**Graphitic carbon nitride-based composites for photocatalytic and photoelectrochemical water splitting**

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Energy crisis and environmental problems have always been considered as challenging and critical issues over the past decades. Solar energy conversion into chemical energies by photocatalysis has emerged as a sustainable and efficient route{Liu, 2011 #307;Liu, 2017 #318}. As a metal-free semiconductor, graphitic carbon nitride (g-C3N4) has attracted much attention because of its layered graphite-like structure, suitable electronic structure for water redox catalysis as well as its simple synthesis from earth abundant elements and chemical stability. However, pristine g-C3N4 has a relatively narrow light response range with bandgap energy at 2.7 eV, suffering from the fast recombination of photo-generated electron/hole pairs. Moreover, it is also restricted by low electrocatalytic activity, severely detrimental to the water splitting process. Integration of a co-catalyst, such as platinum or other noble metals, helps promote the charge separation with a prolonged lifetime for electrons to transfer over the surface, as well as to lower the overpotentials for H2 evolution with an improved electrical conductivity.

MoS2 quantum dots (MSQDs) with high and stable dispersion in water were prepared via a facile one-pot hydrothermal process. The MSQDs were then applied to decorate graphitic carbon nitride (g-C3N4, CN) nanosheets to obtain modified g-C3N4 photocatalysts (MSQD-CN). Compared to pristine g-C3N4, the hybrid photocatalysts showed a slight red shift and stronger light absorption with remarkably improved photocatalytic activity in water splitting to generate hydrogen. The hydrogen-evolution rate over 0.2 wt% MSQD-CN increased by 1.3 and 8.1 times as high as that of 0.2 wt% Pt-CN and g-C3N4, respectively. With deposition of 2 wt% Pt as a cocatalyst, 5 wt% MSQD-CNexhibited the highest photocatalytic efficiency with an average hydrogen evolution reaction (HER) rate of 577 μmol·h-1·g-1. Photoluminescence spectra (PL) and photoelectrochemical measurements inferred that MSQDs introduction drastically promoted the electron transfer for more efficient separation of charge carriers, which could lower HER overpotential barriers and enhance the electrical conductivity. In addition, the well-matched band potentials of the MSQD-CN hybrid with an intimate contact interface of p-n heterojunction also inhibited the recombination of photo-generated carriers, leading to enhanced photocatalytic HER performance. A direct Z-scheme charge transfer mechanism of the MSQD-CN hybrid was proposed to further elaborate the synergistic effect between MSQDs, Pt and g-C3N4. This work underlines the importance of heterojunction interface and presents a feasible protocol for rational construction of g-C3N4 based photocatalysts for various photocatalytic applications.