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Editorial

Innovative and Practical Trends in the Photocatalytic Degradation of Environmental Pollutants

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This *Catalysts* Special Issue explores cutting-edge research in the field of photocatalysis, offering a glimpse into the evolving landscape of environmental science and catalysis. Photocatalytic degradation has emerged as a potent tool in the fight against environmental pollutants. The need to prevent problems that arise due to the impacts of pollutants on ecosystems and human health has driven researchers to explore new frontiers in material science, reaction mechanisms, and real-world applications. This Special Issue is a testament to the resilience of scientific inquiry and its capacity to provide solutions to pressing global challenges.

These eight articles work together to provide an overview of the state of the field:

- Gd_2BiTaO_7/Ag_3PO_4 Heterojunction Photocatalyst (contribution 1)

In the pursuit of visible light-responsive heterojunction photocatalysts, Luan et al. (contribution 1) introduce a novel Gd_2BiTaO_7/Ag_3PO_4 catalyst. This heterojunction exhibits superior photocatalytic activity for the degradation of bisphenol A under visible light irradiation, outperforming conventional photocatalysts. The study provides insights into the structural properties and potential practical applications of this novel catalyst, widening the scope of visible light-responsive heterojunction photocatalysts.

- Biochar Nanoparticles over TiO_2 Nanotube Arrays (contribution 2)

Pinna et al. (contribution 2) propose biochar nanoparticles (BC NPs) as sustainable co-catalysts for TiO_2 nanotube arrays. The study explores the synthesis and deposition of BC NPs, revealing a significant enhancement in the photocatalytic activity of methylene blue degradation. This eco-friendly approach not only improves charge carrier separation but also opens up new avenues for the development of low-cost and sustainable co-catalysts for use in environmental remediation.

- $Cd_{0.7}Zn_{0.3}S$-Based Photocatalyst for Hydrogen Production (contribution 3)

Kurenkova et al. (contribution 3) investigate the sustainable production of hydrogen from starch aqueous suspensions using a $Cd_{0.7}Zn_{0.3}S$-based photocatalyst under visible light irradiation. The study delves into starch pretreatment conditions, providing valuable insights into the maximum H_2 evolution rate and the composition of the aqueous phase. This research contributes to the sustainable utilization of renewable resources for hydrogen production.

- Gas Nanobubbles in Aqueous Photocatalysis (contribution 4)

Yu et al. (contribution 4) explore the introduction of nanobubbles into a photocatalytic reactor, demonstrating their impact on the degradation of methyl orange. Oxygen and air nanobubbles enhance the photocatalytic activity within the reactor, improving the efficiency of the removal of contaminants. This pioneering study introduces environmentally friendly catalysts which can boost the performance of photocatalytic water treatment systems.

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- Gold Nanoparticle-Decorated Bi_2S_3 for Wastewater Treatment (contribution 5)

Nwaji et al. (contribution 5) present a colloidal synthesis approach for constructing Bi_2S_3 particles with rod and flower-like morphology, decorated with gold nanoparticles (AuNPs). The resulting heterostructured photocatalysts exhibit high and stable photocatalytic activity which can be used for the degradation of organic pollutants under solar light irradiation. The incorporation of AuNPs enhances the overall photocatalytic performance, showcasing the potential of these materials for wastewater treatment.

- Materials for Combined NO_2 and Formaldehyde Control (contribution 6)

Russell et al. (contribution 6) investigate novel materials for the combined control of nitrogen dioxide (NO_2) and formaldehyde (HCHO) pollution under ambient conditions. The study evaluates catalysts, adsorbents, and composites, highlighting the effectiveness of metal oxide-based catalysts and composite materials for the simultaneous removal of these pollutants. This research offers a promising avenue for developing pollution control devices which can reduce personal pollution exposure.

- Photocatalytic Nanofiltration Membrane (contribution 7)

Heu et al. (contribution 7) introduce a photocatalytic nanofiltration membrane based on a Zr-MOF/GO nanocomposite. The composite membrane exhibits enhanced flux and anti-fouling properties, which can be attributed to improvements in hydrophilicity, porosity, and charge repulsion. The photocatalytic activity under ultraviolet (UV) irradiation contributes to reducing irreversible fouling and increasing flux recovery, demonstrating its potential for water purification.

- Review of Photocatalytic Materials for Urban NOx Remediation (contribution 8)

Russell et al. (contribution 8) provide a comprehensive review of photocatalytic materials used in urban nitrogen oxide (NOx) remediation. The study assesses the current state-of-the-art research, including field trials and lab studies, offering insights into the challenges and potential of photocatalytic oxidation materials. The review underscores the importance of site-specific testing and the ongoing quest for new materials to address urban air pollution.

The studies presented not only advance our understanding of the fundamental principles of photocatalysis but also bridge the gap between theory and practical applications.

These innovative trends in photocatalysis have numerous practical implications. From the efficient removal of pollutants to the development of eco-friendly co-catalysts and the utilization of renewable resources for hydrogen production, each article contributes to the broader goal of developing sustainable and green technologies.

The utilization of renewable resources, eco-friendly co-catalysts, and the efficient removal of pollutants contribute directly to the Sustainable Development Goals, for example SDG 6 (Clean Water and Sanitation) and SDG 7 (Affordable and Clean Energy). Additionally, the pursuit of green technologies and the advancement of photocatalytic materials align with SDG 9 (Industry, Innovation, and Infrastructure) and SDG 13 (Climate Action).

This collection serves as a catalyst for achieving a harmonious balance between technological advancements and environmental stewardship, fostering a future that is not only cleaner but also more sustainable.

Looking ahead, the future prospects of photocatalytic degradation are promising. The integration of these innovative approaches into real-world scenarios holds the potential to transform environmental remediation strategies. The journey does not end here; it extends into ongoing discussions, collaborations, and the implementation of these trends to create a cleaner, healthier, and more sustainable environment for generations to come.

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List of Contributions

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