Advanced Nano-Photocatalytic Materials

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Background

Photocatalyst is an ultimate green technology to decompose toxic organics or produce hydrogen from water/convert CO_2 into useful hydrocarbon fuel using solar energy. Currently, titanium dioxide photocatalyst has been widely applied to the outdoor environmental purification. However, the application and market is still limited to the existence of UV light by the absorption characteristics of titanium dioxide itself.

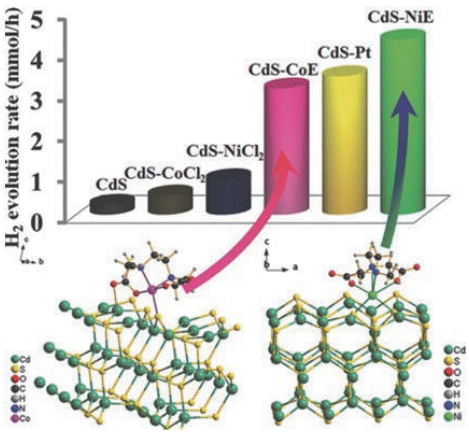
Aim

In order to realize an efficient photocatalysis technology for both indoor environmental remediation and solar-chemical conversion, we have been challenging possibilities of nano-photocatalytic materials, by exploring new materials via energy band engineering for more efficient harvesting of solar light, controlling of surface/interface nano-structures for higher reactivity, and unveiling reaction mechanism.

Advanced Research Topics

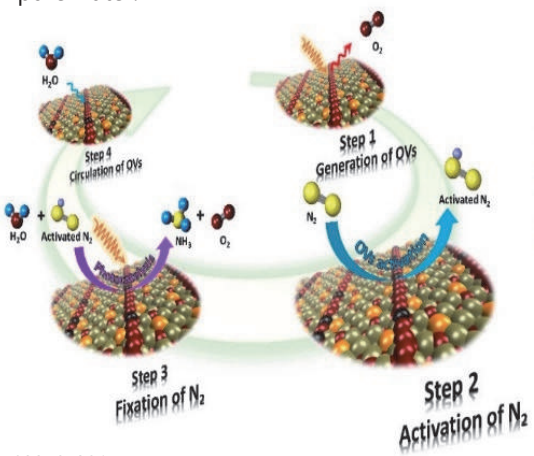
Low cost co-catalyst for H_2 evolution

Well-dispersed Co(II)/Ni(II) species were anchored successfully on a CdS surface as low-cost co-catalyst. Efficient photocatalytic H_2 evolution even exceeding that of Pt were achieved over Ni(II) species, with an apparent quantum efficiency of 67.5% at 420 nm.



Solar-driven N_2 fixation in water

Bi_5O_7Br nanotubes with confined nanotube structure, suitable absorption edge, and visible light-switchable surface oxygen vacancies were fabricated. An excellent visible light driven photocatalytic N_2 fixation was achieved, with a NH_3 generation rate of 1.38 mmol h^{-1} g^{-1} in pure water.



Publications

- Guixia Zhao, **Jinhua Ye***, et al., *Adv. Mater.* 29, 1703258, 2017.
- Shengyao Wang, Hao Chen* and **Jinhua Ye***, et al., *Adv. Mater.* 29, 1701774, 2017.
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Summary

- Low cost and highly efficient co-catalyst for solar-hydrogen production has been developed.
- Solar-driven nitrogen conversion to ammonia has been realized on Bi_5O_7Br nanotubes.
- CO_2 conversion to hydrocarbon fuel has been achieved under visible light.

Research outcome

- Application to indoor environment purification
- Efficient solar-hydrogen production from water
- Efficient solar driven N_2 fixation
- Realization of practical artificial photosynthesis