Graphene in Photocatalysis: A Review

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Abstract

In recent years, heterogeneous photocatalysis has received much research interest because of its powerful potential applications in tackling many important energy and environmental challenges at a global level in an economically sustainable manner. Due to their unique optical, electrical, and physicochemical properties, various 2D graphene nanosheets-supported semiconductor composite photocatalysts have been widely constructed and applied in different photocatalytic fields. In this review, fundamental mechanisms of heterogeneous photocatalysis, including thermodynamic and kinetics requirements, are first systematically summarized. Then, the photocatalysis-related properties of graphene and its derivatives, and design rules and synthesis methods of graphene-based composites are highlighted. Importantly, different design strategies, including doping and sensitization of semiconductors by graphene, improving electrical conductivity of graphene, increasing eloectrocatalytic active sites on graphene, strengthening interface coupling between semiconductors and graphene, fabricating micro/nano architectures, constructing multi-junction nanocomposites, enhancing photostability of semiconductors, and utilizing the synergistic effect of various modification strategies, are thoroughly summarized. The important applications including photocatalytic pollutant degradation, H-2 production, and CO2 reduction are also addressed. Through reviewing the significant advances on this topic, it may provide new opportunities for designing highly efficient 2D graphene-based photocatalysts for various applications in photocatalysis and other fields, such as solar cells, thermal catalysis, separation, and purification.

Keywords

KeyWords Plus: VISIBLE-LIGHT-IRRADIATION; GRAPHITIC CARBON NITRIDE; EXPOSED 001 FACETS; NITROGEN-DOPED GRAPHENE; FEW-LAYER GRAPHENE; ONE-POT SYNTHESIS; ASSISTED HYDROTHERMAL SYNTHESIS; HYDROGEN-PRODUCTION PERFORMANCE; OXYGEN REDUCTION REACTION; METAL-ORGANIC FRAMEWORKS

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