Enhanced visible light-assisted photocatalytic activity of g-C3N4 decorated with ZIF-8 and AgI ternary heterojunctions

Abstract

Fabrication of a suitable photocatalyst system that responds to visible light has become a requirement for photocatalytic environmental remediation processes. For better transfer/separation of photogenerated-charges, successful interfacial engineering to build photocatalytic heterojunctions is essential for improving the photodegradation performance. Herein, ternary composites of zeolitic-imidazolate-framework-8 (ZIF-8) coupled with AgI nanoparticles assembled on g-C3N4 have been fabricated, characterized using XRD, FESEM, EDX, TEM, PL, UV–visible DRS, and N2-adsorption–desorption, and used as visible-light-driven photocatalysts for photocatalytic destruction of methylene blue (MB). The ternary AgI/ZIF-8/g-C3N4 photocatalyst achieved superb photodestruction activity (94.2 %) within 120 min. Besides, the first-order degradation rate constant reached 0.02431 min−1, which was nearly 1.5, 2.5, 4.5, and 5.5 times greater than that reached by ZIF-8/g-C3N4 (0.01628 min−1), g-C3N4 (0.00941 min−1), AgI (0.00542 min−1) and ZIF-8 (0.00441 min−1), respectively. The improved photocatalytic behavior was accredited to the synergistic influence of the photo-charge carrier transfer/separation pathway and the electron mediation assisted by ZIF-8. The trapping tests supported the recommended photocatalytic mechanism, which suggested that the radical dotO2− radicals were the main reacting agents in this process. The parameters affecting the photodegradation, including the AgI/ZIF-8/g-C3N4 dose, the solution pH, and the MB concentration were systematically tested in this work. Furthermore, the AgI/ZIF-8/g-C3N4 demonstrated good degradation stability after multi-consecutive rounds (only 1 % deduction in its activity after 5 rounds), and thus, it is projected to be a promising photocatalyst in wastewater treatment.

DOI: https://doi.org/10.1016/j.inoche.2024.113056