Photochemical degradation of a mixture of pharmaceuticals in treated wastewater

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4.07.P-Mo357 Photochemical Degradation of a Mixture of Pharmaceuticals in Wastewater

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Organic micropollutants, such as pharmaceuticals, represent a significant environmental and public health challenge due to their persistence, toxicity, and potential to contribute to antimicrobial resistance. These contaminants often pass through conventional wastewater treatment, entering aquatic environments and posing risks to ecosystems and human health. Advanced oxidation processes (AOPs), particularly photoelectrochemical oxidation (PEC), offer a promising solution for removing trace-level pharmaceuticals from secondary-treated wastewater. However, the photocurrent conversion efficiency, catalytic activity, and stability of $BiVO_4$-based photoanodes, which are key components in PEC systems, are still limited. Surface modifications have shown potential to address these challenges and enhance their performance. This study aims to improve the PEC activity of $BiVO_4$-based photoanodes for the degradation of pharmaceutical mixtures in secondary-treated wastewater through surface modification using quaternary ammonium-based compounds (QACs). The photoanodes were fabricated using ultrasonic spray pyrolysis and characterized using techniques such as scanning electron microscopy (SEM), X-ray diffraction (XRD), and linear sweep voltammetry (LSV). PEC experiments were conducted under simulated solar light to assess the degradation of a mixture of pharmaceuticals at an initial concentration of 10 µg/L.

The results demonstrated that the surface modification of $BiVO_4$ with QACs significantly enhanced the degradation rate of pharmaceuticals compared to unmodified $BiVO_4$ photoanodes. SEM images confirmed the successful deposition of needle-like QAC particles on the $BiVO_4$ surface, leading to improved charge separation. Notably, pharmaceuticals such as diclofenac, sulfamethoxazole, sulfadimethoxine, and acetaminophen showed higher removal rates in the presence of the modified photoanodes. This research highlights the potential of QAC-modified $BiVO_4$ photoanodes as an effective approach for enhancing the degradation of pharmaceuticals in wastewater. The findings contribute to advancing the field of PEC-based wastewater treatment technologies and offer promising implications for upscaling and practical application in treating pharmaceutical-contaminated wastewater.

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