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Kinetics and Mechanism Study of Photocatalytic Degradation Using Heterojunction Semiconductors

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Abstract : Heterogeneous photocatalytic processes have gained growing interest as an efficient method to generate hydrogen by using clean energy sources and degrading various organic pollutants. The main obstacles that restrict efficient photoactivity are narrow light-response range and high rates of charge carrier recombination. The formation of heterojunction by combining a semiconductor with low VB and a semiconductor with high CB and a suitable band gap was found to be an efficient method to prepare more sensible materials with improved charge separation, appropriate oxidation and reduction ability, and enhanced visible-light harvesting. In our research, various binary heterojunction systems based on the wide-band gap (TiO_2) and narrow bandgap (g-C_3N_4, CuO, and Co_2O_3) photocatalyst were studied. The morphology, optical, and electrochemical properties of the photocatalysts were analyzed by X-ray diffraction (XRD), scanning electron microscopy (FE-SEM), N_2 physisorption, diffuse reflectance measurements (DRS), and Mott-Schottky analysis. The photocatalytic performance of the synthesized catalysts was tested in single and simultaneous systems. The synthesized photocatalysts displayed good adsorption capacity and enhanced visible-light photocatalytic performance. The mutual interactions of pollutants on their adsorption and degradation efficiency were investigated. The interfacial connection between photocatalyst constituents and the mechanism of the transport pathway of photogenerated charge species was discussed. A radical scavenger study revealed the interaction mechanisms of the photocatalyst constituents in single and multiple pollutant systems under solar and visible light irradiation, indicating the type of heterojunction system (Z scheme or type II).

Keywords : bandgap alignment, heterojunction, photocatalysis, reaction mechanism
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