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Photocatalytic degradation of 2,4,6-trichlorophenol over g-C_3N_4 under visible light irradiation

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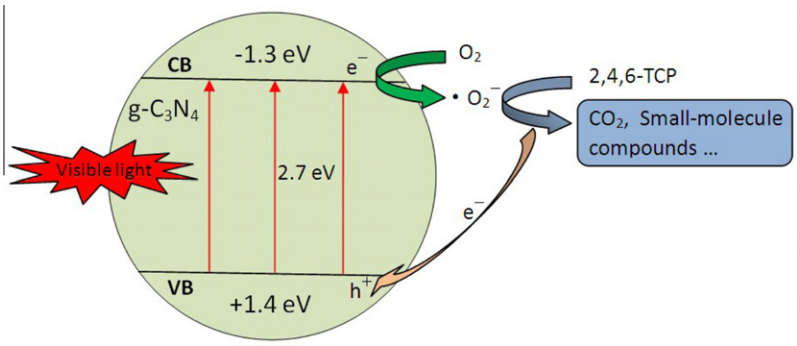
HIGHLIGHTS

- g-C_3N_4 was synthesized by directly thermal condensation of dicyandiamide.
- 2,4,6-TCP could be degraded over g-C_3N_4 under visible irradiation.
- $\cdot O_2^-/\cdot OOH$ was the most important reactive species in the presence of O_2.
- 2,4,6-TCP was oxidized by hole at N_2 gas ambient in the presence of metal ions.
- The possible degradation pathway of 2,4,6-TCP was proposed.

GRAPHICAL ABSTRACT



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ABSTRACT

Graphitic carbon nitride (g-C_3N_4) was synthesized by directly thermal condensation of dicyandiamide and characterized by XRD, XPS, SEM, TEM and FT-IR. Then the as-prepared catalyst was employed to degrade priority pollutant 2,4,6-trichlorophenol (2,4,6-TCP) under visible light irradiation ($\lambda > 420$ nm). The 2,4,6-TCP could be completely mineralized over g-C_3N_4, and the pseudo-first-order rate constant for 10^{-4} M 2,4,6-TCP degradation was 0.70 h^{-1} in the presence of 1 g/L catalyst. $\cdot O_2^-/\cdot OOH$ was identified as the most important reactive species contributing to 2,4,6-TCP degradation in air. Meanwhile, valence band holes (VB holes) of g-C_3N_4 was observed to play important roles for the degradation of 2,4,6-TCP at N_2 gas ambient when metal ions were added as electron acceptors. The possible degradation pathway of 2,4,6-TCP was proposed.

1. Introduction

There is an increasing concern about g-C_3N_4 in the field of photocatalysis due to the appropriate band gap for visible light driven, reliable chemical inertness and stability. Many works based on organic dye degradation, like rhodamine B (RhB) [1], methyl orange [2], and methylene blue [3], have been devoted to study the photocatalytic performance of a variety of graphitic carbon nitrides. However, there are few reports about the photocatalytic degradation of organic pollutants by g-C_3N_4 except dyes. Very recently, mesoporous g-C_3N_4 was employed to treat 4-chlorophenol and phenol in water by Wang et al. [4]. But the porous g-C_3N_4 involved complex synthetic procedure and template using. In their research, the bulk g-C_3N_4 prepared by ammonium thiocyanate showed very low photocatalytic activity. For the wide application of the graphitic carbon nitride catalysts, it is urgent to investigate their performances in catalyzing the photodegradation of various pollutants.

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