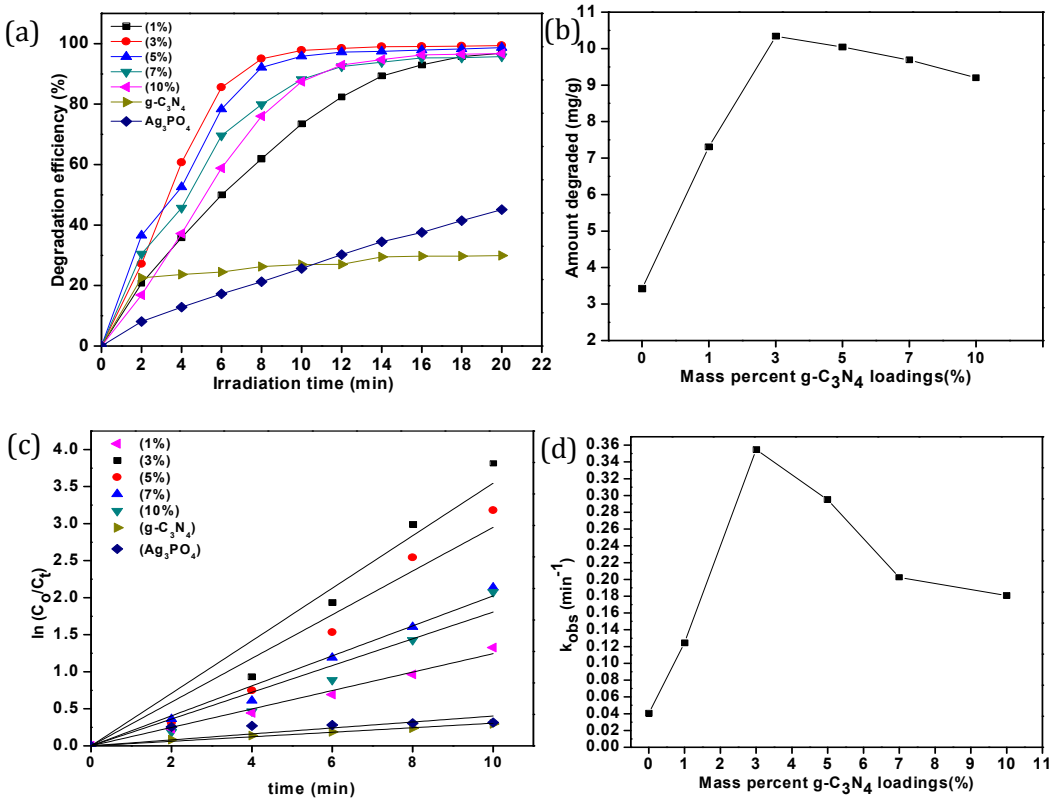

Fig. 1 (a). Degradation efficiency, (b) amount of degraded, (c) kinetic study, and (d) rate constant of Ag_3PO_4, g-C_3N_4 and Ag_3PO_4/g-C_3N_4 composites.

CONCLUSIONS

High efficiency visible light driven Ag_3PO_4/g-C_3N_4 composite photocatalysts were synthesized by a facile co-precipitation method. The Ag_3PO_4/g-C_3N_4(3%) composites exhibited the excellent photocatalytic activity (98% in 10 minutes) on the degradation of MO compared to pure Ag_3PO_4 and g-C_3N_4 under very low intensity of visible light irradiation.

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