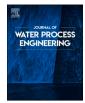


Contents lists available at ScienceDirect

Journal of Water Process Engineering





CQDs embed g-C₃N₄ photocatalyst in dye removal and hydrogen evolution: An insight review



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ARTICLE INFO

Keywords: CQDs g-C₃N₄ Photocatalysis Hydrogen evolution Dye wastewater treatment

ABSTRACT

Recent research has highlighted heterogeneous photocatalysts as a feasible contender for addressing energy shortages and environmental cleanup. One of the best semiconducting photocatalysts used in wastewater treatment, disinfection, and energy evolution is graphitic carbon nitrate (g-C₃N₄). Researchers have used carbon quantum dots (CQDs) to maximize and enhance the photocatalytic activity of g-C₃N₄ and to get over the material's limits due to photoinduced charges, partial surface area, and insufficient light-capturing difficulties. In this context, the fundamentals of CQDs and $g-C_3N_4$ are described in length, along with their structural state, synthesis, and modification techniques. The classification, manufacturing procedure, and characterization of CQDs/g-C₃N₄ are then highlighted in this paper. Following that, it is shown how CQDs/g-C₃N₄ photocatalysts are used in dye removal and hydrogen evolution studies. The discussion of CQDs/g-C₃N₄'s present hurdles, unmet needs, and future research prospects concludes while keeping in mind their practical applications. This study shows that by embedding CQDs, the influence of charges, morphological modification, and textural quality of g-C₃N₄ have been altered. It is anticipated that this review will offer a practical overview and comprehension of CQDs embedded with g-C₃N₄ photocatalysts in order to promote their utilization. The ultimate goal of this review may be to impart a fundamental understanding of photocatalysis while also providing an expository evaluation of the most recent advancements in g-C3N4/CQDs photocatalysts in the sectors of energy and environmental security.

1. Introduction

Currently, environmental remediation and energy security have emerged as serious problems that are harmful to both people and the environment. Physical, chemical, biological, advanced and hybrid technologies are successfully applied to overcome energy and environmental issues [1,2]. Numerous advanced oxidation processes (AOPs) are used in wastewater treatment, including fenton oxidation, ultrasonic oxidation, moist air oxidation, photochemical oxidation, ozonation, and electrochemical oxidation [2,3]. However, there are many underlying factors that limits the application and performance of the methods such as pH dependent, costly, slow process, secondary sludge and well catalyst requires [3–5]. Consequently, researchers introduced AOPs based photocatalysis method to combat and purify the wastewater and simultaneously convert solar energy into green hydrogen [6]. Several photocatalysts such as TiO₂, ZnO, Mn₂O₃, ZnS, SnO₂, Fe₂O₃, WO₃ are commonly used in photocatalysis system that are widely functional in hydrogen (H₂) production, pollutants photodegradation, CO₂ reduction, and other related fields [7–15]. Therefore, conventional photocatalyst has some drawbacks such as low photo quantum efficiencies, high electron recombination rate, low efficiencies and poor stabilities that need to be solved [6,16]. A well functional photocatalyst should have an appropriate bandgap that satisfies efficient light absorption as well as an excellent conduction band (CB) and valance band (VB) and high

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https://doi.org/10.1016/j.jwpe.2023.104645

Received 22 August 2023; Received in revised form 4 October 2023; Accepted 30 November 2023 Available online 7 December 2023 2214-7144/© 2023 Elsevier Ltd. All rights reserved.