



AN ANALYSIS OF g-C₃N₄ PHOTOCATALYSIS AND ITS USES

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ABSTRACT

Heterogeneous photocatalysis using g-C₃N₄-based photocatalysts has emerged as an attractive and promising approach for the direct conversion and storage of renewable solar energy into sustainable and green solar fuels. In this review, we systematically summarize the photocatalytic fundamentals of g-C₃N₄-based photocatalysts, including their unique physicochemical, optical, and electrical properties. Various design strategies for optimizing the properties of g-C₃N₄-based photocatalysts and enhancing their photocatalytic performance are thoroughly reviewed. Furthermore, we highlight the numerous applications of g-C₃N₄-based photocatalysts, including photocatalytic water splitting, pollutant degradation, carbon dioxide reduction, and selective organic transformations. The review also focuses on the recent advances in photocatalytic destruction of dyestuff effluents using g-C₃N₄/semiconductor nanocomposites and the critical role of modified g-C₃N₄ in the mechanism of organic pollutant degradation and fouling control of composite membranes. The prospects for the future study and practical applications of g-C₃N₄-based photocatalysts, such as photocatalytic membranes, are also proposed. Overall, this review provides new opportunities for designing and constructing highly effective g-C₃N₄-based photocatalysts for various applications in photocatalysis and other related fields.

1. Introduction

The use of heterogeneous photocatalysis for the direct conversion and storage of renewable solar energy into sustainable and green solar fuels has become a popular approach. Among the various photocatalysts, g-C₃N₄-based photocatalysts are gaining attention due to their unique physicochemical, optical, and electrical properties. In this review, we summarize the fundamental mechanisms of heterogeneous photocatalysis and the advantages and challenges associated with g-C₃N₄-based photocatalysts. We also discuss the various design strategies used to optimize the properties of g-C₃N₄-based photocatalysts and enhance their photocatalytic performance, including band-gap engineering, defect control, dimensionality tuning, pore texture tailoring, surface sensitization, heterojunction construction, co-catalyst, and nanocarbon loading.

One of the most promising visiblelight responsive materials is graphitic carbon nitride (g-C₃N₄), a metal-free photocatalyst with the benefits of low cost, environmental friendliness, good stability, and ease of synthesis. The relatively narrow band gap (2.7 eV) of g-C₃N₄ can improve its utilisation of solar light considerably [5]. Furthermore, the mixture of inorganic and organic properties. This makes it an excellent material for the preparation of photocatalytic membranes. Previous work has focused on g-C₃N₄ structure customization [6] and nanomaterials-modified membranes [7]. However, we discovered that our knowledge of the integration of g-C₃N₄ and membranes was still incomplete. In this article, In order to thoroughly understand the microstructural matching between g-C₃N₄ and membrane for synergistical water purification, we present an overview of g-C₃N₄-based photocatalytic membranes. The strategies for g-C₃N₄ structure tailoring, fabrication and modification of g-C₃N₄ composite membranes, and their application in the removal of organic and inorganic pollutants, as well as membrane fouling control, were thoroughly addressed. Finally, we presented prospects for their future growth.

Furthermore, we provide an overview of the applications of g-C₃N₄-based photocatalysts, such as photocatalytic water splitting, pollutant degradation, carbon dioxide reduction, and selective organic transformations. We specifically focus on recent advances in the destruction of dyestuff effluents using g-C₃N₄/semiconductor nanocomposites and the critical role of modified g-C₃N₄ in the mechanism of organic pollutant degradation and fouling control of composite membranes. Additionally, we propose

perspectives for the future study and practical applications of $g\text{-C}_3\text{N}_4$ -based photocatalysts, such as photocatalytic membranes.

Overall, this review provides a comprehensive overview of the fundamental mechanisms of heterogeneous photocatalysis, the advantages and challenges associated with $g\text{-C}_3\text{N}_4$ -based photocatalysts, and the various design strategies used to optimize their properties and enhance their photocatalytic performance. We also discuss recent advances in the destruction of dyestuff effluents using $g\text{-C}_3\text{N}_4$ /semiconductor nanocomposites and the prospects for future study and practical applications of $g\text{-C}_3\text{N}_4$ -based photocatalysts. This review offers new opportunities for designing and constructing highly effective $g\text{-C}_3\text{N}_4$ -based photocatalysts for various applications in photocatalysis and related fields.

2. Basics of $g\text{-C}_3\text{N}_4$ -based photocatalysts

2.1. Heterogeneous photocatalysis mechanism

The fundamental mechanism of heterogeneous photocatalysis has been well proposed thus far. In general, heterogeneous photocatalysis contains seven main phases that can be divided into four major processes:

Light harvesting (step 1), charge excitation (stage 2), charge separation and transfer (stages 3, 4, and 5) and surface electrocatalytic processes (stages 3, 4, and 5). (stages 6 and 7). To begin, it is well known that the light harvesting process (stage 1) is highly dependent on the surface morphology and structure of photocatalysts, which can usually be significantly improved by constructing hierarchical macroporous or mesoporous architectures, resulting in more efficient light harvesting, as shown in figure 1. light consumption by numerous reflections and scattering effects [8]. The flat and smooth surface of 2D $g\text{-C}_3\text{N}_4$ is adverse for increasing light harvesting in this aspect. Second, charge excitation in a semiconductor is strongly related. has its distinct electrical architecture. In general, an electron in the semiconductor's VB could be stimulated to its CB by light irradiation with energy greater than or equal to the band gap energy (E_g), leaving a positive hole in the VB. Table 1 summarises the band gap structures of many common photocatalysts. As shown in Table 1, $g\text{-C}_3\text{N}_4$ has the strongest negative CB level (1.3V vs NHE at pH 7) and a medium band gap when compared to TiO_2 , BiVO_4 , and WO_3 .

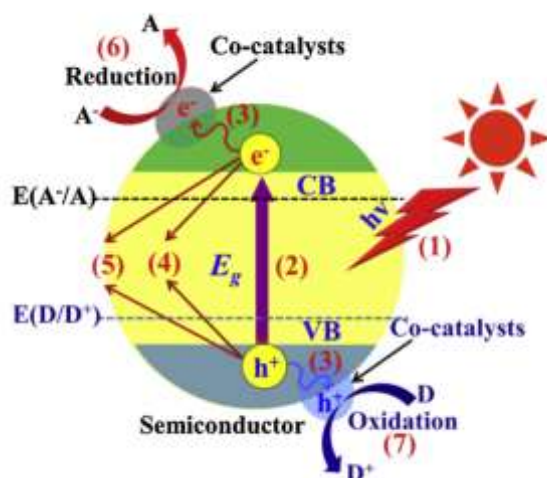


Figure 1: The fundamental mechanism of heterogeneous photocatalysis.[2]



This makes it more widely applicable in visible-light photocatalysis. To increase the usage of visible light, the band gap of $g\text{-C}_3\text{N}_4$ should be lowered further using simple doping, defect, and other potential sensitization procedures [9]. Finally, unfavourable charge recombination in the bulk (stage 4) and on the surface (stage 5) of a semiconductor is harmful to charge separation and transfer (stage 3) to surface/interface active sites, which has been viewed as the determining factor for photocatalytic quantum efficiency.

Table 1 : Band gap structure of several typical photocatalysts. Jiuqing Wen et.al [2]

Semiconductor	Crystal structure	CB	VB	E_g/eV	Ref.
TiO_2	Anatase	-0.5	2.7	3.2	[29]
Cu_2O	Anatase	-1.16	0.85	2.0	[30]
CdS	Anatase	-0.9	1.5	2.4	[31]
$g\text{-C}_3\text{N}_4$	Anatase	-1.3	1.4	2.7	[37]
$g\text{-C}_3\text{N}_4$	Anatase	-1.53	1.16	2.7	[32]
Ta_3N_5	Anatase	-0.75	1.35	2.1	[33]
TaON	Anatase	-0.75	1.75	2.5	[33]
BiVO_4	Anatase	-0.3	2.1	2.4	[34]
WO_3	Anatase	-0.1	2.7	2.8	[35]
Ag_3PO_4	cubic	0.04	2.49	2.45	[36]

Typically, decreasing the diffusion length of photo-generated charge carriers or creating interfacial electric fields might effectively lower recombination rates, thereby significantly increasing photocatalytic activity [9,10]. Finally, it is clear that only energetic enough electrons and holes that migrate to the semiconductor's surface without recombination can be trapped by surface active sites or co-catalysts, further stimulating the electrocatalytic reduction (stage 6) and oxidation (stage 7) reactions of the semiconductor. Adsorbed reactants on the semiconductor, respectively. It should be emphasised that surface reactions are only possible when the reduction and oxidation potentials are more positive and negative than the CB and VB levels.

As a result, in order to create highly efficient photocatalysts for a variety of photocatalytic applications, all of these typical four-step processes must be thoroughly addressed and optimised. Regardless of Despite tremendous progress in heterogeneous photocatalysis, there are still several hurdles in light harvesting (particularly in the visible light spectrum), charge carrier excitation, separation, and use. To address these critical scientific issues, a variety of engineering modification strategies, such as band structure engineering, micro/nano engineering, bionic engineering, co-catalyst engineering, surface/interface engineering, and their synergistic effects, have been proposed and implemented in improving the visible-light photocatalytic performances of heterogeneous semiconductor materials [9].

2.2 Considerations for $g\text{-C}_3\text{N}_4$ -based photocatalyst design

For these above reasons, great consideration must be paid to the logical design of $g\text{-C}_3\text{N}_4$ for getting the optimum photocatalytic performances. Many modification strategies have been attempted to produce highly efficient $g\text{-C}_3\text{N}_4$ -based photocatalysts in order to minimise some of these disadvantages

and maximise photocatalytic efficiency. The design considerations of $g\text{-C}_3\text{N}_4$ -based photocatalysts are summarised based on their precise composition, structures, and characteristics. More definitely speaking, hetero-junction construction [11], dimensionality tuning (nano-templating) and nanocarbon loading have been widely employed in increasing the charge transfer, mobility and separation respectively. Additionally, adequate co-catalyst loading and defect control have been made accessible to aid in the acceleration of surface reaction kinetics (charge utilization). In addition, pore texture tailoring, surface sensitization, and band-gap engineering (non-metal doping [12] and co-polymerization [13] techniques) The red-shift of its optical absorption edge was used to construct highly mesoporous $g\text{-C}_3\text{N}_4$ with a high surface area and to boost light harvesting and visible absorption. Further engineering modification strategies to improve the photocatalytic performances of $g\text{-C}_3\text{N}_4$ -based photocatalysts are planned to be developed in the future. Most critically, all photocatalytic phases, including light harvesting, charge excitation, charge transfer, mobility and separation, and surface charge usage, should be considered and optimised at the same time. In other words, the synergy and integration effect of these many tactics should be given greater consideration.

The various features, design methodologies, and potential applications will be thoroughly detailed in the following sections.

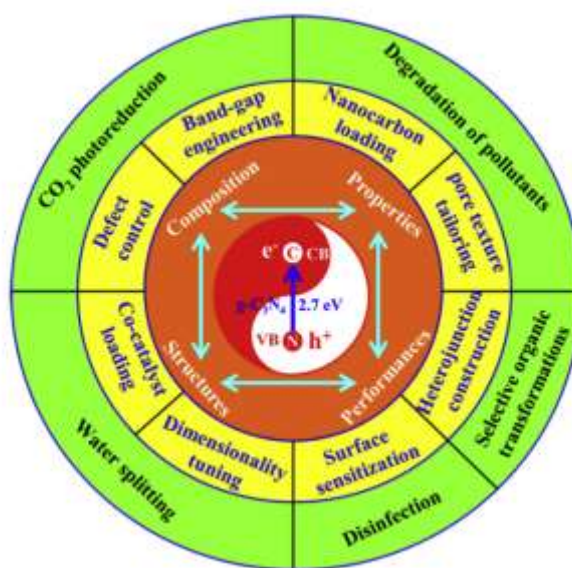


Figure 2: Design consideration of $g\text{-C}_3\text{N}_4$ [4]

3. Engineered methods for CNS nanocomposites

A number of efficient methods for synthesising CNS nanocomposites have been discovered, including solution mixing, hydrolysis, sol-gel, hydro(solvo)thermal, microwave irradiation, and mechanical grinding. The parts that follow will provide a more detailed description of the various synthesis routes.

3.1. Solution mixing method

The most straightforward method for creating CNS nanocomposites involved mixing or sonicating $g\text{-C}_3\text{N}_4$ powders with the chosen metal oxides in an organic solvent solution. When the organic solvent solution evaporated, the metal oxides distributed over the $g\text{-C}_3\text{N}_4$ surface and created the composites. $\text{ZnO}/\text{mp } g\text{-C}_3\text{N}_4$ photocatalysts with varying $\text{mp } g\text{-C}_3\text{N}_4$ loadings, for example, were effectively



synthesised by vigorously mixing the two compounds in methanol overnight [14]. The composites were then completely dried in 110 °C for 12 hours. Huang et al. [15] reported the synthesis of MoO₃/g-C₃N₄ photocatalysts in which the MoO₃ and g-C₃N₄ particles were ultrasonically mixed in an ethanol-water system, followed by a calcination process to produce interface interaction between the two particles. Those named Ou et al. used BiVO₄ and g-C₃N₄ photocatalysts to make BiVO₄/g-C₃N₄ composites using a simple mixing and ultrasonication technique, followed by heat treatment in ambient air. Because of its simplicity, this technique was very appealing.

However, because chemical bonding was not anticipated in this method, the interaction between the two phases was typically weak. Direct interaction between semiconductor nanoparticles and g-C₃N₄ particles was critical for electron-hole transport between the two phases.

3.2. Hydrolysis approach

The hydrolysis of a metal oxide precursor is a traditional method for producing CNS nanocomposites. The basic steps are hydrolysis of the metal oxide-precursor over the g-C₃N₄ surface, precipitate formation, and precipitate calcination to make the nanocomposites. A simple hydrolysis technique, for example, can yield TiO₂/g-C₃N₄ nanocomposites [16]. First, 100 mL of aqueous solution was vigorously stirred with a certain quantity of g-C₃N₄ powder and 1 mL titanium tetrachloride. The combination was then dried for 12 hours at 70 °C before being annealed for 1 hour at 400 °C. Similarly, g-C₃N₄ powders were mixed with NaBiO₃ in HCl aqueous solution, followed by Bi³⁺ hydrolysis to produce BiOCl/g-C₃N₄ hybrid photocatalysts [17]. The small BiOCl nanoplates with sizes approximately 1 nm were successfully spread on the bulk g-C₃N₄ surface, as evidenced by typical SEM pictures. It was critical to observe that the quick hydrolysis process of the precursors can cause nanoparticle aggregation on the g-C₃N₄ surface. Stabilizers can be used to control the pace of hydrolysis and the formation of nanoparticles, as well as to increase the contact of g-C₃N₄ between nanoparticles [18].

3.3. Sol-gel synthesis

Although it is currently challenging to regulate, sol-gel synthesis is becoming increasingly relevant in the synthesis and production of CNS nanocomposites. It was chosen for its high purity and homogeneity in the end products, low processing temperatures, low cost, and simple synthetic method. Metal alkoxides and metal salts are the beginning components or precursors, which have been hydrolyzed and polycondensed to produce a colloid. The sol evolved over time to create an inorganic three-dimensional network, resulting in the creation of another phase gel .

The sol-gel synthesis was appropriate for the development of CNS nanocomposites due to the metal-OH network, which allowed for the formation of new bonds of oxygen bridges via hydrolysis-polycondensation processes on the g-C₃N₄ surfaces. As a result, a chemical connection formed between the metal oxide nanostructures and the g-C₃N₄ surface. An annealing process was then performed to facilitate the crystallisation of the nanocomposites. Chang et al. [19], for example, employed the sol-gel method to generate TiO₂/C₃N₄ hybrids as follows: a specific amount of C₃N₄ was poured into 40 mL of isopropanol, and the resulting suspension was rapidly agitated for 2 h before adding 4 mL tetra-nbutyl titanate. After 3 hours of stirring, 40 mL of deionized water was added to the aforesaid combination. After 3 hours of stirring, 40 mL of deionized water was added dropwise to the aforesaid combination, and the resulting milky liquid was dried in a drying oven at 60 °C for 24 hours to yield a powder. Finally, it was annealed at 400 °C for 1 hour to produce well-crystalline TiO₂/C₃N₄



hybrids. After hybridising with C_3N_4 , the TiO_2/C_3N_4 hybrids showed a large surface area of $140.13 \text{ m}^2 \text{ g}^{-1}$ and well-defined mesoporous of uniform size distribution of TiO_2 .

3.4 Hydro(solvo)thermal preparation

Because of its many advantages, including generally non-polluting setup, high reactivity, low energy demand, and simplicity of regulating the aqueous solution, the hydro(solvo)thermal approach has been frequently used in the creation of CNS nanocomposites. The hydrothermal synthesis is a reaction that occurs within a closed system and uses water as the reaction medium. A broader term, "solvothermal," referred to a comparable process in which a non-aqueous (organic or inorganic) solvent is used. These procedures are frequently performed in an autoclave under regulated temperature and pressure. To self-produce saturated vapour pressure, the reaction temperature is kept above the boiling point of water (or solvent) [58]. In the case of $In_2S_3/g-C_3N_4$ heterojunction composites, $g-C_3N_4$ powder, $In(NO_3)_3 \cdot 5H_2O$, and thioacetamide were dissolved in deionized water. It was then sealed in a Teflon-lined autoclave and held at $120 \text{ }^\circ\text{C}$ for 12 hours. Finally, the heterojunction composites $In_2S_3/g-C_3N_4$ were precipitated. Interestingly, Li and colleagues [20] devised a hydrothermal synthetic technique for producing $Zn_{0.8}Cd_{0.2}S/g-C_3N_4$. In particular, $Zn(Ac)_2 \cdot 2H_2O$ and $Cd(Ac)_2 \cdot 2H_2O$ were added to deionized water (Solution A), and then $g-C_3N_4$ and Na_2S (Solution B) were added to the Solution A while vigorously stirring. The mixture was then cooked for 12 hours at $120 \text{ }^\circ\text{C}$ in a stainless steel S. The precipitates were washed and dried at $60 \text{ }^\circ\text{C}$ for 24 hours to produce $Zn_{0.8}Cd_{0.2}S/g-C_3N_4$ composites. Ternary composites such as $Ag/AgBr/g-C_3N_4$ composites have also been made utilising a hydrothermal technique using starting ingredients such as $g-C_3N_4$, $AgNO_3$, cetyltrimethyl ammonium bromide, urea, and ethylene glycol [21].

3.5. Microwave irradiation method

Microwave irradiation has recently emerged as a fast synthesis approach for the creation of particles or nanostructured films, including CNS nanocomposites [22]. Microwave irradiation is primarily based on microwave dielectric heating of the precursor solution, which results in volumetric heating of the solvents and reagents. Zhou et al. [23] used microwave aided synthesis to create $Bi_2S_3/g-C_3N_4$ composites. The following were the experimental details: 0.2 g of $g-C_3N_4$ was typically distributed in 25 mL of ethylene glycol. In 15 mL of ethylene glycol, $Bi(NO_3)_3 \cdot 5H_2O$ and $Na_2S_2O_3 \cdot 5H_2O$ (mole ratio 2:3) were dissolved separately. The three solutions were then well mixed and cooked in a microwave oven at $180 \text{ }^\circ\text{C}$ for 5 minutes under N_2 flow while stirring. The creation of the $Bi_2S_3/g-C_3N_4$ heterostructure was detailed in their study as follows: For starters, $g-C_3N_4$ can effectively adsorb Bi^{3+} due to its surface $-NH$ and $-NH_2$ groups. Following microwave treatment, S^{2-} ion can be created and interacted with Bi^{3+} ion to produce Bi_2S_3 distributed over the surface of $g-C_3N_4$. He et al. [23] also used a one-pot ethylene glycol (EG) aided microwave technique to create $BiOBr/g-C_3N_4$ porous microspheres in the presence of 1-hexadecyl-3-methylimidazolium bromide ($[C_{16}mim]Br$). The primary benefits of microwave irradiation are rapid volumetric heating, rapid response rate, and good reaction selectivity. Other noted advantages of microwave irradiation included the ability to programme the microwave settings and regulate the various preparation stages. As a result, it is simpler, faster, and more energy efficient. As a result, it is easier, faster, and more energy efficient than traditional conduction heating methods such as water or oil bath [24].

4. Application of $g-C_3N_4$ as catalyst



Due to its stability and lack of toxicity, TiO₂ is a common catalyst. Nevertheless, due to charge recombination and a very broad band gap, it has a poor photocatalytic effectiveness [25]. As compared to TiO₂, g-C₃N₄ has a suitable mid-wide band gap to effectively absorb visible light. Moreover, its oxidation and reduction potential make it appropriate for splitting water. More crucially, adaptability in modification with metals entrapping to generate active sites with plenty of melon moieties is another crucial factor to improve photocatalytic activity. This combination of qualities makes it a viable photocatalyst material [26].

4.1 As catalyst for Friedel-Crafts reactions

Due to flaws in the material such as curvature, edges, or doping atoms, which serve as catalytically active sites in the oxidative dehydrogenation of ethylbenzene, graphite can cause electrons to delocalize in both the conduction and valence bands. Typically, g-C₃N₄ exhibits nearly all of the electrical characteristics of graphite and transforms into.

The most crucial potential replacement for carbon in materials applications [26]. The most promising catalyst for Friedel-Crafts reactions is g-C₃N₄ as a result. It has been utilized by Goettman et al. to achieve the Friedel-Crafts acylation of benzene. They studied the impact on the surface and crystallinity of the employed catalysts using heptane as the solvent for the Friedel-Crafts acylation. Moreover, Zhang et al. examined the porous g-C₃N₄, whose catalytic characteristics and chemical interaction with absorbing and activating benzene is depicted. To investigate the chemical relationship between Goettman et al. hypothesized the HOMO-LUMO hybridization of Mellem and benzene. benzene and faulty g-C₃N₄. The idea is in line with the findings of Lebreton and colleagues, who considered the three HOMOs to have symmetry in 1984 [27]. Nevertheless, HOMO-3 is an antibonding combination of the atomic orbitals representing the lone pairs of the "aromatic" nitrogen atoms. Because the HOMO is made up solely of the PZ orbitals of the heterocyclic nitrogen, which are precisely the same as the benzene's PZ orbitals, it is possible for g-C₃N₄ units to transfer electron density to benzene through an overlap with these orbitals. This results in a very unusual aromatic rings activation, symmetrical to the largest vacant π^* -type orbital in the benzene Hückel model [26]. When solid fluorinated polymeric carbon nitride (CNF) was used as a catalyst to oxidise benzene to phenol under visible light, NH₄F was used as the source of fluorine. The effectiveness of the introduced catalyst. The performance of turnover frequency is greatly improved by fluorinating g-C₃N₄ when compared to pure g-C₃N₄.

4.2 As catalyst for water splitting

To combat the energy problem and environmental damage brought on by the misuse of fossil fuels, hydrogen is now seen as a clean energy source. Water is the best source of hydrogen. Small band gap heterogeneous photocatalyst with appropriate band. When using solar energy, location is crucial [28]. Two approaches are outlined below to increase photocatalyst efficiency: Lower the band gap to adjust the energy of visible light; and second, adequately separate excitons by adding certain defects and local lattice to lower the rate at which excited excitons and holes recombine during the catalytic reaction. About g-C₃N₄, its variable band gap, characteristics of electron localization or anchoring the active sites as well as defects and nitrogen atoms make it a potential material for water. With Wang et al. groundbreaking work using g-C₃N₄ to split water for the first time, much research has focused on this area. By fluorinating, Wang and his colleagues increased the catalytic effectiveness of water splitting. Takanabe et al. investigated the photocatalytic hydrogen evolution using a Pt/mpg-C₃N₄



photocatalyst that had been enhanced with MgPc dye. The results show that the amount of loading dye had an impact on how well the photocatalytic activity performed. Adequate dye input will boost photocatalytic activity, but excessive dye introduction will have the opposite effect. The dye layer on the surface of mpg-C₃N₄ is therefore essential for the photocatalytic processes. The cocatalyst sites are covered by thickening the layer, which reduces the photocatalytic performance since charge transfer between monolayer dye and cocatalyst has the maximum photocatalytic activity. Zhang et al. performed the electrochemical examination of g-C₃N₄ and carbon nitride copolymerization with barbituric acid to thoroughly examine the photocatalytic characteristics of g-C₃N₄ vs. its electronic structure (CNB). Displays the results, which also include Mott-Schottky plots, electrochemical impedance spectroscopy (EIS) Nyquist plots, and photocurrent response. Due to the nitrogen atoms acting as an n-type donor, the Mott-Schottky plots' positive slopes showed that g-C₃N₄ is an n-type semiconductor. Significantly, flat-band potential was also measured here, and for g-C₃N₄ and CNB0.2, respectively, 1.42 and 1.22V vs Ag/AgCl were proposed. Hence, both include the inset of Fig. 10a's photocatalytic water reduction potential. Recently, a structure that was built using g-C₃N₄ and metal-based catalytic systems was developed. It was discovered that the nickel-based catalyst system performed well at H₂ evolution and had the maximum catalytic activity. The system's mechanism is shown. Initially, There are two ways that electrons can enter the conduction band (CB) of g-C₃N₄: either by sensitising the acriflavine or by being excited by light. Then [MII(TEOA)₂]₂⁺ (M = Ni, Co) complexes get an electron that has been transferred from the g-C₃N₄ conduction band, developing into the [MI(TEOA)₂]⁺ intermediate that is crucial for the photocatalytic H₂ generation.. It is a promising method that blends organic polymer light-harvesting materials with non-precious metal to build a catalyst system that will increase the catalytic lifetimes of catalyst systems in photochemical H₂ generation the catalytic system.

CONCLUSION

Because of growing worries about environmental issues and natural resource depletion, the use of renewable energy has become a crucial objective in modern times. Heterogeneous photocatalysis has emerged as an appealing and feasible option for directly converting and storing solar energy into green fuels. g-C₃N₄ -based photocatalysts have received a lot of attention due to their unusual physicochemical, optical, and electrical features.

We carefully summarised the fundamentals of g-C₃N₄ -based photocatalysts, including their characteristics and design ideas for improving their photocatalytic activity, in this study. We also discussed photocatalytic water splitting, pollutant degradation, carbon dioxide reduction, and selective organic transformations using g-C₃N₄ -based photocatalysts. In addition, we reviewed recent developments in photocatalytic degradation of dyestuff effluents employing g-C₃N₄ /semiconductor nanocomposites, as well as the crucial role of modified g-C₃N₄ in the process of organic pollutant degradation and fouling management of composite membranes. The review gave readers a thorough overview of g-C₃N₄ -based photocatalysts and their prospective uses in photocatalysis and other domains. The paper highlighted the potential future uses of highly effective g-C₃N₄-based photocatalysts, such as photocatalytic membranes.

Finally, the review emphasises the importance of photocatalysts based on g-C₃N₄ in sustainable energy conversion and storage. The research outlines the distinct features of g-C₃N₄ -based photocatalysts as well as the numerous design options for improving their performance. In addition, the paper examined



the multiple uses of g-C₃N₄-based photocatalysts and their potential. Prospects for further research and uses of g-C₃N₄-based photocatalysts were also offered. The review provides a thorough grasp of g-C₃N₄-based photocatalysts and opens up new avenues for designing and fabricating highly effective photocatalysts for use in photocatalysis and other related domains.

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