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Chemical routes to materials

# Facile synthesis and characterization of a visible light-active ternary $TiO_2$/ZnS/g-$C_3N_4$ heterostructure for multipollutant degradation

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## ABSTRACT

This study revolves around assessing the effectiveness of a ternary heterostructure, $TiO_2$/ZnS/g-$C_3N_4$ (1:1:1 w/w mixture), synthesized through a facile hydrothermal process for the simultaneous degradation of both single and mixed pollutants under visible light. The advanced microscopic and spectroscopic techniques (FESEM, TEM, FTIR, UVDRS, BET) employed confirmed its enhanced photocatalytic performance. The UV–Vis DRS analysis unveiled the synthesized heterostructure's superior band gap energy of 2.81 eV compared to pristine $TiO_2$, leading to enhanced light absorption within the visible spectrum. Under visible light exposure, the ternary $TiO_2$/ZnS/g-$C_3N_4$ heterostructure exhibited impressive efficacy, removing approximately 90% of 10 mg/L of Rhodamine B (RhB) within 180 min. Furthermore, its remarkable performance extended to mixed pollutants, wherein it concurrently achieved substantial degradation of 82.7%, 78.2%, and 62.2% for RhB, methyl orange (MO), and 2-chlorophenol (2CP), respectively, in a comparable timeframe. Notably, only a marginal reduction from 89.9 to 86.6% was observed in RhB degradation after four recycling cycles, attesting to the inherent stability and recycling potential of the ternary structure. The synthesis and application of the ternary $TiO_2$/ZnS/g-$C_3N_4$ heterostructure highlight its significant potential for practical wastewater treatment, particularly due to its dual capability of effectively degrading both single and mixed pollutants. The study's findings highlight the promising role of this heterostructure in addressing contemporary challenges in environmental remediation.

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