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Science mapping of TiO₂ modification strategies for wastewater treatment: Current and future trends

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Abstract

TiO₂ is the most widely used photocatalyst owing to its advantages, such as exceptional surface area, stability, and high surface activity. However, TiO₂ suffer from a wide band gap and high recombination rate of charge carriers. This research assesses the knowledge structure of the various strategies adopted to modify titanium dioxide (TiO₂) for wastewater remediation. Capitalizing VOSviewer software, a bibliometric analysis was performed on 898 articles extracted from the Web of Science (WoS) database to determine the intellectual structure of collected documents. Three major clusters were generated through bibliographic coupling and four from co-occurrence analysis, from which the emerging and future trends of TiO₂ modification approaches were determined, respectively. Bibliographic coupling highlighted three key clusters on the emerging trends of the TiO₂-modification technique. The analysis revealed that the current trends focus on the utilization of

copper-based dopants in TiO₂, demonstrating improved charge isolation and visible light activation. The second cluster underscores the noble metal doping, with gold and silver compounds leveraging localized surface plasmon resonance (SPR) properties. The third cluster explores graphene-based co-doping strategies. Co-occurrence analysis of 56 high-frequency keywords revealed four thematic clusters centres on nanocomposites for pollutant treatment, integration of adsorption, photocatalysis and advanced thin-film deposition techniques. The significance of this study lies in its potential to guide researchers in exploring identified nanocomposite materials and techniques to enhance the efficiency and properties of TiO₂ for the photodegradation of organic molecules in wastewater. © Published under licence by IOP Publishing Ltd.

Indexed keywords

Engineering controlled terms

Bibliographic retrieval systems; Bibliographies; Deposition; Energy gap; Gold compounds; Metal analysis; Nanocomposite films; Nanocomposite thin films; Photodegradation; Remediation; Semiconductor doping; Silver compounds; TiO₂ nanoparticles; Titanium; Wastewater treatment

Engineering uncontrolled terms

'current; Bibliographic couplings; Co-occurrence analysis; Emerging trends; Future trends; Property; Surface activities; Surface area; TiO₂; Wide-band-gap

Engineering main heading

Titanium dioxide

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