New Wastewater Purification Strategy: Graphitic Carbon Nitride and Low-Temperature Plasma

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Water pollution is a pressing global issue, exacerbated by inefficient wastewater treatment technologies that fail to remove emerging contaminants such as pharmaceuticals, antibiotics, and antimicrobial-resistant bacteria. In this project, a novel wastewater treatment reactor was designed and constructed, integrating photocatalysis using graphitic carbon nitride (gCN) with multi-hollow surface dielectric barrier discharge (MSDBD) plasma technology. gCN, a metal-free, visible-light-responsive photocatalyst, effectively degrades persistent pollutants, while MSDBD plasma generates reactive species, enhancing pollutant breakdown. The reactor was tested on both model pollutants and real wastewater effluent, demonstrating superior removal efficiencies compared to conventional treatment methods while maintaining water quality parameters such as pH. The investigated technology also presents a promising solution for the treatment of animal manure used as fertilizer, addressing a globally neglected environmental challenge. Untreated manure, rich in antibiotics and antimicrobial-resistant bacteria, is frequently applied to soil and crops, posing significant risks to human health, ecosystems, and water resources. By adapting this advanced wastewater treatment technology for manure processing, contamination risks could be minimized, contributing to sustainable agriculture and circular water economy. This innovative, scalable, and cost-effective solution represents a major advancement in environmental engineering, offering an effective strategy for tackling water pollution, reducing antimicrobial resistance, and ensuring global water security.

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