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Review

An aimed review of current advances, challenges, and future perspectives of TiO_2-based S-scheme heterojunction photocatalysts

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Abstract

Photocatalytic technology is fascinating the world due to its potential to combat global warming caused by CO_2 emissions, split water to generate H_2 fuel, and remediate water pollution. TiO_2 has been regarded as a fascinating photocatalytic material because of its low-cost, abundance, and effective photoresponse. However, efficiency bottlenecks with TiO_2 outlets persist, involving a lack of visible light harvesting due to its intrinsic large bandgap and inadequate separation of photoinduced charges. To boost efficiency at the industrial levels, visible light-sensitive TiO_2 photocatalysts with the lowest recombination of photocarriers are required. TiO_2-based S-scheme heterosystems have emerged as the most promising candidates due to their low charge recombination loss, strong redox ability, and high performance. Herein, this review article summarizes recent advances in the construction of outstanding TiO_2-based S-scheme heterosystems, including scientific introduction, fundamental design concepts, crystal structures of TiO_2, characterization methods, and design strategies of TiO_2-based S-scheme heterojunction photocatalysts. In particular, the contributions of morphological control, oxygen vacancy, co-catalyst loading, structural design, and nanocarbon loading in TiO_2-based S-scheme photocatalysts are examined in detail, research gaps are identified, and recommendations are proposed. The current review aims to motivate more novel research on the rational construction of metal oxides-based S-scheme photocatalysts, hence expediting the advancement of highly efficient S-scheme photocatalysts for a wide range of applications.