Accepted Manuscript

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PII: S0925-8388(18)33700-9

DOI: 10.1016/j.jallcom.2018.10.034

Reference: JALCOM 47852

To appear in: *Journal of Alloys and Compounds*

Received Date: 30 June 2018

Revised Date: 4 October 2018

Accepted Date: 6 October 2018

Please cite this article as: X. Li, J. Xiong, J. Huang, Z. Feng, J. Luo, Novel g-C_3N_4/h'$ZnTiO_3$-a'TiO_2 direct Z-scheme heterojunction with significantly enhanced visible-light photocatalytic activity, *Journal of Alloys and Compounds* (2018), doi: https://doi.org/10.1016/j.jallcom.2018.10.034.

Novel g-C_3N_4/h'$ZnTiO_3$-a'TiO_2 direct Z-scheme heterojunction with significantly enhanced visible-light photocatalytic activity

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ABSTRACT: Novel g-C_3N_4/h'$ZnTiO_3$-a'TiO_2 (CN/h'ZT-a'T) ternary composites were successfully prepared by combining in-situ precursor-synthesized h'$ZnTiO_3$-a'TiO_2 (h'ZT-a'T) nanoparticle with nanoporous g-C_3N_4 (CN) powders. X-ray diffraction (XRD), Transmission electron microscopy (TEM), and X-ray photoelectron spectroscopy (XPS) results revealed that the grains of hexagonal-phase $ZnTiO_3$ (h'ZT) were in-situ generated together with anatase-phase TiO_2 (a'T), forming a symbiotic structure of tightly bonded interface. Compared with CN and h'ZT-a'T, the absorption edge of CN/h'ZT-a'T exhibited a red-shift and the absorption intensity was obviously enhanced. With increasing CN content, the degradation efficiency of CN/h'ZT-a'T for methylene blue (MB) initially increased and then decreased, reaching the highest value of 99.8% with the CN content of 50 wt% (50CN/h'ZT-a'T). The 50CN/h'ZT-a'T composites exhibited the highest apparent reaction rate constant of 2.92 h^{-1}, which was 37.4 and 3.0 times higher than that of h'ZT-a'T and CN, respectively. Photocurrent response of 50CN/h'ZT-a'T was indicative of the highest photocurrent value and the elongated lifetime of photogenerated charges. The greatly enhanced photocatalytic activity was attributed to the high mobility of photogenerated electrons. H'$ZnTiO_3$ with high electron mobility in the direct Z-scheme heterojunction played a role of electronic transfer station and reduced the recombination probability of photogenerated carriers.

Keywords: Direct Z-scheme; Heterojunctions; Photocatalytic; Electron mobility

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