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Communication

Solution-based processing of carbon nitride composite for boosted photocatalytic activities

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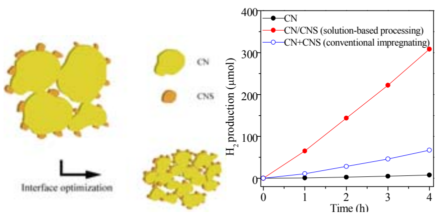
Graphical Abstract



Thanks to the dissolution of bulk carbon nitride (CN), a heterojunction of CN and sulfur-doped CN was constructed *via* a solution-based processing way, which led to a more homogeneous composite and an improved photocatalytic H_2 production activity up to 230% with respect to that by conventional impregnating.

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ABSTRACT

Graphite-phase polymeric carbon nitride (CN) was reported to be a promising material in photoelectrochemical solar energy conversion. However, its high recombination rate of photogenerated carriers limits its potential applications. In this article, a heterojunction of CN and sulfur-doped CN (CNS) was constructed through a solution-based processing way. Interestingly, it was observed that the photocatalytic hydrogen production of the as-prepared composite was 32.6 times higher than that of bulk carbon nitride and 2.3 times higher than that of the composites by conventional impregnating method. This study opens a new avenue to construct heterojunction of CN for large-scale industrial applications in environmental remediation.

Since the first report of TiO_2 photocatalyst for water splitting in 1972 by Fujishima and Honda[1], photocatalysts based on semiconductor has drawn much attention [2-4]. It is because that it can provide a sustainable and clean option that handle energy and environment issues [5,6]. In recent years, a metal-free semiconductor, graphite-phase polymeric carbon nitride (CN) has been widely used as photocatalysts for the superiorities of facile synthesis, proper electronic band structure, high thermal and chemical stability, and “earth-abundance” [7-11]. However, the photocatalytic activities of pristine CN were still hindered by the obstacles of low surface area [12,13], high recombination rate of photogenerated carriers [14-16] and the limited visible absorption [17,18]. In order to improve the photocatalytic activities, many strategies have been applied *e.g.*, nanostructure engineering[17,19-22], chemical doping [16], crystallinity/defects modulation [23, 24], and building heterojunction [25].

Among them, for solving the issue of high electrons and holes recombination rate of CN, construction of heterojunction has been extensively studied [26-31]. However, due to the insolubility of CN in almost all solvents, it is difficult to construct highly homogeneous CN-based composites, which restricts the further improvement of the performance of the CN materials [32]. Recently, our group reported that CN could be dissolved in concentrated sulfuric acid *via* synergetic effects of intercalation and protonation interactions [33]. Although concentrated sulfuric acid is highly oxidative and corrosive, we had verified that such treatment did not

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