

Accepted Manuscript

Full Length Article

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PII: S0169-4332(18)32352-3
DOI: <https://doi.org/10.1016/j.apsusc.2018.08.209>
Reference: APSUSC 40246

To appear in: *Applied Surface Science*

Received Date: 10 May 2018
Revised Date: 22 August 2018
Accepted Date: 23 August 2018

Please cite this article as: L. Tian, X. Yang, X. Cui, Q. Liu, H. Tang, Fabrication of Dual Direct Z-scheme g-C₃N₄/MoS₂/Ag₃PO₄ Photocatalyst and Its Oxygen Evolution Performance, *Applied Surface Science* (2018), doi: <https://doi.org/10.1016/j.apsusc.2018.08.209>

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Fabrication of Dual Direct Z-scheme g-C₃N₄/MoS₂/Ag₃PO₄ Photocatalyst and Its Oxygen Evolution Performance

Lin Tian ^a, Xiaofei Yang ^{a,b,c,*}, Xingkai Cui ^a, Qinqin Liu ^a, Hua Tang ^{a,*}

^a School of Materials Science & Engineering, Jiangsu University, Zhenjiang 212013, P. R. China

^b College of Science, Nanjing Forestry University, Nanjing 210037, P. R. China

^c State Key Laboratory of Photocatalysis on Energy and Environment, Fuzhou University, Fuzhou 350116, P. R. China

Abstract:

Semiconductor-based photocatalytic materials have emerged as promising candidates for solar-driven hydrogen production and oxygen evolution reactions. Direct Z-scheme photocatalysts offer competitive advantages that are superior to single-component or intensively studied heterojunction photocatalysts in photocatalytic water splitting. The development of high-performance direct Z-scheme photocatalysts is crucial to improving solar-driven water splitting efficiency. Herein, we report the fabrication of a novel g-C₃N₄/MoS₂/Ag₃PO₄ ternary composite and its application in photocatalytic oxygen evolution under white light LED illumination. As-exfoliated, highly conductive two-dimensional molybdenum disulfide (2D MoS₂) nanoflakes and modified graphitic carbon nitride (g-C₃N₄) nanosheets were employed simultaneously to couple with oxygen-evolving silver orthophosphate (Ag₃PO₄), forming a dual direct Z-scheme g-C₃N₄/MoS₂/Ag₃PO₄ (CMA) composite photocatalytic system for highly improved oxygen evolution from water splitting. The optimal CAM-20 exhibits the fastest oxygen-producing rate of 232.1 μmol·L⁻¹·g⁻¹·h⁻¹, which is 5 times higher than that of bulk Ag₃PO₄. The enhancement in the photocatalytic oxygen evolution can be ascribed to synergistic effects of improved visible light absorption, more efficient separation of photoexcited electron-hole pairs and a specific charge transfer pathway of tandem dual direct Z-scheme configuration under light illumination. This work paves the way for the construction of direct Z-scheme composite photocatalytic systems in water splitting.

Keywords: g-C₃N₄; MoS₂; Ag₃PO₄; oxygen evolution; water splitting; direct Z-scheme

* Corresponding authors.

E-mail: xiaofei_yang1980@163.com (Prof. X. Yang); tanghua@mail.ujes.edu.cn (Prof. H. Tang)

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