Efficient degradation of organic dyestuffs wastewater by liquid phase plasma synergy with nano-material photo catalysis

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Clean water is a prerequisite not only for human life but also for all life on the planet. But the aquatic ecosystem is severely affected by industrialization, notably industry dyestuffs wastewater, due to its unique features, such as composition complicated, high density and toxicity, and difficult to bio-chemical degradation. In the past several decades, numerous efforts based on advanced oxidation processes(AOPs)have been made to remediation these wastewaters, such as photocatalytic oxidation, ozone oxidation, wet oxidation, non-thermal plasma processing. Among those AOPs, non-thermal plasma can achieve greater output and better efficiency, due to the discharge processes where a lot of high energy electrons and active radicals and molecules are generated, which can effectively have degraded of dissolved organic compound molecules. However, fast and efficient degradation of organic wastewater in few minutes is still facing substantial challenges, and it's the main technical barriers that impede its commercialization. Here, an innovative method for rapid degradation of organic wastewater by electrolytic plasma processing synergy with four photocatalysis of nano-material: Au@SiO_2, TiO_2, NiO, and ZnO with 2g of $K_2S_2O_8$ addition. The results showed that 50 mg of RhB dyestuffs fully degraded in less than 10 minutes were observed by UV and fluorescence. The mechanism behind these effects were investigated in detail, and it's mainly attributed to the two reasons: A large number of free electrons and high-energy active substances were produced under the environmental of electrolytic plasma processing, as a result of free radical chain quickly reacts in the system; on the other hand, sulfate radical (E°=2.7-3.1 EV) with extremely strong standard electrode potential was introduced into system, and it can efficient degradation of the vast majority of dissolved organic matter. In addition, sulfate radical has a wide range of pH value applicable range: at pH 2.0-7.0, and the sulfate radical in the water can exist in a relatively stable state; when the pH is higher than 8.0-10.0, hydroxyl free radicals is formed by the part of the sulfate radicals reacting with the water; when pH value of solution is higher than 10 most of the sulfate radical is transformed to hydroxyl free radicals, and the coexistence or shift of both radical can greatly enhance the oxidation capacity of the system. The organic dyestuffs wastewater can be efficiently degraded by the cooperation of those reactions, which provides a broad prospect for industrial wastewater treatment.

Biography

Wanyuan Gui received his doctorate in materials science and engineering, form State Key Laboratory for advanced metals and materials, University of Science and Technology Beijing, China. His research interest is towards liquid phase plasma engineering applications, such as surface modification, coating and wastewater treatment.

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